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THE SECOND WORLD WAR

1939-1945

ROYAL AIR FORCE

MAINTENANCE

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THE DEVELOPMENT OF ROYAL AIR FORCE MAINTENANCE, SEPTEMBER 1939 TO MAY 1945

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Part I
EXPANSION AND
DEVELOPMENT

CHAPTER 1

PRE-WAR EXPANSION

The Expansion Schemes¹

In 1918 Great Britain possessed the most powerful air force in the world. She disbanded it, except for a nucleus, after the war, and in a few years ranked only fifth amongst the Air Forces of the Nations. No such voluntary self-disarmament was undertaken by other countries, so in 1923 we began to re-arm, in a very modest fashion, and the programme then adopted was still far from complete ten years later. The reasons for the retardation were partly political and partly financial. In 1933 Germany commenced to re-arm and in a few years developed and equipped an air force of major proportions. In an attempt to achieve parity with Germany's increasing air strength, the British Government introduced a number of schemes for the expansion of the Royal Air Force, which followed each other in quick succession between the years 1934 and 1939.

The first scheme (Scheme 'A'), adopted in July 1934, was a very modest programme. It was followed by Scheme 'C' when the size of Hitler's air force became known in 1935. There was no Scheme 'B.' Scheme 'C' was succeeded by Schemes 'F,' 'L' and 'M.' Schemes 'H,' 'J' and 'K' were formulated also but never passed beyond the stage of proposals; and the missing letters represented tentative suggestions which did not mature. The purpose of these early programmes was to make a show of force and thus, it was hoped, to deter Germany from proceeding with her plans. Militarily, however, these schemes were unsound, as the necessary reserves of equipment to meet them were not provided for and the question of maintenance was practically ignored. Everything possible was crammed into the first line while a background to the façade was almost non-existent. Fortunately, the tendency to create a force which was not as strong as it appeared was eventually checked, and the schemes which mattered most, such as 'F,' 'L' and 'M,' did not err in this way. They were, on the whole, sound and well-balanced schemes, so far as they went.

Scheme 'C' was notable in so far as it provided (in 1935) for a Metropolitan Air Force of 123 squadrons, which was, in fact, only one less than the number of squadrons on our nominal first-line establishment in the autumn of 1939. The programme was, however, to have been completed in 1937, but before that date it was superseded by Scheme 'F'—the longest lived of all the schemes. It was the only one which ran its full course and was completed before the war began. Framed in the light of the speeding-up of German re-armament, it provided for a Metropolitan Air Force of nearly 1,750 first-line aircraft, as compared with a little over 1,500 under Scheme 'C.' It was a distinct improvement on Scheme 'C' in so far as it gave our air striking force more offensive power and provided more reserves. It was approved in February 1936. Scheme 'F' would not, however, have given us parity, so, at the end of the year, Scheme 'H' was proposed. This increased the first-line strength at the expense of the reserves and the overseas formations. Scheme 'H' was withdrawn soon after it was proposed,

¹ A.H.B. Monograph, *Expansion of the R.A.F.*

and the next scheme ('J') which followed it a year later also failed to commend itself to the Cabinet.

Scheme 'J' was in some respects the best of all the pre-war proposals. If it had been speeded up and the necessary measures taken to expand production, it would have enabled us to make up at least most of the lee-way in our pursuit of parity. It would have given us a Metropolitan Air Force of nearly 2,400 first-line aircraft, including nearly 900 heavy bombers, by the summer of 1941. But such progress was too slow—Germany would, it was estimated, have had as many aircraft by the end of 1939. To put us on even terms we should have had to accelerate the completion of the scheme considerably, necessitating interference with the course of normal trade and involving the country in considerable financial expenditure. These measures were not acceptable to the Government and the Air Ministry was instructed to prepare a cheaper version, which it did in the form of Scheme 'K.'

Scheme 'K' came before the Cabinet in March 1938, but by that time the German move into Austria had occurred, and the necessity for an accelerated programme became evident. Scheme 'L' was the result. It provided in the usual way for a number of bomber, fighter and other squadrons, but was not adopted in that definite form. What was approved on 27 April 1938, was a programme of construction which represented the maximum output estimated to be obtained from industry within two years, Scheme 'L' being kept as a background to this programme. Long before the first year had passed, however, the Munich crisis occurred, and the relegated Scheme 'L' was superseded by Scheme 'M' which was approved on 7 November 1938; approved, that is to say, in the sense that the establishment for which it provided—2,550 first-line aircraft in the Metropolitan Air Force—was substituted for the first-line aircraft contained in Scheme 'L,' the constructional programme already in force being continued meanwhile.

Scheme 'M' was timed for completion by 31 March 1942, i.e., two years later than Scheme 'L' so that when the war commenced in September 1939 our establishment of aircraft, in the absence of the necessary reserves, was not even sufficient to meet the requirements of Scheme 'F.' The 124 squadrons and (approximately) 1,750 first-line aircraft authorised by Scheme 'F' existed nominally, but we had not that establishment. Some of the squadrons had to be 'rolled up' to provide six weeks' reserves, whilst others were needed to serve as training units, and as a result the effective first-line strength of the Metropolitan Air Force did not exceed 1,500 aircraft in September 1939. To produce that number, we had to leave the fighter squadrons with practically no reserves behind them. In contrast, the first-line strength of the German Air Force was about 4,000 aircraft with sufficient reserves available.

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Shadow Factories

The programme of construction involved in Scheme 'C' was not beyond the capacity of the firms existing in the aircraft industry who up to that time had supplied the needs of the Royal Air Force. Scheme 'F,' however, was too large for these firms to undertake unaided, and it was therefore decided to bring into operation a number of 'shadow factories' which it had been intended to reserve

for zero hour. The factories in question were large motor car plants in the Birmingham and Coventry districts, and in order that the ordinary business of the manufacturers concerned should not be interfered with, the shadow factories were erected in close proximity to the parent works. This involved some additional risk in the event of air attack, but it facilitated supervision of the new works and lessened the difficulty of labour supply. Strictly, the opening of the shadow factories for the purpose of the pre-war expansion was a departure from the purpose for which they were intended, which was to serve as an additional source of supply after the war had begun, but the absence of adequate reserves of engines and airframes rendered this procedure necessary.

The motor manufacturers originally selected were the Austin, Daimler, Rootes, Rover, Singer, Standard and Wolseley Companies. Lord Nuffield (Morris Motors) was asked to participate but at first refused. In fact he raised considerable opposition to the scheme, and it was not until May 1938 that he agreed to organise a big factory at Castle Bromwich for the production of Spitfire fighters. Of the other companies, Singer and Wolseley fell out of the scheme before it was inaugurated, and their places were taken by the Bristol Aeroplane Company and the Austin Motor Company, which had thus a double role.

In addition to the airframe and engine factories, others were established for the manufacture of propellers, carburettors and magnetos. The decision to adopt the shadow factory scheme was not allowed to pass without challenge and there was considerable opposition from the firms engaged in the aircraft industry before the expansion commenced. The scheme generally, however, was successful, although many difficulties were encountered. In the case of the factory at Castle Bromwich it was necessary eventually to place it under the control of Messrs. Vickers, as the methods of the Nuffield organisation, based as they were on the mass production of motor cars, proved to be unsuitable for the rapid production of aircraft.

Repair and Maintenance Facilities

At the beginning of 1938 there was no R.A.F. repair depot or properly planned system of repair. There were two primary reasons why it had by this time become essential to develop a sound Service repair organisation. First, the industry was occupied to capacity with new production and was unable to expand its repair facilities on the scale which would be required in war; it was anticipated that, until an efficient repair organisation had been built up, wastage of aircraft in the event of war might rise to 40 or 50 per cent per annum instead of the normal 16 to 20 per cent.¹ The second reason was that repair overseas was almost entirely a Service responsibility and to supply the skilled personnel necessary to man overseas depots on a much expanded war-time scale, it was essential that a pool of fully trained men should be maintained on which overseas depots could draw. Such a pool could be constituted only by establishing, at home, Service repair depots at which all types of aircraft repairs were undertaken. The Home Aircraft Depot, Henlow, had been temporarily converted to a School of Technical Training to assist in the expansion programme, and it had never been possible to re-establish the depot as had been intended. Two new Service depots had been approved at Sealand

¹ E.P.M. 115.

and St. Athan respectively. They would not be opened until mid-1939, however, and it would be well into 1940 before they were in full operation. Steps were taken to provide additional schools of technical training to relieve Henlow, which it was decided to reopen as a depot as soon as possible.

There was considerable discussion as to whether it should be reopened as a civilian or as a Service depot, the argument in favour of the latter being that it would be the first depot in full operation and should therefore be used for training of maintenance personnel for overseas. The objection to a Service depot was that it would put a further strain on the technical staff resources of the Royal Air Force at a time when the shortage was most acute. A further argument in favour of a Service depot was that it had become increasingly necessary to supply R.A.F. parties to units to install equipment in aircraft not incorporated before delivery and to incorporate certain major modifications. Such work was at present a drain on skilled unit personnel or on factory staffs where firms' working parties were supplied. Where working parties could not be supplied, aircraft had to be returned to the factories with consequent delay and expense. The lack of a pool of skilled personnel, which could in emergency supply overseas repair units, had been a serious disadvantage on more than one occasion in previous years.

The inevitable question of cost arose, and as a Service depot was more expensive to run than a civilian-manned unit, it was urged that the two R.A.F. depots under construction should suffice. The discussion was inconclusive at this meeting and was left to the further attention of the Air Member for Personnel and A.M.S.O. At the following meeting, during a discussion on the provision of facilities for surplus pilots to obtain flying practice, the Secretary of State stated that the crux of the matter was the need to improve the repair and maintenance facilities in order to eliminate the delay in returning unserviceable aircraft to the force. A.M.S.O. replied that the Director of Aircraft Production was already engaged on a survey of spare contractor-capacity which could be used for repair work. He preferred to see the increased repair requirements handled by a civilian organisation rather than by Service depots, which, he considered, were essentially training establishments rather than productive units. The Air Member for Research and Development anticipated considerable difficulty in staffing civilian repair depots, if established, and pointed out that personnel could not be held after training. The Secretary of State made a suggestion that units near industrial areas might relieve their manpower shortage by employing civilians. This was opposed, however, on the grounds that the provision of Service transport would raise difficulties and that, in any case, the work of most units was restricted by the available technical equipment on the station. Following the Cabinet acceptance of the accelerated air programme (Scheme 'K') S. of S. evolved a plan on 15 March 1938 for overcoming the bottleneck of skilled repair and maintenance personnel: selected firms were to erect shops alongside their factories to be used for the repair of aircraft.¹ Firms would repair their own products and thus allow Service personnel to concentrate on maintenance rather than repair. In spite of this proposal and the apparent realisation of the seriousness of the existing lack of proper repair facilities, when the question of repair depots was raised again

¹ E.P.M. 116.

six months later, it was reported that Henlow was still awaiting the completion of St. Athan and Weston-super-Mare as schools of technical training before reverting to its proper function as a depot. Although work was proceeding night and day, A.M.S.O. was unable to forecast dates for the completion of these two stations. He pointed out that the question of repair depots was typical of many items essential for the maintenance of the Air Force which were lacking. We had, he continued, been building up a front-line Air Force which was nothing but a façade. We had nothing by way of reserves or organisation behind the front line with which to maintain it. The meeting decided that a repair organisation should be got going as quickly as possible and that for the time being A.M.D.P. would be the member responsible; the arrangements for the reversion of Henlow to its proper functions being pressed on in the meanwhile.¹

Three Service depots were now approved and in course of preparation—Sealand, St. Athan and Henlow. A previous proposal for three civilian depots had been turned down as it was considered that on completion of the expansion programme the shadow factories could be utilised for repair work. The September 1938 crisis and continued expansion led A.M.S.O. to raise the question again. He proposed the formation of two civilian repair depots, but after discussion it was decided that one only should be considered at present. After the investigation of a possible site at Preston it was agreed finally to establish the unit at Warrington (Burtonwood).² By November 1938 work had started on this site, and it was decided to pursue the original plan for a total of three civilian-manned depots, machine tools for all three to be ordered immediately.³ A factory site at Dumfries was considered but the Treasury and the Ministry of Labour objections ruled this out.⁴ There was a difference of opinion as to the advisability of having two larger depots instead of three smaller ones. The Director of Repair and Maintenance considered that each depot should be capable of repairing 500 aircraft annually but he asked for an outside opinion if possible. It was decided to consult Sir Amos Ayre and Mr. Beal.⁵ Following the report of these gentlemen the Council decided to seek the advice of Sir Malcolm McAlpine on the construction of the depots and of the industry concerning the economies of layout, expeditious routing of jobs and the complements and grading of industrial, supervisory and managerial staffs likely to be required. The second depot was sited at Abbotsinch, and on 27 June 1939 it was reported that a site had been decided for a further depot at Stoke.⁶ With the increasing shortage of skilled manpower, however, the staffing of these depots was likely to be difficult, and it was realised that though there would be little work for the depots in peace the expansion in the event of war would be rapid.⁷ A managerial staff with the necessary knowledge of the industry and of trade union and labour matters was necessary and it seemed advisable to have the depots run on an agency basis by large engineering firms whose work was likely to diminish in war-time. War came, however, without a definite policy having been decided upon.

¹ E.P.M. 137.

² E.P.M. 138.

³ E.P.M. 140.

⁴ E.P.M. 141 and 145.

⁵ E.P.M. 148.

⁶ E.P.M. 161.

⁷ E.P.M. 173 and 178.

Increased Recruitment and Training of Maintenance Personnel

With the adoption in 1935 of the programme of expansion, it became impossible to turn out fitters II in adequate numbers and with sufficient rapidity to man the flights of all the new squadrons on the approved basis. As a temporary measure it was decided to introduce the trades of flight mechanic and flight rigger to fill the aircraftmen posts in flights under the supervision of skilled fitter and rigger non-commissioned officers. The new tradesmen were to be recruited from men with some engineering or mechanical training, enlisting initially for training as mates, the best being selected at the end of the mates' course for a further eight months' training to fit them for the flight servicing of engines and airframes. It was also decided to increase the intake of apprentices in excess of immediate requirements.

The employment of unskilled mates in flights, introduced in 1932, had not proved to be a success in view of the advent of aircraft of greatly increased power, speed and complexity. In fact, it was considered by the Commands to be highly dangerous. For the first three years of the expansion, therefore, the squadrons functioned on one of two systems, i.e. (a) fitter I—fitter II—mate or (b) flight mechanic—flight rigger supervised by fitter and rigger N.C.O.s.¹ Another measure taken to provide skilled personnel for maintenance purposes was the encouragement of ex-airmen to return to the Service.² The response was encouraging, and the numbers obtained from this source steadily increased. No training was given to former mechanics.

Throughout the summer of 1935 new recruits came in satisfactorily, but the numbers sent forward by the recruiting centres had to be reduced owing to the lack of accommodation at the Depot at Uxbridge. The old trade of 'aircraft-hand and mate' was kept as low as possible, but every available fitter was taken. By 8 October 1935, 1,700 applications had been received from boy apprentices. These applications continued satisfactorily, but the intake, except for fitters, had to be restricted to the accommodation available at the apprentice schools.³

The Scheme 'C' programme required 15,792 airmen in the fitter group, but, following a change of policy in favour of medium as opposed to light bombers, the requirement was altered to 17,236 to be reached by 1 April 1939. This necessitated an increased recruitment during 1936 and 1937 for the new trade of flight mechanic and flight rigger at the rate of 650 per annum, the total requirements in this trade being estimated at 8,613 by 1 April 1939.⁴

Recruiting of skilled men continued satisfactorily for some months, but, in spite of a Press campaign, the applications in 1937 fell off.⁵ In May of that year the total for the previous 12 months was only 1,400 compared with 1,670 for the corresponding period in 1936. It therefore became obvious that to meet the expansion programme many more men would have to be trained by the Service. No. 1 School of Technical Training at Halton was incapable of dealing with

¹ E.P.M.122.

² E.P.M.8.

³ E.P.M.7, 9 and 13.

⁴ E.P.M.25.

⁵ E.P.M.80.

the numbers required, and although a site for a new school had been selected at Cosford, construction had not begun. It was not until November 1937 that the building of the new school commenced.

Towards the end of 1937 a number of discussions took place at the Air Ministry regarding the difficulties of training sufficient servicing personnel. One suggestion put forward by the Air Member for Personnel was that certain Group II tradesmen could be obtained from elementary schools, but this was considered eventually to be impracticable owing to the special treatment such young entrants would require. A syllabus for the training of airmen at contractors' works was then drawn up and a plan to this end was submitted to aircraft firms for their concurrence. With the exception of Messrs. Handley Page, who required certain relaxations, all agreed to co-operate. Courses were arranged for from 12 to 20 men at a time at each firm and the Commands were instructed to release airmen for the special courses even if it meant units working at reduced pressure.

By March 1938 it was realised that additional steps must be taken to provide trained men of all trades for maintenance duties in the Royal Air Force under the expansion programme and that the whole of the overseas maintenance organisation depended upon the availability of personnel from the home depots. In April, therefore, the Air Member for Supply and Organisation prepared a memorandum on the accommodation required for training units to meet the Scheme 'K' programme up to April 1939.¹ He drew the conclusion that an immediate and considerable expansion of ground training facilities was necessary, and that even with such an expansion several years would elapse before deficiencies in certain trades would be made good. The new repair depots, which provided training facilities, at Sealand and St. Athan had been approved and would be ready by mid-1939; they would not be working to capacity, however, until well into 1940. Henlow, the one original home aircraft depot, had been turned temporarily into a school of technical training and should have reverted to a depot in 1936 or 1937, but, with the successive increases in the expansion requirements, this had not been possible. The position in March 1938 was that even the opening of a new school of technical training at St. Athan would not permit Henlow to be re-established as a depot. Ground training accommodation had not been extended since the inception of Scheme 'C,' but it had been possible so far for Henlow and the School of Technical Training, Manston, to cope with requirements. The new training figures were, however, far in excess of the capacity available.

In order to permit the re-establishment of the depot at Henlow, and at the same time to increase the total training capacity, it was decided to establish a new technical training school of three Wings at Weston-super-Mare for the instruction of fitters III as an alternative to Manston, which was in a very vulnerable area, and to erect hatted accommodation for 1,000 electricians at Henlow.

Meanwhile it was recognised as no longer practicable to employ mates on modern aircraft to the extent to which they had been used in the past. In fact,

¹ E.P.M.115.

there was now no work on which they could be employed which could not be done equally well by aircrafthands, and in April 1938 the 'mate' system was abandoned.

The crisis in September 1938 resulted in another effort to obtain skilled airmen in sufficient numbers.¹ It was then decided to accept the maximum possible of suitable recruits irrespective of the Scheme 'L' establishment and to use hutted and temporary accommodation to house them. This decision made the accommodation problem even more acute, but the shortage of maintenance personnel made it essential that applicants should not be kept waiting. A further school of technical training additional to Weston and St. Athan was also considered necessary, and the possibility of using holiday camps for the purpose was examined. These, however, were thought to be unsuitable.²

The Air Member for Personnel tried to raise the intake of recruits to 1,000 a week during November 1938, hoping to take advantage of the effect of the crisis, but this number was not achieved and it became apparent that the only way of maintaining an adequate flow was by National Service.

The recruiting position was changed completely in the early part of 1939 by the introduction of the Military Training Bill. By 13 June of that year between 25,000 and 26,000 men had expressed a preference for the Royal Air Force against a total of 12,000 vacancies.³ The shortage of trained men in squadrons continued, however, and it was decided that the dilution of skilled personnel which had been adopted in the past to relieve the position must cease for at least nine months. As an alternative to dilution, the Air Member for Supply and Organisation was asked to consider the possibility of the further civilianisation of R.A.F. establishments.

As war became more imminent the personnel requirement increased to a total intake of 45,000 against the original figure of 26,000. This necessitated an entry of at least 900 a week until the end of the year. To reach this figure the Grade I medical standard was relaxed. It was also decided to withdraw from courses all men who had completed 75 per cent of their instruction in certain trades in order to provide training facilities for the newcomers. These measures did not, however, produce the numbers required and it was only the large influx of volunteers which resulted from the declaration of war that clarified the position. In the first 19 days of war 7,000 men were accepted and it was estimated that the total would reach 14,000 by the end of the month with a further 10,000 in October. The number of skilled men accepted was considerably in excess of existing training facilities but they had been taken on in order to secure a lien on their services.⁴ The dilution of fitter grades had been considerably reduced by the call-up of reservists, but as the latter were being regarded as fully trained men the figures could not be taken at their face value. The instrument trades were in the worst position and it was decided to transfer 800 recruits from West Drayton to Manston in order to permit the use of West

¹ E.P.M.137, 138 and 139.

² Actually, the holiday camps in the various parts of the country proved to be most suitable for training purposes after the war commenced. There was great competition amongst the Navy, Army and Air Force to obtain them. (Narrator's experience.)

³ E.P.M.173.

⁴ E.P.M.185.

Drayton as a training centre for women instrument repairers. A reduction of the annual intake of fitter apprentices from 2,000 to 500 was agreed since the capacity at Halton was required for training older skilled men, and it was considered that on the basis of a 3 year war the apprentices would not become effective sufficiently early to be of value.¹ It was decided in November 1939 that the total number of apprentices under training should be reduced to 2,700 with a further reduction to 1,000 early in 1941. It was not considered possible to accelerate the training of the apprentices but it might be feasible to give certain parts of their training away from Halton—such as putting them into productive work in factories for a period.²

Inception of Maintenance Command

In September 1937 the Director of Organisation prepared a Note for the consideration of the Air Council on the advisability of the formation of a Command to control the maintenance units of the Royal Air Force.

In his Memorandum the Director of Organisation drew attention to certain unsatisfactory features about the existing maintenance organisation under which the maintenance units were controlled and administered in a technical sense by the Director of Equipment, while their domestic administration was in the hands of the Air Officer Commanding-in-Chief, Training Command. This meant that the Director of Equipment was, in effect, acting as an executive A.O.C. over units whose numerous functions were remote from him, and it was wrong in principle that he should do this in addition to being a Staff Officer in charge of a department of the Air Ministry. In any case, this arrangement—which had been possible (and indeed desirable on grounds of economy) in pre-expansion days—could not now continue without the machine becoming clogged. The Air Officer Commanding-in-Chief, Training Command, for his part was in the position of having to deal with the domestic needs of units with whose functions and operations he was not concerned, and this arrangement which, for a variety of reasons, was unsatisfactory in peace-time would be totally impracticable in time of war.

The aim of the new Maintenance Command, which it was suggested should be set up, would be to control and to co-ordinate the various maintenance services, and to undertake a large part of the operational control at present exercised by the Air Ministry, and also to relieve the Training Command of its present administrative duties in respect of the maintenance units. The organisation which had been drawn up for the proposed Command had been based primarily on the conditions in which units in the United Kingdom would have to operate in war, but the arrangements proposed would also satisfy the requirements of the Overseas Commands and of the Continental contingents.

The Memorandum then went on to discuss the basis (geographical or functional) on which the Maintenance Command ought to be organised. It was pointed out that the purpose of the maintenance organisation must be the service of the flying units, and its duties in the main were salvage, repair, holding and distribution. Further, although distribution from the maintenance

¹ E.P.M.186.

² E.P.M.200.

units was carried out on a geographical basis, the variety of maintenance units involved made it impossible to arrange for a complete supply system for a particular geographical area, and the areas supplied by different types of maintenance units inevitably overlapped.

The conditions which must determine the grouping and sub-division of the supply areas were so varied that any organisation of the Maintenance Command as a whole on a geographical basis (or on a pattern matching that of the Commands it served) was impracticable, and the conclusion reached in the Memorandum was that it would be necessary to establish the Command on a functional basis. Each of the groups within the Command would then control a number of distribution units (organised for servicing on an area basis) and in some cases a number of reserve holding units also from which the distribution units would be replenished.

It was proposed that there should be four such groups with functions as under :—

- (a) A repair and salvage group comprising the aircraft depots, and any other workshop units which might become necessary.
- (b) An ammunition and fuel group comprising the ammunition depots, ammunition parks, fuel and oil reserves and distributing depots.
- (c) An equipment group comprising the equipment depots.
- (d) An aircraft, mechanical transport and marine craft group comprising all the aircraft storage units and the packing depot.

The proposals contained in the Director of Organisation's Note were considered at an Expansion Progress Meeting of the Secretary of State for Air on 21 September 1937, and, after discussion, it was decided that :—

- (a) The formation by gradual stages of a maintenance organisation, consisting of a number of Groups (the exact number to be left open), to control the various maintenance units, and a central organisation to co-ordinate the functions of the Groups, should be approved in principle. The question of the designation of the central controlling authority should be reserved, as also should the question of whether or not the higher organisation and the various Groups should be under one roof.
- (b) The control of the Groups would be under Equipment Branch officers, the central authority under a General Duties officer.
- (c) The new maintenance Groups should be functional in character and, with whatever higher organisation which might eventually be decided on for their control, should be located outside the Air Ministry.
- (d) The Air Member for Supply and Organisation should work out the various stages by which the new Maintenance Organisation should be put into effect.

Initial Difficulties of Maintenance Command

Although the decision to form a Maintenance Command had been taken, six months elapsed before it was decided to press forward with the necessary arrangements. The Headquarters of the Command commenced to form on

1 July 1938, Air Vice-Marshal J. S. T. Bradley taking over administrative and technical responsibilities from Training Command and the Directorate of Equipment respectively.¹ On 7 August 1938, Headquarters, Maintenance Command, moved to Andover, assuming executive command of the maintenance units which had been administered by No. 11 (Fighter) Group, No. 23 (Training) Group and No. 24 (Training) Group.²

At the end of 1938 less than half of the minimum and provisional numbers required for the Command and Group Headquarters staffs had been supplied. Another source of worry was the fact that a proportion of the civilian employees at the maintenance units were R.A.F. reservists who, in the event of war, would be called upon to return to Service duties and be lost to the Command. The lack of housing for the civilian employees also provided a problem. Many of the maintenance units were in sparsely inhabited districts, and suitable labour to staff them could not be obtained when houses were not available.

In the Equipment Group there was a lack of planned accommodation which necessitated a considerable dispersion of stocks for security reasons and raised distribution problems almost impossible to overcome. It was apparent in this Group that the inadequate stocks of technical spares would, in the event of war, prove to be most serious. The most acute shortage was in spare parts for the latest types of aircraft. In connection with these spares there were several disturbing features:—

- (a) The non-interchangeability of parts of aircraft of nominally the same type.
- (b) The numbers of the types and variants for which parts had to be supplied.
- (c) The complications created by the acceptance of incomplete material (e.g. engines less certain parts) from contractors.

The constantly mounting number of mechanical transport vehicles to be stored in reserve against mobilisation was also a problem. The figure at the end of 1938 was 8,000, with little storage space available.

It had been estimated by the Air Ministry that the load of the equipment depots measured in terms of stock issues would increase between seven and eight times immediately upon the outbreak of war. This increase could only be met by the most intensive and detailed peace-time preparations. With the amount of work already in hand, however, it was not possible to undertake such preparations.

The difficulties of the Aircraft Group in 1938 and early 1939 were caused mainly by the lack of staff for the Group Headquarters. Supervisory control was therefore in the hands of the already overloaded staff of the Command Headquarters and much of the work proper to the Group was done from the Air Ministry. Another difficulty was in obtaining labour for the storage units. This labour which was required for the preparation and maintenance of aircraft had to be new and trained before it was of any use. By March 1939, in the

¹ A.M. File CS.1070/39.

² Maintenance Command O.R.B. 1938.

absence of the required personnel, the aircraft in store could not be properly maintained.

The Ammunition and Fuel Group was generally in a happier position than the others, although only a nucleus staff for the control of the Group had been provided. In the spring of 1939 more stock was available in relation to the consumption to be anticipated, and dependable distribution arrangements had been planned. The stocks of the ammunition depots were, however, disposed unsatisfactorily due to the slow and piecemeal constructional development of the underground storage. The security of the ammunition depots, particularly of the highly concentrated H.E. bomb holdings, was a matter of concern owing to the large number of contractors' employees at work inside the holdings. The antecedents of many of the men were unknown and it was difficult to guard against possible sabotage.

As regards fuel and oil, excepting supervision of the custody of stocks *in situ*, the control of the organisation remained with the Air Ministry and the service was an agency one performed entirely by the Oil Companies.

No attempt had been made to form the Repair Group by the summer of 1939, and the lack of salvage and repair sources was the most serious gap in the new maintenance organisation.

Introduction of the Technical Branch

Although the necessity for a technical branch to meet the requirements of the rapidly growing complexity of modern aircraft had been apparent for many years, it was not until the early months of 1939 that the Air Council approved proposals for the direct entry of engineers from industry and the universities and agreed to the creation of a Technical Branch of the Service. An announcement to this effect was made in the Press on 1 August 1939. Hitherto the policy for the provision of officers for technical duties in the Royal Air Force had been that they should be general duties branch officers trained as pilots before being trained as specialists; should be employed alternatively in specialist and in non-specialist posts and should be eligible equally with non-specialists to rise to the highest appointments in the Royal Air Force. This policy had originally been laid down by Lord Trenchard. It had been modified by the introduction of commissioned warrant officers, mainly for employment on station and maintenance unit duties, who had gained their technical knowledge and skill in the ranks. This class filled most of the junior posts and would fill a small proportion of the squadron leader posts.

On 26 March 1940 the Air Member for Personnel submitted a Memorandum which embodied a scheme for applying in war the policy which had been approved in peace for forming a technical branch for permanent officers. The branch was to be made up from existing permanent specialist G.D. officers, from those officers granted G.D. commissions immediately before the war for specialist duties only, from existing commissioned engineer officers and signals and armament officers, and in the future from airmen commissioned for engineer duties. The Council approved these proposals.

Investigation by the Jones Committee into R.A.F. Administrative Procedure¹

As the result of the proceedings of the first meeting of the Air Council on the expansion of the R.A.F. operational Commands to Scheme 'L,' it was decided in June 1938 to form the two sub-committees to examine the existing system of administration in the Royal Air Force in the light of the requirements of operational and general efficiency, readiness for war, and economy, and to make recommendations with a view :—

- (a) To ease, as far as possible, the burden of administration on Station, Squadron and Flight Commanders so that they could give proper attention to their operational and training responsibilities.
- (b) To confine the paper work of administration to real essentials.
- (c) To adopt in peace methods of administration approximating as closely as possible to war requirements.

Amongst some of the main directions in which it was suggested that administration could be simplified were :—

- (a) The general policy under which aircraft were inspected, maintained and repaired and the procedure for recording the processes of maintenance.
- (b) The procedure for demanding, estimating and accounting for equipment, the holding and transfer of aircraft inventories and the necessity for some of the returns which were being rendered.

Considerable discussion took place subsequently as to the composition of the committees. At first it was thought that the Chairman should be a serving officer of Air Rank. One committee should have a Group Captain engineer, a civilian with engineering and business qualifications, and a secretary. The other would include a Group Captain (General Duties), a chartered accountant, or other civilian with business experience, and a secretary. Eventually, however, it was decided that only one committee was necessary under the chairmanship of a well-known industrialist with a number of civilian and Royal Air Force members.

The first Chairman to be appointed was Lieutenant-Colonel J. H. M. Greenly of Messrs, Babcock and Wilcox Ltd., Engineers, but on his appointment as Chairman of the Prime Minister's Panel of Industrial Advisers, Colonel Greenly resigned in favour of Brigadier-General H. A. Jones of the Imperial Tobacco Company. Several other changes took place before the committee commenced its sittings in December 1938, and after 24 full meetings rendered its report on 2 August 1939.² Every aspect of the administration of the Royal Air Force

¹ A.M. File S.45433/38.

² The composition was :—

Brigadier-General H. A. Jones (<i>Chairman</i>).	..	..	..	..	London Passenger Transport Board.
Major M. J. H. Bruce	..	..	..	..	Director of Equipment, Air Ministry.
Air Vice-Marshal A. G. R. Garrod	..	..	..	..	General Post Office.
Captain A. Hudson	..	..	..	..	H.Q. Fighter Command.
Air Vice-Marshal A. C. Maund	..	..	..	..	Messrs. Peat, Marwick, Mitchell & Co., Chartered Accountants.
Sir Harry Peat and Mr. H. J. Sanders	..	..	..	..	Air Ministry.
Mr. R. C. Chilver (<i>Secretary</i>)	..	..	..	..

was covered, including administrative training, administrative control by the Air Ministry, administrative control by Commands, Groups and Stations, the system of assessing and accounting for airmen's pay, equipment accounting, personnel administration, and the inspection and maintenance of equipment. For the purpose of this monograph, however, it is only proposed to deal with those sections concerned with the maintenance services of the Royal Air Force.

The Committee had a great deal to say about the engineer services.¹ It considered that the responsibilities of the Director of Repair and Maintenance were too narrowly understood and that inadequate provision had been made for effective control. There was misunderstanding between the Air Ministry and the Commands on technical matters, inspection schedules were issued based on inaccurate information, instructions regarding inspections were being misinterpreted by units and maintenance was not proceeding in accordance with the intention of the Directorate of Repair and Maintenance. It was recommended that :—

- (a) The staff of the Director of Repair and Maintenance should be strengthened.
- (b) The Director of Repair and Maintenance should be consulted on all personnel and establishment questions affecting the repair and servicing organisation, including the recruitment and training of civilian personnel and instructors.
- (c) On technical questions connected with the behaviour of equipment in service, the Director of Repair and Maintenance should correspond direct with Service units and not through the Directorate of Equipment.
- (d) The director of Repair and Maintenance should be placed in a position of full responsibility for the technical control of the repair depots and directly to the repair Group.
- (e) The running of the repair depots should be costed.
- (f) Endeavour should be made to recruit experienced personnel from civil life for certain senior posts to be filled by the specialist technical branches.
- (g) The post of Director General of Research and Development should be held by an officer drawn from one of the specialist technical branches.
- (h) The title of ' Director General of Research and Development ' should be changed to ' Director General of Engineering Services.'
- (i) The Director General of Engineering Services or his nominee should be a member of all promotion boards dealing with specialist technical officers.
- (j) When the proposed specialist technical branches came into existence, a larger proportion of the posts connected with the development of Service equipment should be filled by Service personnel.

Regarding the equipment administration, the Committee said that they were struck by the serious shortage of some items of equipment at stations, particu-

¹ Report of the Committee on R.A.F. Administration, 1939, Part II, Section IV.

larly of spares for airframes and engines.¹ This shortage was seriously holding up repair and maintenance work in station workshops and had resulted in a low rate of serviceability. It was suggested that equipment inspectors or liaison officers should be provided to ensure that items were produced. It was recommended that :—

- (a) Use should be made of equipment inspectors in connection with shortages of equipment.
- (b) The equipment, contract and finance branches dealing with particular types of equipment should be accommodated close to each other.
- (c) Steps should be taken to ensure that financial scrutiny of requisitions for equipment was not allowed to become a complete duplication of the calculations made by the equipment branches.
- (d) Commanding officers of maintenance units should be authorised to spend up to £100 in any one instance on local purchases of equipment, and to accept tenders other than the lowest in all cases where they thought it necessary.
- (e) Decentralisation of provisioning from the Air Ministry should be confined to those cases where it was clear that the greater part of the information required was available at the maintenance units or could readily be supplied to them.
- (f) The necessity for special returns connected with shortages of equipment should be reviewed periodically.

The Committee examined in detail the current system of inspection and maintenance of technical equipment and found that the system was defective in the following respects :—²

- (a) The number of aircraft unserviceable on account of inspections was unduly large. The frequency of inspections was unnecessarily great and individual items were inspected unnecessarily often.
- (b) The form of inspection schedule in use was inclined to be too indefinite in some of its terminology and certain of the instructions were actually impracticable in some types of aircraft.
- (c) The records of inspection were in a form which made it impossible for the individual making the inspection to mark off the items as they were examined. There was no proof that all the items which should have been inspected had, in fact, been inspected. It was thus impossible to obtain essential evidence as to whether inspections were too frequent or the reverse. Consequently, efficient supervision on the spot was extremely difficult, if not impracticable.

It was considered that the inspection system should be overhauled and simplified.

In regard to the supply and maintenance of mechanical transport the Committee recommended that :—³

- (a) Standardisation on one type of vehicle should obtain for not less than six years.

¹ Report of the Committee on R.A.F. Administration, 1939, Part II, Section V.

² Report of the Committee on R.A.F. Administration, 1939, Part VII, Section I.

³ Report of the Committee on R.A.F. Administration, 1939, Part VII, Section II.

- (b) In preparing the list of firms to be invited to tender for vehicles the Director of Contracts should be guided by the directorates responsible for development, production and supply.
- (c) Detailed specifications should only be issued when competitive tenders were required for an article which could be produced exactly similarly by different manufacturers.
- (d) In selecting new types of vehicles preference should be given to those types which embodied the largest proportion of components which were also used in the ordinary commercial vehicles of the same make and employed interchangeable units or components within the range of vehicles supplied to the Royal Air Force.
- (e) Manufacturers should be required to guarantee the supply of spares for specified minimum periods after contracts for vehicles had been placed.
- (f) Units should be supplied with manufacturers' part lists instead of the lists being transcribed into the Air Ministry's general vocabulary.
- (g) Responsibility for authorising the scrapping of vehicles beyond economical repair should be transferred from the Director of Equipment to the Director of Repair and Maintenance.
- (h) The maintenance schedules for mechanical transport should be reviewed.
- (i) Fitters employed on the maintenance of mechanical transport and marine craft should be mustered in a separate trade from fitters, aero-engine.

Copies of the Jones Committee's report were not distributed until the end of August 1939, and the outbreak of war on 3 September prevented, of course, the recommendations of the Committee being given the attention which otherwise they would have received. However, a great many of the recommendations, although by no means all, were given effect to as the war progressed.¹

¹ Copies of the Jones Committee's report are held by the Air Historical Branch.

CHAPTER 2

THE MAINTENANCE ORGANISATION SEPTEMBER 1939 TO APRIL 1940

The Position at the Outbreak of War

The aircraft servicing and repair organisation of the Royal Air Force in September 1939 was the responsibility of the Directorate of Repair and Maintenance, Air Ministry. The Directorate issued instructions to the Service regarding the maintenance and repair of airframes, engines and other technical equipment in use. It also gave technical advice to the Air Ministry design and production staffs regarding the maintenance, repair and interchangeability of parts in new types of airframes and engines in order to reduce to a minimum maintenance and repair problems in the Service.

A Deputy Directorate of Repair and Maintenance was first formed in 1932 with Group Captain Roderick Hill as Deputy Director. Originally under the Directorate of Equipment, which formed part of the Department of the Air Member for Supply and Organisation, it was soon afterwards placed under the Air Member for Research and Development, who later became the Air Member for Development and Production. In February 1937, Group Captain Hill was succeeded by Group Captain Sir C. J. Q. Brand who, on 1 July of the same year, when the Deputy Directorate was upgraded to a Directorate, was promoted to Air Commodore. Further expansions took place in September 1938, August 1939 and November 1939.¹

Repair was carried out only to a very limited extent by Service squadrons in 1939 and work beyond their capacity was allotted either to R.A.F. maintenance units through Maintenance Command or to contractors who operated under instructions issued by the Directorate of Repair and Maintenance.

The supply services of the Royal Air Force at the outbreak of war were administered by the Directorate of Equipment, Air Ministry, under the control of the Air Member for Supply and Organisation, the executive work being done by Headquarters, Maintenance Command. The maintenance organisation of the Royal Air Force therefore presented a somewhat anomalous situation. The main activities of Maintenance Command, the channel of supplies and their method of operating within the Royal Air Force plus the administration of the salvage and repair depots all came within the province of the Air Member for Supply and Organisation.² His machinery for controlling these, however, was lacking in one important aspect, namely, that the technical control of repair and servicing of material within the Royal Air Force was vested in the Director of Repair and Maintenance who operated under the Air Member for Development and Production.³

¹ The Directorate as it was constituted soon after the war commenced when it moved to Harrogate is shown in Diagram 1.

² See Diagram 2.

³ See Diagram 3.

ORGANISATION OF THE DIRECTORATE OF REPAIR AND MAINTENANCE, NOVEMBER 1939

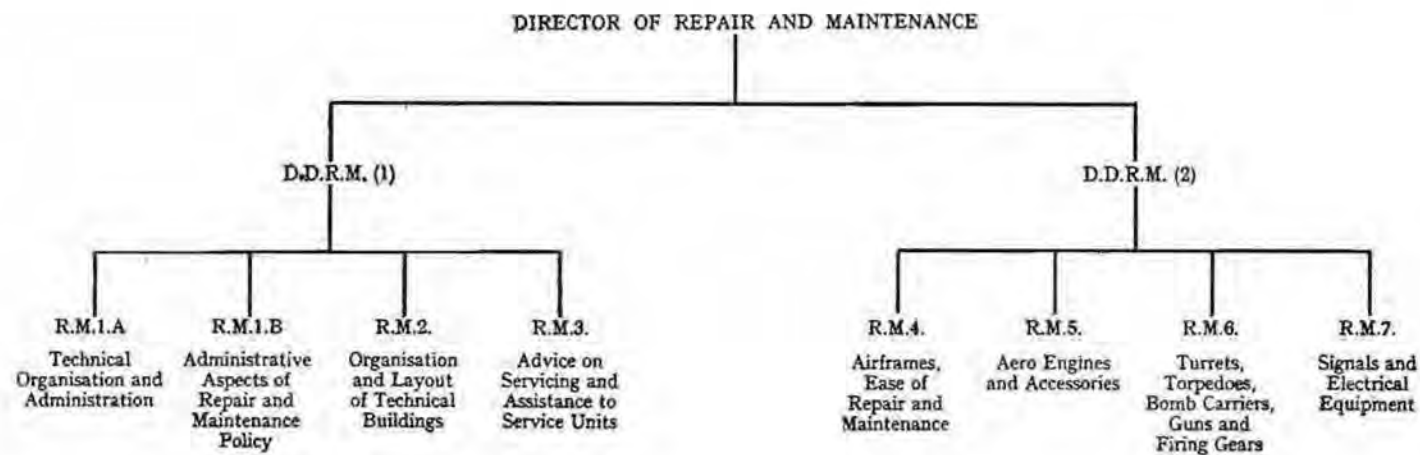
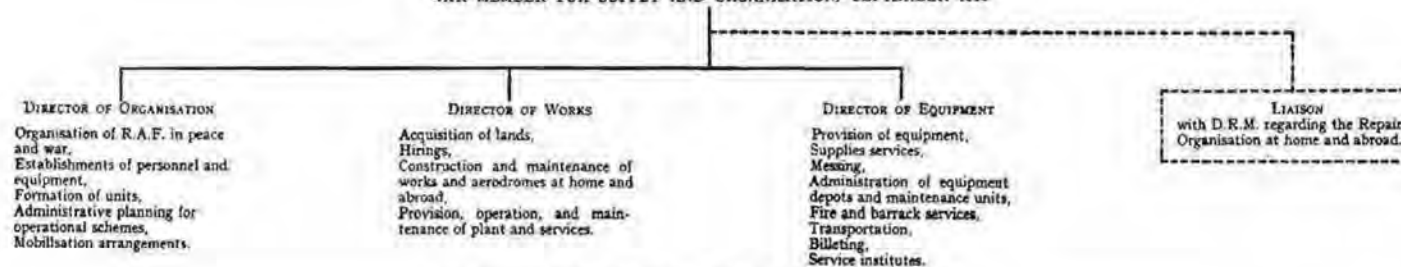


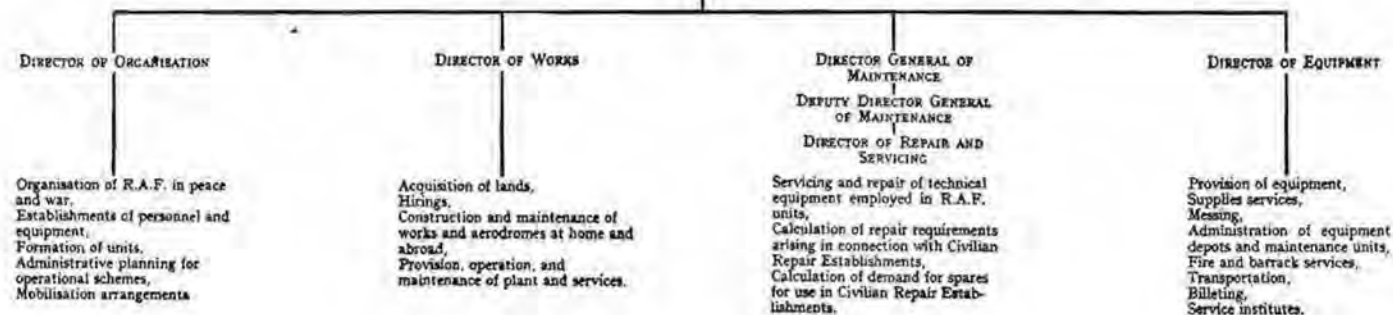
DIAGRAM 1

SUPPLY AND ORGANISATION, SEPTEMBER 1939 AND JANUARY 1940

AIR MEMBER FOR SUPPLY AND ORGANISATION, SEPTEMBER 1939



AIR MEMBER FOR SUPPLY AND ORGANISATION, JANUARY 1940



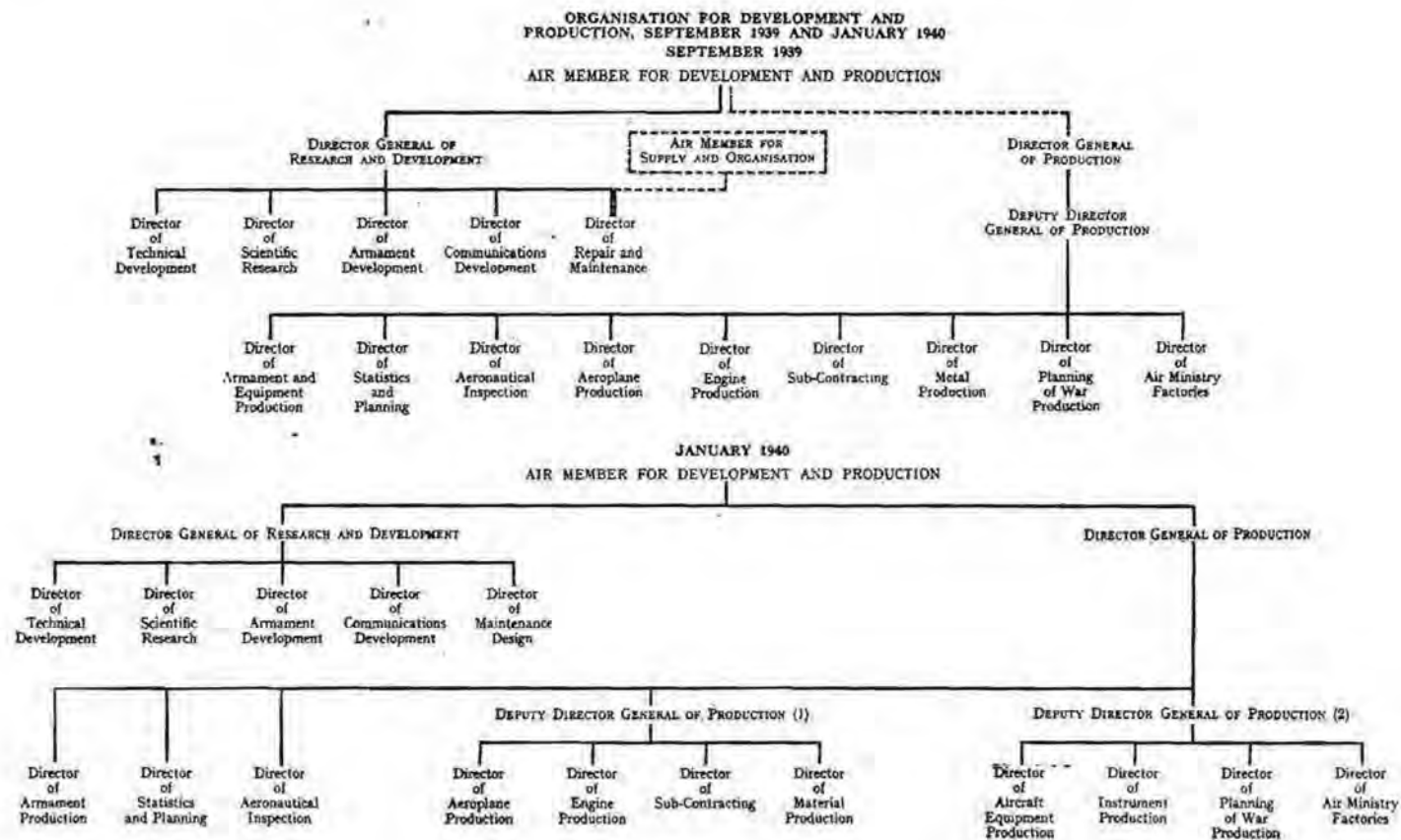
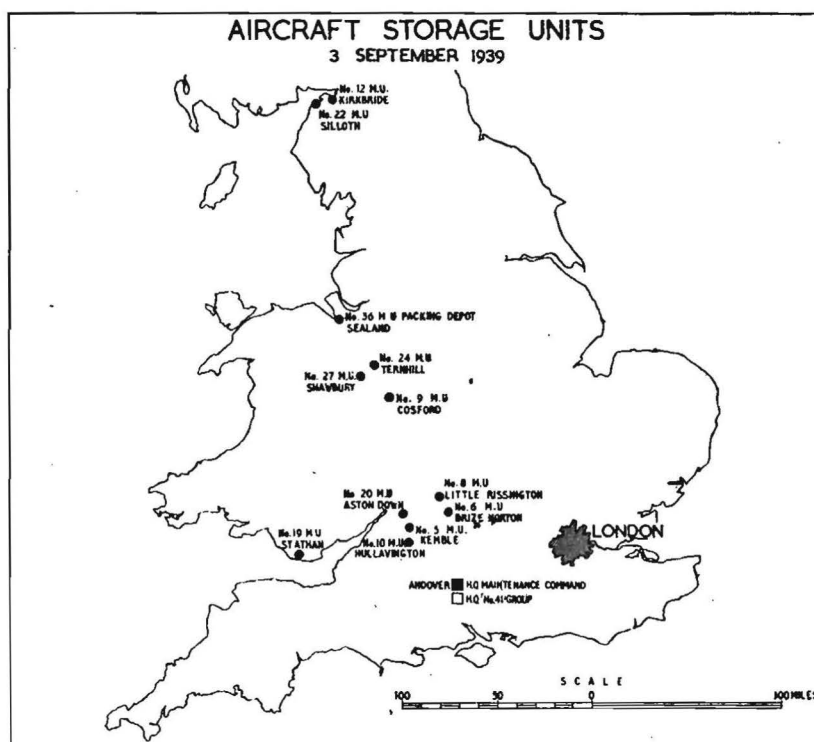
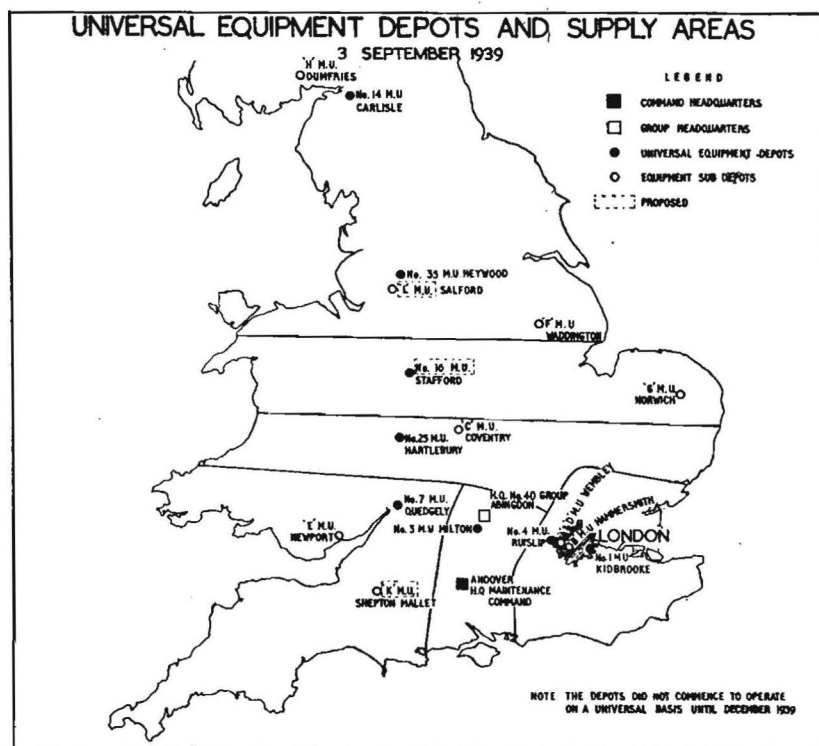


DIAGRAM 3

DIAGRAM 4



In September 1939 the maintenance of units in the Royal Air Force, up to the point where it became their own responsibility, was, subject to the general direction of the Air Ministry, the duty of Maintenance Command. Its activities under peace conditions covered the storage and distribution of serviceable equipment and supplies and the conservation of stocks in such a manner that they would be readily available for use in war. The Command was also charged with the duty of salvage and, where so directed, the repair of equipment, in order to supplement the main supply from contractors and the technical resources for repair work of the units of other Commands.¹

In addition to the immediate servicing of units in the United Kingdom, Maintenance Command was also responsible for the despatch of equipment and supplies (with certain exceptions such as fuel) to overseas Commands and to contingents of the Metropolitan Force operating outside the United Kingdom. The responsibility of Maintenance Command as regards Commands and units overseas ended, however, with the despatch of the required materials.

The Command was divided into four Groups, the functional responsibilities of each being :—

- No. 40 Group (Equipment) .. Estimating for, custody and distribution of all categories of equipment to home units and equipment overseas. Maintenance of reserve M.T. vehicles and M.T. allotment.
- No. 41 Group (Aircraft) .. The maintenance of all aircraft reserves ; their allotment and delivery to home units, and shipment overseas.
- No. 42 Group (Ammunition and Fuel) Supply of ammunition, oxygen, aviation and M.T. fuel and oil to all home units and shipment of oil and ammunition overseas.
- No. 43 Group (Repair) .. The repair of all types of equipment and the salvage of aircraft beyond the capacity of units to repair.

The allocation of responsibility between Maintenance Command and the Headquarters of its Groups differed from that in the other R.A.F. Commands. The primary duties of the Command Headquarters' staff were planning and co-ordination. All administrative and executive work which did not require to be centralised for economical or other reasons was done by the Groups, which were given the staff necessary. Specialist staff were, as far as possible, concentrated at the Groups, though owing to the nature of the work of the Command most of the staff at Command Headquarters had in some degree to be specialists. When the Command was formed, the Group offices were placed near to the Command Headquarters office, so making the particular specialists readily available to the Command staff when their advice was needed.

¹ A.M. File S.37588/36.

For the purpose of supply of ammunition, oxygen, fuel and equipment the country was divided into a number of subsidiary supply areas, each of which was served by a supplying unit. The sizes of the supply areas varied according to the intensity of consumption and the distance over which supply was economical. Flexibility and security were obtained by giving each distribution area an overload capacity and by transferring consuming units from one area to an adjoining one to meet changes in load concentrations.

Composition of the Maintenance Command Groups

No. 40 Group (Equipment). No. 40 Group formed at Andover on 1 January 1939, and moved to Abingdon on 31 August of that year. Under the expansion scheme No. 40 Group was planned to consist of seven or more equipment depots, each holding a complete range of equipment to supply the consuming units in their service areas in all respects. Distribution from the equipment depots was to be entirely by road convoys which would link up all the consuming units in their service areas. The aim in war was to deliver material within 48 hours of demand.

On the outbreak of war six equipment depots were in being but were not yet operating as Universal Equipment Depots (U.E.D.). It was not until December 1939 that the first U.E.D. commenced issues on a geographical basis. In addition to the depots, a number of small maintenance units holding varying items of stores were located in different parts of the United Kingdom.¹

No. 41 Group (Aircraft). No. 41 Group Headquarters formed at Andover on 1 January 1939 but did not assume executive control of its units until 3 April 1939. The Group Headquarters was responsible for the administration of the Aircraft Storage Units and the Packing Depot in the United Kingdom. The functions of the Group as a whole were to receive, store, equip, maintain while in store and issue aircraft to R.A.F. units at home and despatch those allotted to overseas Commands.

Under peace conditions, the Aircraft Storage Units only held the reserve aircraft behind the initial equipment and immediate reserve aeroplanes with which the flying units were supplied. Aircraft for re-equipment or to replace wastage were, as far as possible, delivered direct to units from the factories at which they were manufactured, the equipping of the aircraft being completed after they arrived at units. It was intended, however, that under war conditions the A.S.U.s would supply to squadrons aircraft fitted with the full scale of operational equipment.

The number of aircraft stored at the A.S.U.s at the end of August 1939 was approximately 2,500. These included reserves for all the R.A.F. Commands and the Fleet Air Arm, those of the latter being held on deposit for the Admiralty. Deliveries to the A.S.U.s from the factories were at the rate of about 500 per month and issues from the A.S.U.s to R.A.F. units at about 250 per month.

Under the expansion scheme twenty-four Aircraft Storage Units and two Packing Depots were planned, each of the former to have a holding capacity

¹ The R.A.F. Supply Areas in the United Kingdom and the equipment depots of No. 40 Group applicable to those areas in September 1939 are shown in Diagram 4.

of 400 aircraft. By 3 September 1939 eleven A.S.U.s had been formed and nine were functioning. One Packing Depot was in existence.¹

The allotment of aircraft to units at the outbreak of war was carried out by the Air Ministry, but it had been planned to transfer the task to No. 41 Group Headquarters as soon as sufficient personnel for the purpose could be provided and trained. Delivery into the A.S.U.s from contractors was undertaken by two Ferry Pools with a total strength of 32 pilots. One was located at Filton and the other at Hucknall. They were controlled by the Air Ministry. Aircraft issued to units were normally collected by the consignee.

*No. 42 Group (Ammunition and Fuel).*² No. 42 Group Headquarters formed at Andover on 17 April 1939 and assumed executive control of its units on 15 June 1939. The Group included the ammunition, fuel, oil and oxygen supply services. It differed widely from the other maintenance groups in that, although the ammunition organisation had features in common with equipment, fuel and oxygen supplies were essentially agency services, in respect of which Maintenance Command controlled a part of the resources of large industrial concerns.

The plan for the Group included five Ammunition Depots. These were to be universally stocked like the Equipment Depots, excepting that, owing to special storage requirements, incendiary bombs were to be held at only three of them. The formation of the Ammunition Depots presented special problems owing to the vulnerability of the stock to be held and the fact that the explosive content of much of the stock was so great that explosives regulations made overground storage prohibitive on account of the area required. Both to facilitate distribution and for security, more depots than those planned were desirable, but their siting presented so many difficulties, chiefly those of finding or building underground storage, that it was not considered possible to develop more.

The stocks at each Ammunition Depot consisted of H.E. bombs, bomb components, small arms ammunition, pyrotechnics and filling materials. The H.E. stock was held underground and fully protected. In some cases disused mines and quarries were used, whilst in others, concrete chambering was prepared on the floor of disused open quarries and covered with soil available from the quarry workings. The pyrotechnics and other materials of less explosive content were stored in separated sites consisting of small semi-underground buildings which were lightly covered with earth and turfed over.

Under peace conditions, distribution of ammunition was made direct from the depots to the consuming units. In war it was planned to establish six or seven Air Ammunition Parks in the neighbourhood of the operational units. It was intended that the Parks would hold one week's stock at war consumption rates for the units they served. Ammunition was to be drawn from the Parks using transport belonging to the consuming units. Distribution to the Parks from the Depots was to be done by rail.

¹ The units of No. 41 Group in September 1939 are shown in Diagram 4.

² No. 42 Group O.R.B. and information from Gp. Capt. E. J. H. Starling, S.A.S.O. No. 42 Group.

The supply of oxygen for H.P. breathing apparatus was on an agency basis. Arrangements were made for eleven drying and compressing plants at civilian works, producing commercial oxygen and suitably situated in relation to consuming units, to provide the R.A.F. requirements. The oxygen was delivered from the plants in large-capacity transport cylinders from which units recharged their aircraft containers. Under peace conditions supply was made from the producer direct to consuming units. In war it was intended that units should draw their supplies from the Air Ammunition Parks unless the supplying firms were nearer to the units than the Parks.

Supplies of aviation fuel and oil for the R.A.F. had, from the termination of the 1914-1918 war to the outbreak of hostilities in September 1939, been obtained directly from the petroleum supplying companies in Great Britain under a scheme of standing contracts. The Royal Air Force possessed no reserve stocks of aviation petrol, and this commodity was not included in the extensive range of supplies held in Maintenance Command. In 1937 it was realised that the position was not entirely satisfactory and arrangements were made to construct a limited amount of Air Ministry reserve tankage within the confines of the supplying companies' main ocean tanker reception terminals. Consequent upon the Munich crisis in 1938 this scheme was extended to include a system of underground Reserve and Distribution Fuel Depots of large tonnage capacity to be constructed mainly on the West Coast. This position was decided upon in view of the fact that aviation fuel would normally be received from the U.S.A. In addition, fuel depots of a smaller nature were to be located in the areas from which it was anticipated that major bomber forces would operate, i.e. East Anglia. A number of these depots were completed and partially filled immediately prior to the outbreak of war. The supply system envisaged also included the construction of two Air Ministry owned factories for the production of containers and the mechanical filling of the containers with aviation fuel and oil.

No. 43 Group (Repair). The Repair Group Headquarters had not been formed when war commenced. Up to 1938 the relatively small amount of aircraft repair was undertaken for the Air Ministry by the aircraft industry. In 1938, when large-scale planning for war took place, it was decided that there would be insufficient capacity available in the aircraft industry to cope with the increase envisaged in repair work. The Royal Air Force had, therefore, to aim at self-sufficiency. But, as the expansion of R.A.F. repair depots had to be closely related to mobilisation and training requirements, civilian industry had somehow to find the capacity for the excess of repair work anticipated. It was not long, however, before doubts about industry's ability to play even this minor role prevailed and the Air Ministry decided to assume direct responsibility for the entire repair programme, using part Royal Air Force and part civilian repair shops.

Following up this decision, it was agreed in March 1939 that the R.A.F. repair organisation would consist of :—

- (a) Three Service Repair Depots.
 - No. 13 Maintenance Unit, Henlow.
 - No. 30 Maintenance Unit, Sealand.
 - No. 32 Maintenance Unit, St. Athan.

(b) Three Civilian Repair Depots :—

No. 34 Maintenance Unit, Abbotsinch.

No. 47 Maintenance Unit, Burtonwood.

No. 00 Maintenance Unit, probably at Stoke.

The three Service depots were each to have an establishment of 1,500, and their primary purpose was to provide on mobilisation personnel for aircraft depots for Field and Advanced Air Striking Forces, a war salvage organisation, and aircraft storage units for the erection of reserve aeroplanes. In addition, it was anticipated that the Service depots would account for 25 per cent of the repair arisings of airframes, aero-engines, aircraft equipment, mechanical transport, etc. Salvage was to be covered by the establishment of six centres in different parts of the country.

The major part of repair production (i.e. 75 per cent) was to be undertaken by the civilian depots, each with a peace-time strength of 3,500, under the supervision of R.A.F. officers. The civilian depots were to be regarded broadly as interchangeable units, and war conditions were to be met by increasing establishments and working treble shifts.

When hostilities broke out, no repair had been carried out by the new repair organisation. Of the three Service depots only No. 13 Maintenance Unit at Henlow was in being, while Burtonwood, the only one of the civilian depots to be commenced, was still in the building stage. Some repair work was, however, being performed by aircraft parent and fringe firms under the control of the Director General of Production. As soon as war was declared, No. 43 Group with Headquarters at Andover was formed to control the repair and salvage maintenance units in the United Kingdom.

Arrangements for the Maintenance of Aircraft¹

The question of improving the technical organisation of the Royal Air Force had been under consideration both by the Air Ministry and the various Commands for some two years before the commencement of the 1939–1945 war. As the result of their deliberations an Air Council letter was issued on 1 February 1939 which stated briefly that it had been decided to reconstruct the repair organisation at home and to modify the technical administration at operational stations. In the new organisation, repair and servicing responsibilities were distributed as follows :—

- (a) Repair depots were to undertake major repairs and salvage and provide working parties for the embodiment of difficult modifications at units.
- (b) Station workshops were to be responsible for the work of allied tradesmen and the repair of mechanical transport.
- (c) Squadron servicing parties were to undertake major inspections of aeroplanes, minor repairs and the embodiment of modifications within their capacity.
- (d) Flights were to undertake minor inspections of initial equipment aeroplanes.

¹ A.M. File 756487/38.

The main difference in the station technical organisation lay in the introduction of the squadron servicing parties under the control of squadron engineer officers or warrant officers, engineer. The latter were provided in addition to the station engineer officers introduced several years earlier. The effects of the new organisation may be summarised as under :—

- (a) The responsibility for heavy work, e.g. major repairs and complete overhauls was transferred from flying units to a repair organisation.
- (b) The functions of station workshops were curtailed.
- (c) The varying degrees of skill of tradesmen were more correctly utilised. For example, flights were manned by Group II tradesmen and squadron servicing parties by Group I mechanics. All supervisory personnel were Group I tradesmen.

When the war started, the majority of units were in process of reorganising their maintenance on the new lines but were handicapped by a general shortage of skilled tradesmen and engineer officers which prevented the increased establishments resulting from the reorganisation being filled.

Transfer of the Repair Organisation to Morris Motors, Ltd.

As stated previously, war came before the R.A.F. repair organisation, as planned, could be brought into being. Apart from the difficulty experienced in completing, equipping and staffing both the Service and civilian depots, the question of the management of the latter had already given rise to considerable discussion. At a meeting on 10 August 1939, it was agreed that of the three civilian depots one should be operated by R.A.F. personnel, one by a civilian firm on an agency basis, and the third in the way proved most suitable from the experience of the first two. The discussion, however, proved to be academic. Immediately the war started, the Secretary of State for Air (Sir Kingsley Wood) suggested to Lord Nuffield, the Chairman of Morris Motors, Ltd., that the Morris organisation should take over the control of the repair depot being built at Burtonwood, staff it and be entirely responsible for its management.¹

Sir Kingsley also asked Lord Nuffield whether he would consider managing the proposed repair depot at Stoke, pointing out that construction had not been started and Morris Motors could develop the new depot as they wished. On 7 September 1939 Lord Nuffield agreed to take over the Burtonwood depot on the understanding that he would be made Honorary Controller, and the Deputy Chairman of Morris Motors (Mr. Oliver Boden) Honorary Deputy Controller.² As an alternative to developing the Stoke project he offered to place at the disposal of the Air Ministry his vacant shop-space at Cowley, near Oxford, for use as a repair depot, saying that there was an abundant source of labour of the right type in the district and the complete executive and staff of the factory available. Regarding the financial arrangements, Lord Nuffield said the factory could be run on the basis of a fixed Government contribution to overheads and a rate per airframe.³ At a meeting held at the Air Ministry on

¹ A.M. Folder D.G.P. 279, Minutes of Meeting, 10 August 1939.

² Mr. Boden was also the Deputy Controller of the Government shadow factory for the manufacture of aircraft at Castle Bromwich which had been under the management of Morris Motors since its completion in 1938.

³ A.M. File S.56626/39.

8 September, which was attended by Lord Nuffield, Mr. Boden, Mr. E. J. H. Lemon, the Director General of Aircraft Production, Air Marshal Sir Wilfrid Freeman, Air Member for Development and Production and Air Vice-Marshal Welsh, Air Member for Supply and Organisation, it was agreed that Lord Nuffield's offer should be accepted.

The acceptance of the Cowley factory in replacement of that originally proposed at Stoke meant in practice the abandonment of the R.A.F. scheme, already outdistanced by events. Only Burtonwood of the three projected R.A.F. civilian depots was ever brought into operation. Moreover, its role was very different from that originally conceived. After inspecting the site of the depot and the plans for the repair of equipment, Mr. Boden said on 11 September that the R.A.F. planning had progressed too far for it to be altered. He added that the depot was unlike anything in industry and he felt that he could not manage it as a commercial concern. He would, however, give all the advice and help he could. Mr. Boden also at first recommended that the organisation should not be altered and the Air Ministry should continue to provide personnel for the depot as originally planned. A manager should, however, be provided by the Morris organisation.

On 23 September, Mr. Boden changed his views regarding the participation of the Royal Air Force in running the Burtonwood depot. At a meeting under the chairmanship of the Permanent Under-Secretary of State for Air (Sir Arthur Street) attended by the Air Member for Supply and Organisation, the Second Deputy Under-Secretary (Mr. A. Rowlands) and the Director of Works, he stated that he had gone further into the planned repair organisation and had come to the conclusion that, as conceived, the civilian repair depot at Burtonwood would be incapable of providing in war the output required. In his opinion it had been a mistake to plan the civilian depots to undertake every range of repair, and the remedy would be to form a separate repair organisation within industry itself split up into the various specialised sectors. It would be necessary to keep that repair organisation entirely separate from the production side to avoid any risk of interference with production. The R.A.F. conception of the depots had been based on the assumption that in war industry would not be able to undertake repairs. It had now become apparent that that assumption was incorrect and that there were sections of all branches of industry which would be used for repair work. To meet the position Mr. Boden made the following recommendations :—

- (a) The original conception of the civilian repair depots in war should be abandoned in spite of any financial loss that would be entailed.
- (b) The aid of a number of well-known industrialists should be sought to set up a repair organisation in industry itself, dividing into its various specialised sectors and utilising existing surplus industrial capacity. One of their number might be appointed to co-ordinate the scheme under some such title as Director General of Repair and Equipment, and Mr. Boden intimated that, if he were invited, and provided Lord Nuffield concurred, he would be prepared to undertake this work.
- (c) The best use that could be made of Burtonwood would be as a repair depot mainly for airframes on the lines of the Cowley works where damaged airframes were to be stripped of components, which would be

sent away elsewhere for repair. Demands for replacement equipment would be made on R.A.F. equipment depots and the repaired aircraft would be turned out complete.

- (d) The delivery of machine tools to Burtonwood should not at present be stopped but they should not be bedded down.
- (e) No steps should be taken to post Air Ministry personnel to Burtonwood.

Mr. Boden's further recommendations were discussed at length at a special meeting held at the Air Ministry on 27 September 1939.¹ At the meeting the Permanent Under-Secretary explained the situation which had arisen in connection with the R.A.F. repair arrangements and said that the stage had been reached when two questions called for urgent settlement :—

- (a) Whether the original conception of the repair depot at Burtonwood as a general repair depot in war should be abandoned in favour of Mr. Boden's recommendations.
- (b) If these recommendations were adopted, what arrangements would be required within the Air Ministry for controlling and accepting responsibility for the repair function.

The Air Member for Development and Production expressed his opinion that in view of Mr. Boden's heavy responsibilities in other directions, especially in connection with the Castle Bromwich factory, he should not be invited to organise the scheme to establish a repair organisation within industry itself.

On the first question, no decision was taken pending settlement of the second which concerned the revised arrangements required within the Air Ministry. In respect of the second question, there was considerable divergence of opinion. On the one hand it was argued that there was intimate connection between upkeep of material and salvage within the Royal Air Force and the supply of material in war. Owing to the high wastage which would result in war, the policy of supply of new material must be interlocked very closely with the policy of Repair and Upkeep. There was urgent need for an organisation which would allow the control of Supply, Repair and Upkeep by a common head, not only in the Air Ministry but throughout the Commands at home and overseas. The organisation should embrace Supply, which in fact existed under the Director of Equipment, and should also contain a Repair and Upkeep side which was at present directed by the Director of Repair and Maintenance who was attached to Production. On the other hand it was argued that Repair was as closely connected with Production as with Supply and

¹ Those present were :—

Under-Secretary of State (in the chair).
Air Member for Development and Production.
Air Member for Supply and Organisation.
Director General of Production.
Permanent Under-Secretary.
First Deputy Under-Secretary.
Second Deputy Under-Secretary.
Director of Equipment.
Director General of Research and Development.
Director of Repair and Maintenance.
Deputy Director of War Organisation.

A.M. File S.2077/39.

it was essential that the production work outside the Royal Air Force should conform to Service technical requirements. For that reason, the Director of Repair and Maintenance should be attached to Production. It was equally necessary for any head of the repair organisation to be attached to the production side in order, particularly, to ensure that there would be no overlapping in the selection of industrial capacity and that the available industrial capacity (including skilled labour) was wisely used.

It was generally agreed at the meeting that the present position whereby the Director of Repair and Maintenance was filling a role calling for his direction by two members of Council was not satisfactory and it was finally decided that the Air Member for Development and Production and the Air Member for Supply and Organisation should each prepare for consideration by the Air Council a close functional analysis on paper of their proposals for the control of and acceptance of responsibility for the repair organisation within the Air Ministry and that, if necessary, the Secretary of State should be invited to determine the issue.

On 21 October 1939 Sir Kingsley Wood decided finally to appoint Lord Nuffield to be the Director General of Maintenance at the Air Ministry and his assistant (Mr. Oliver Boden) to be the Deputy Director General. The appointments were announced on 1 November 1939. In the meantime, Air Marshal Welsh and Air Marshal Freeman, after many discussions as to who should control aircraft repairs, agreed to settle the question on a compromise basis. On 23 October it was arranged that the Air Member for Supply and Organisation would be responsible for the administration and control of the Service repair depots, Burtonwood, and the repair units under the Nuffield organisation, while the Air Member for Development and Production would continue to administer and control all fringe firms engaged on repair work. The Deputy Directorate of Repair and Maintenance together with all members of D.R.M.'s staff engaged on repair were to be transferred to A.M.S.O.'s Department to assist Lord Nuffield's organisation. The remainder of D.R.M.'s staff was to concern itself only with the design aspects of repair and maintenance.

The Directorate of Repair and Servicing and the Directorate of Maintenance and Design

The splitting up of the Directorate of Repair and Maintenance between the Air Member for Supply and Organisation and the Air Member for Development and Production was found to be unsuitable and was followed, after more discussion, by the formation of two new directorates. That part of D.R.M. transferred to A.M.S.O. became the Directorate of Repair and Servicing (D.R.S.) the remainder under A.M.D.P. was named the Directorate of Maintenance and Design (D.M.D.). Air Commodore G. C. Bailey from Headquarters Maintenance Command was appointed to control D.R.S. while Air Commodore Sir Quinton Brand became D.M.D.¹ and it was not until 19 March 1940, i.e. over four months after the new Directorates were formed, that the memorandum (No. 56 of 1940) defining such respective responsibilities was published.²

¹ The new organisations of the Air Member for Supply and Organisation and the Air Member for Development and Production are shown in Diagrams 2 and 3 respectively.

² A copy of the memorandum is shown at Appendix I.

On 10 May 1940 Mr. Churchill became Prime Minister, and shortly after assuming office appointed Lord Beaverbrook to be Minister of Aircraft Production. The latter as part of his duties promptly assumed control of aircraft repairs in the United Kingdom and took over from the Air Ministry many of the responsibilities which had been allocated to the department of the Air Member for Supply and Organisation.

Lord Nuffield and the Civilian Repair Organisation

The direct result of the appointment of Lord Nuffield as Director General of R.A.F. Maintenance was the establishment of what came to be known as the Civilian Repair Organisation, the controlling and guiding spirit of which was Morris Motors Ltd. The success which this organisation ultimately achieved owed a great deal to the work of Mr. Oliver Boden who was responsible for most of the planning and development in the early stages. Apart, however, from the fact that Lord Nuffield was instrumental in introducing a scheme of building up within industry a repair organisation of firms specialising in the different types of work and controlled by one parent firm, his appointment as Director General of R.A.F. Maintenance was not, in the true sense of the term, a success. Indeed, it is difficult to see how any industrialist, no matter how successful he may have been in civil life, could have taken over at short notice an appointment such as the Director General of R.A.F. Maintenance without those years of experience of R.A.F. methods which the ramifications of the task demanded, particularly when it is remembered that the maintenance service needed considerable development if it was to meet the requirements of a world-wide war.

The Civilian Repair Organisation operated from the Morris Motors Headquarters at Cowley under the control of a Director. The staff were not Government employees but Morris personnel paid by that organisation under a comprehensive financial arrangement with the Air Ministry. The staff at Cowley were considerably handicapped from the commencement of their activities by lack of knowledge of aircraft repairs and it was necessary to attach experienced R.A.F. engineer officers to the Morris Headquarters in the initial stages in an advisory capacity.

It was not until the week ending 2 March 1940, that the first 12 airframes were produced with a stock holding of no less than 535. Progress for the next three months was slow and the stock of aircraft awaiting repair steadily increased as the following figures show :—

<i>Week ending</i>	<i>Output per week</i>	<i>Total holding at the end of the week</i>
2.3.1940	12	535
9.3.1940	29	510
16.3.1940	27	540
23.3.1940	7	560
30.3.1940	9	580
6.4.1940	12	600
13.4.1940	20	620
20.4.1940	28	625
27.4.1940	34	630
4.5.1940	15	640
11.5.1940	17	655
18.5.1940	20	695
25.5.1940	22	720

It was not until the Civilian Repair Organisation was transferred to the control of the Ministry of Aircraft Production on the formation of the latter in May 1940 that any real improvement was made.¹ During the week ending 1 June 1940 the output of repaired aircraft jumped from the total of 22 during the previous week to a total of 99, of which 55 were made serviceable on site. From then on the improvement was maintained and during the week ending 21 September 1940 no less than 199 airframes were repaired, of which 66 were made serviceable on site and 133 at works.

Mr. Oliver Boden unfortunately died from heart failure on 6 March 1940, while he was in process of organising the Civilian Repair Organisation. Mr. Boden was a remarkable man and probably got through more work in two days than most men could in double that time. He carried an immense load. He was Lord Nuffield's chief executive and as such had to give attention to every one of the Nuffield activities. These included the Castle Bromwich factory, the Burtonwood repair depot, the Civilian Repair Organisation with all its associated fringe firms, produce depots, etc., as well as the work of the Deputy Director General of Maintenance. In addition he apparently directed factories both for gun manufacture and tank manufacture and looked after the normal motor-car production at Cowley. All these activities, of course, only enabled him to put in about two days a week at the Air Ministry.²

The replacement of Mr. Boden presented difficulties, and after discussion it was agreed between Lord Nuffield and the Air Member for Supply and Organisation that, in view of the work involved, two Deputy Director Generals of Maintenance should be provided at the Air Ministry.³ Consequently, on 15 April 1940, two other Directors of Morris Motors Ltd., Mr. H. A. Ryder and Mr. H. Seaward, were appointed D.D.G.M.1 and D.D.G.M.2 respectively. The functions of these two gentlemen were:—

D.D.G.M.1 ... To deal with questions arising on the technical side, e.g. in connection with the allocation of repair work, provision of plant, extensions of buildings, etc.

D.D.G.M.2 ... To deal with questions arising in connection with the arrangements for holding repairable material, requirements in spares, and the administration of the repairable equipment depots and the repairable aircraft storage units directly controlled by the Civilian Repair Organisation at Cowley.

The titles Deputy Director Generals of Maintenance were selected by Lord Nuffield himself, although by this time it was becoming apparent to everyone concerned that Lord Nuffield and his assistants were dealing exclusively with airframe repairs in the United Kingdom and not with the provision of equipment or spare parts, the repair of engines and the various aspects of maintenance of the R.A.F. overseas. Messrs. Ryder and Seaward planned their repair policy and repair capacity in accordance with the requirements of the Royal Air Force at home which were notified to them by the Directorate of Repair and Servicing. A branch of the Directorate of Contracts of the Air Ministry was attached to Cowley in order that contracts could be concluded without delay

¹ C.R.O. Records.

² A.M. Folder D.G.P.391/40.

³ A.M. Office Memo. 82/40.

between the Air Ministry and the firms selected by the Directors of the Civilian Repair Organisation.

Lord Nuffield at this stage took little part in the direction of repair and left practically everything connected with the Royal Air Force to his two Deputy Director Generals. When on 17 May 1940 the Ministry of Aircraft Production was formed, with Lord Beaverbrook as its Minister, the posts of Director General of Maintenance with two Deputies at the Air Ministry lapsed, but in view of the fact that the work put into the Civilian Repair Organisation was beginning to bear fruit it was recommended by the Air Council to Lord Beaverbrook that the organisation with its Headquarters at Cowley should continue to exist and be transferred to his Ministry.¹ This was agreed, and on 16 June 1940 Mr. T. C. L. Westbrook of Messrs. Vickers-Armstrongs was appointed Director of the Aircraft Civilian Repair Organisation at M.A.P. Headquarters, while Mr. Achurch, of Morris Motors Ltd., retained control of the Headquarters at Cowley. Lord Nuffield, Mr. Ryder and Mr. Seaward returned to their normal activities in industry. The Aircraft Depot at Burtonwood, which had not then reached the production stage, was transferred to the administration of the Fairey Aviation Company. Subsequently it was managed jointly by Fairey's and the Bristol Aeroplane Company. It became the chief centre for the erection, modification and repair of American aircraft and was handed over to the United States Army Air Force in 1942.

The Directorate of Equipment

The organisation of the Directorate of Equipment which came into being immediately before the outbreak of war was the result of recommendations made by the Directorate of Equipment in June 1939. The organisation was designed to carry the load experienced in the early summer of that year under the conditions of peace expansion. The proposals for the war establishment of the Directorate provided for the addition of a number of junior equipment officers, but did not include any upgradings or any splitting up of branches since it was hoped that the additions provided for would meet requirements during the early weeks of the war.

The experience of the first two months of the war showed that this forecast was wrong and the load on branches increased to such an extent as to make it impossible for many of the heads of branches to exercise efficient supervision over the range of equipment for which they were responsible. The effect of these developments was that the Director of Equipment found himself having to deal with an increasing number of problems which should have been handled by subordinates. In addition, his position was complicated by the fact that the Directorate moved to Harrogate when the war commenced but the Air Member for Supply and Organisation to whom he was responsible remained in London.

After considerable discussion the Treasury, on 11 March 1940, agreed to an expansion of the Directorate whereby its various branches were split up so that the load on each branch was no more than the head of the branch could carry.² A number of Deputy Directors were provided to supervise the branches,

¹ A.M.S.O. Correspondence with Lord Beaverbrook, 1940.

² A.M. File S.B.860/39.

three Directors of Equipment were added to handle matters without delay on the Director level and the head of the Department was upgraded to Deputy Director General. Air Vice-Marshal Garrod was appointed the Deputy Director General of Equipment. The three officers selected for the posts of Directors of Equipment were, Air Commodore E. W. Havers, Group Captain W. J. B. Curtis and Air Commodore R. W. Thomas.

The Proposal to Appoint a Business Adviser to the Directorate of Equipment

When the arrangements for the reorganisation of the Directorate of Equipment were brought to the notice of the Secretary of State for Air, Sir Kingsley Wood pointed out to the Air Member for Supply and Organisation that several senior posts in the Quartermaster General's Department at the War Office were filled by civilians with large industrial experience and he considered that at least one of the Directors of Equipment should be a business man. This proposal was not received favourably by the Deputy Director General of Equipment who said that apart from the injurious effect it would have upon the morale of the whole of the equipment branch, no imported man could exercise the responsibility of a Director without having first served his apprenticeship in a number of less important posts. As a compromise he suggested that the equipment organisation could be strengthened by attaching an experienced business man to his department in an advisory capacity. The individual selected would remain a civilian and would have no executive responsibilities but would be free to roam over the whole equipment system with the aim of speeding up the machinery, simplifying and reducing paper processes, detecting inefficient or inadequate or excessive staffs and so on. He would exercise these functions not only by sitting in with the branches of the Deputy Director General of Equipment but also by visiting the units of the Maintenance Command and the equipment organisations of all the other Commands.¹

This suggestion was put to the Secretary of State by the Air Member for Supply and Organisation on 26 March 1940 and it was recommended that Brigadier-General Jones, who was chairman of the committee which investigated the methods of administration in the Royal Air Force in 1938, should be appointed business adviser to D.D.G.E. The suggestion was not pursued, however, because when Sir Samuel Hoare replaced Sir Kingsley Wood as Secretary of State for Air on 3 April 1940 it was no longer necessary for the Air Ministry to follow Sir Kingsley's policy of infiltrating industrialists into Service departments.

Business methods were, however, not entirely ignored by the equipment branch of the Service. When Maintenance Command was first formed in 1938, the Headquarters staff made a point of studying the methods adopted in industry. Railway General Managers were consulted regarding rail transportation and the layout of sidings and branch lines; the petrol chiefs in regard to the scheme for fuel depots; the Automobile Association for road routing; Harrods for quick delivery service; Selfridges for post order business and office systems, etc.

¹ A.M.S.O. Folder 309/40.

Immediately after the war commenced, the Treasury recommended that a firm of business efficiency experts should examine the whole of the R.A.F. equipment system. This proposal was welcomed by the Air Member for Supply and Organisation and the Director of Equipment so long as the enquiry was not likely to interfere with the work of the Directorate which was operating under high pressure, and provided that any reforms proposed were not likely to slow up or dislocate the Service while they were being introduced.¹ Subsequently it was suggested that use should be made of the services of men with wide business experience who became available or who were anxious to serve within the equipment service of the Royal Air Force in war-time.²

¹ A.M.S.O. Folder, 'Organisation of the R.A.F. in U.K.' 1940.

² A.M.S.O. Folder, 'A.M.S.O. Staff' 1940.

CHAPTER 3

THE GROUPS OF MAINTENANCE COMMAND, SEPTEMBER 1939 TO APRIL 1940

The Equipment Depots of No. 40 Group

On the outbreak of war No. 40 Group was commanded by Air Commodore R. W. Thomas and comprised the following equipment depots :—

- No. 1 Maintenance Unit, Kidbrooke
- No. 3 Maintenance Unit, Milton
- No. 4 Maintenance Unit, Ruislip
- No. 7 Maintenance Unit, Quedgeley
- No. 14 Maintenance Unit, Carlisle
- No. 25 Maintenance Unit, Hartlebury
- No. 35 Maintenance Unit, Heywood

In addition, the undermentioned sub-depots were used for storing various items of equipment :—

- ' A ' Maintenance Unit, Wembley
- ' B ' Maintenance Unit, Hammersmith
- ' C ' Maintenance Unit, Coventry
- ' D ' Maintenance Unit, Wembley
- ' E ' Maintenance Unit, Newport
- ' F ' Maintenance Unit, Waddington
- ' G ' Maintenance Unit, Norwich
- ' H ' Maintenance Unit, Dumfries

It had been decided before the war that No. 1 Maintenance Unit, Kidbrooke, was situated in a vulnerable position and the majority of the stocks had been transferred elsewhere. On 3 September 1939 the other six major M.U.s were in process of being reorganised as universal equipment depots. Kidbrooke was in use as storage for repairable equipment. During the four weeks that followed, No. 7 Maintenance Unit, Quedgeley, No. 14 Maintenance Unit, Carlisle, and No. 25 Maintenance Unit, Hartlebury, were in addition all engaged in packing and despatching equipment and M.T. vehicles for the units of the Advanced Air Striking Force for service on the Continent. These depots also equipped and despatched Nos. 1, 2, 4, 5 and 6 Air Stores Parks, Nos. 1 and 2 Supply and Transport Sections and part of No. 21 Aircraft Depot for the maintenance of the Force. Altogether 43 units and 933 vehicles were moved to the Continent during the month.¹

In order to provide for the rapid supply of urgent equipment and stores to the Air Stores Parks on the Continent an Air Transport Service was organised on 7 September to operate between selected bases in the United Kingdom and in France.² The aircraft for the service were supplied on a temporary charter by Imperial Airways, Ltd. and British Airways, Ltd. Initially two aircraft were made available ; two weeks later a further three with three more in

¹ No. 40 Group O.R.B.s, 1939-40.

² Maintenance Command Administrative Instruction No. 12, dated 7 September 1939.

reserve were supplied and arrangements were made for additional machines to be provided if necessary. The aircraft were accommodated and maintained at the National Air Communications base at Whitchurch (Bristol) but operated from Brockworth (Gloucester) aerodrome where a R.A.F. Collection Centre was established to deal with the receipt and despatch of consignments of stores between the United Kingdom and France. The aircraft were controlled by N.A.C. Headquarters at Whitchurch, the tasks and destination of the aircraft being notified to that organisation by Maintenance Command Headquarters via Air Transport Officers established at Brockworth and on the Continent. The Air Transport Service¹ remained in being until 9 December 1939 when it closed down and was replaced by the normal sea transport.

On 1 November 1939 the reorganisation of the equipment depots on a universal basis was still uncompleted, and on 2 November the Air Officer Commanding the Group called a conference which was attended by all his unit commanders to discuss the means whereby the dispersion of stocks in all vocabulary sections to five universal maintenance units could be speeded up with a view to commencing issues on 30 November. Various measures for improving the situation which existed were recommended and agreed upon, but it was not until 15 December that the machinery for implementing the universal supply system was completed. An additional U.E.D.—No. 16 Maintenance Unit—was formed at Stafford on 1 December 1940.

At a further conference held on 9 and 10 January 1940 to discuss the ways and means of increasing the supply efficiency of the universal depots, the Group Commander stated that the degree of competence to be aimed at was :—

(a) *Receipts*

A maximum time interval of 72 hours from the time of receipt of a case of equipment into the depot and the time it is brought on charge and its receipt advised to the Master Provisioning Office.

(b) *Issues other than those on which specific time instructions are given*

A maximum time interval of 48 hours from the receipt of a demand in the depot to the handing over of the equipment to the transportation section for despatch.

(c) *Transportation*

A 48-hour despatch service to all stations.

He expressed the view that these standards of efficiency could only be obtained by establishing immediately routine processes in the transportation sections and at the stocking sites of the depots, and providing adequate personnel to supervise and undertake the work. In the discussion that followed it was agreed by the depot commanders that by working to a standard it should be possible to bring about the degree of efficiency demanded and recommenda-

¹ During its period of operation, from September to December 1939, the Air Transport Service carried the following weights of equipment :—

		<i>Tons</i>	<i>Cwt.</i>	<i>Qr.</i>	<i>Lb.</i>
September	..	35	15	3	18
October ..	..	165	18	0	9
November ..	..	121	3	2	13
December	..	38	9	0	21

² Maintenance Command O.R.B., 1939, Appendix 19.

tions were made as to the establishments required and the changes in administrative procedure necessary to produce this result.

On 19 January 1940 a conference was held at Maintenance Command Headquarters to discuss the space required by No. 40 Group for equipment storage.¹ It was then stated by the Air Ministry representative that storage for nine months stocks of equipment was desirable and that for this 9½ million square feet was required. It was estimated that the existing universal equipment depots and other storage, including No. 4 Maintenance Unit, Ruislip, but excluding No. 1 Maintenance Unit, Kidbrooke, would supply 8 million square feet, leaving 1½ million to be found. It was agreed that one additional universal equipment depot at least was necessary; in the meantime no hirings could be given up and other hirings would be required whilst additional U.E.D.s were being built. At the moment, the full 8 million square feet was not available as several storage sheds at Quedgeley and Heywood were not complete and no sheds at Stafford were in use. It was considered that the best way to provide the additional area would be to establish specialised depositories and to ensure that steps were taken to dispose of obsolete stocks. The existing and proposed hirings were reviewed but these did not appear to provide the accommodation required and it was the opinion of the meeting that it would be necessary to use Kidbrooke (when emptied of repairable equipment) and other hirings in the London area to act as specialised depositories to the universal equipment depots.

A review of the accommodation available for the storage of mechanical transport vehicles showed that it would be necessary to find space for 12,800 vehicles in addition to the normal reserves. These vehicles would be received at the rate of 1,000 per month commencing 1 February 1940. It was estimated that the storage available when the M.T. sites at Heywood and Stafford were completed would be :—

M.T. sites at five U.E.D.s at 750 each	...	...	3,750
Wembley and Park Royal...	...	...	1,600
			<hr/> 5,350

leaving accommodation for over 7,000 vehicles to be found. It was suggested that the Air Ministry should approach the Automobile Association with a view to obtaining particulars of civilian firms and municipalities which could undertake to store and maintain small quantities of vehicles for the Royal Air Force.

By March 1940 the shortage of storage space in the Group presented a major problem. Only two depots—Hartlebury and Carlisle—were virtually complete. Heywood and Quedgeley were still far from completion. Stafford would not be able to hold stocks for another six weeks and Milton was still in the throes of reorganisation. It was estimated that the shortage of storage space on the provisioning programme was 2,500,000 square feet. In the sub-depots there was acute congestion. At Wembley and Hammersmith this was due chiefly to overcrowding with anti-gas clothing. At Coventry and Newport the cause was the vast amount of barrack equipment with dues in requiring another 400,000

¹ Maintenance Command O.R.B., Appendix, 2 January 1940.

square feet. In addition, sites totalling 200,000 square feet had been misappropriated at the U.E.D.s for the storage of furniture.¹

Various measures were adopted to relieve the position. Arrangements were made for units to hold three sets of anti-gas clothing per man, much repairable equipment, including furniture, was transferred to the Civilian Repair Organisation, and steps were taken to persuade building contractors to work overtime to complete the depots still in course of construction. In April 1940 it was decided to use part of the M.T. sites at Carlisle, Hartlebury, Heywood and Stafford, which had been earmarked for reserve vehicles, for the storage of other equipment. Arrangements were also made for galvanised items such as dustbins, barbed wire, etc., and material in drums such as oil, caustic soda and silicol to be stored in the open. Available empty bomb stores were used for equipment which required no heating. Obsolete stocks at Kidbrooke were disposed of and the vacant space used for new furniture of which large quantities were being received. Action was also taken to get rid of obsolete engine spares and engines in store at Ruislip to provide additional space. Storage for approximately 30,000 parachutes was found in the White City exhibition buildings at Shepherds Bush, which were also called upon to house some of the stocks of anti-gas clothing. To find accommodation for the reserve M.T. vehicles displaced from the U.E.D.s it was decided to utilise vacant balloon hangars, other than those in inaccessible parts, and to obtain particulars of open air 'hard standings' normally used for agricultural shows, etc., which could be employed pending the availability of other storage. The Society of Motor Traders was also approached with a view to arranging for the storage of vehicles at trade garages.

The Master Provisioning Scheme

The Air Council's decision to disperse the stocks of R.A.F. equipment amongst several universal holdings and issuing depots presented a number of administrative problems.² The chief of these was perhaps the question of how to co-ordinate the requirements of the various stock holders, and how to ensure that fresh stock was not purchased for one depot at a time when surplus stock of the same equipment was available elsewhere, and when one particular depot could not satisfy a demand, the quickest method by which stock available at other depots could meet the requirement.

During 1938 the staff of the Headquarters of Maintenance Command devoted continuous thought to the devising of a system which would overcome the difficulties, and in the autumn of that year submitted to the Air Ministry details of a scheme which provided for each equipment maintenance unit to have within its organisation a 'Master Provision Office' responsible for certain sections of the vocabulary of R.A.F. equipment, regardless of whether the stocks of these sections were held at the maintenance unit at which the M.P.O. was located or at other maintenance units. The special responsibility vested in each Master Provisioning Officer consisted principally of :—

- (a) Determining when replenishment by repair or contract was required for all equipment maintenance units regarded as a whole.
- (b) Calculating replenishment quantities.

¹ Maintenance Command O.R.B., Appendix, 6 March 1940.

² A.M. File 880976/39.

- (c) Issuing instructions to the repair organisation for replenishment of quantities which could be met from this source.
- (d) Submitting to Air Ministry details of requirements which had to be met by contract action.
- (e) Allotting supplies of equipment from repair maintenance units and contractors to equipment maintenance units for direct delivery.
- (f) Hastening the delivery of repaired items of equipment from contractors or repair maintenance units when such items were behind schedule.
- (g) Clearing inabilities notified by equipment maintenance units.
- (h) Arranging transfers of equipment between equipment maintenance units when necessary.
- (i) Ensuring that stocks of equipment were dispersed in accordance with the security policy.

The scheme originally put forward was not approved by the Treasury, and the Air Officer Commanding Maintenance Command was advised to reconsider his proposals. Immediately the war started, however, the objections of the Treasury were withdrawn and on 26 October 1939, after a number of amendments had been incorporated, the system for master provisioning at equipment maintenance units was inaugurated.¹

The new system, although it was ultimately most successful, did not, of course, come into being without many teething troubles. Much confusion was caused at the outset by disagreements amongst members of the Air Ministry, Maintenance Command, No. 40 Group and the U.E.D.s regarding responsibilities.² The master provisioning offices suffered from a lack of personnel sufficiently skilled to undertake the work required. There were complaints from the Commands regarding delays in obtaining replies from the M.P.O.s and the lack of information given in the replies received.³

The Aircraft Storage Arrangements⁴

Immediately after the outbreak of war, No. 41 (Aircraft Storage) Group was given the task of impressing the large numbers of civilian aircraft which existed in various parts of Great Britain. These aircraft, many of which had been employed in civil schools, were required for the expansion of R.A.F. flying training and for communication purposes. The aircraft were at first inspected and reported upon by R.A.F. engineers from units adjacent to the aircraft, but as the numbers to be taken over increased, arrangements were made for the inspections to be carried out by technical personnel from No. 43 (Repair) Group. Owing to the work and the large numbers of aircraft involved, however, it was decided at the end of November to form a section under a Wing Commander engineer at No. 41 Group Headquarters to undertake the impressment of aircraft. Attached to this section were four pilots from each of the two Ferry Pilots Pools for the collection of aircraft impressed. In December,

¹ A copy of the scheme with the amendments included up to 2 November 1940 is contained in A.M. File 880976/39.

² A.M. File 880976/39.

³ Equipment Service Conference, 22 February 1940. A.M. File S.B.4054.

⁴ No. 41 Group O.R.B.s, 1939 to April 1940.

arrangements were made for the inspection of aircraft earmarked for impressment to be undertaken by the Air Registration Board working in conjunction with the Group impressment officers. The numbers of civil aircraft impressed for training and communication purposes during the period under review were :—

November 1939	..	..	..	67
December	..	..	..	52
January 1940	..	..	..	82
February	..	..	..	48
March	..	..	..	74
April	..	..	..	34

On 12 September 1939 the methods existing in the Royal Air Force for the supply and equipping of aircraft were changed in the following manner :—

- (a) Arrangements were made for all operational type aircraft to be delivered from the manufacturers to the aircraft storage units in No. 41 Group by the pilots of the two Ferry Pilots Pools.
- (b) On arrival at the A.S.U.s the aircraft were to be equipped to operational standard less items required for special purposes which were to be supplied and fitted at squadron stations. In order to conserve equipment the stocks held by the A.S.U.s were limited to one month's requirements.
- (c) The three Commands of the Metropolitan Air Force, i.e. Bomber, Fighter and Army Co-operation, were instructed to demand their requirements in aircraft for wastage from Headquarters No. 41 Group instead of from the Air Ministry as heretofore. Bomber and Fighter Commands were told to include in their demands the requirements of their units on the Continent.
- (d) The allocation of aircraft for war wastage of the Metropolitan Air Force was transferred from the Air Ministry to H.Q. No. 41 Group, but the Air Ministry continued to issue all other aircraft allotments with the exception of those for the Fleet Air Arm which were effected by the Admiralty from the stocks held in the A.S.U.s on their behalf.

The scheme introduced for the final equipping of aircraft by the aircraft storage units was not extended to training and Fleet Air Arm aircraft beyond the fitting of items which should have been installed by the manufacturer. Training Command, therefore, continued to collect their aircraft from the manufacturers and to fit the final equipment at stations. Aircraft not immediately required by training units were delivered to the A.S.U.s by the Ferry Pilots Pool.

The new arrangement for operational aircraft did not work satisfactorily at first, and six weeks after No. 41 Group had assumed the responsibility only a very few machines had been completed. The reason for this was the delay experienced by the aircraft storage units in obtaining the necessary equipment from the depots of No. 41 Group, due partly to the fact that those depots were in process of being converted from specialist to universal supply units and did not know what the depots contained, and partly because the production of some items by civil manufacturers was behind schedule. The situation eventually became so serious that Headquarters, Maintenance Command, ordered No. 40

Group to carry out an investigation to ascertain which items were and which were not available. During the enquiry copies of all the demands outstanding were taken to the various depots and it was finally discovered that there were over a hundred different items which could not be supplied. A list of these was then forwarded to the Director of Equipment for investigation by his production staff.

The next step taken to overcome the shortage was to ascertain the possibility of obtaining serviceable equipment from the salvage sections of the repair group, but it was decided that any items forthcoming would not be supplied direct to the aircraft storage units but would be issued via the equipment depots in the normal manner in order that demands could be regulated and the A.S.U.s relieved of the responsibility of testing the equipment.

In November 1939 the supply of operational equipment improved but the availability from production was still 25 per cent short. At this stage it became apparent that provided the equipment was available, the time taken by the average A.S.U. to equip a twin-engined bomber aircraft to operational standard was approximately 14 days while smaller types were taking seven days.

The operational aircraft completed by the aircraft storage units of No. 41 Group included the requirements of other users besides those of the Royal Air Force. In September and October 1939 aircraft were supplied to the Rumanian Government. In December, aircraft were sent to Finland and Jugoslavia. In January 1940 aircraft were packed and sent by sea to South Africa, and further supplies were despatched by air to Finland. In February, March and April aircraft were prepared for both the Egyptian and the Canadian Governments. The A.S.U.s were also called upon to undertake work additional to their normal activities. For instance, owing to delays in the production of certain types of aero-engines during the early months of the war, numbers of aircraft had to be delivered to the Group with 'slave' engines which were removed, returned to factories and used for ferrying other aircraft. Meanwhile, the airframes were stored until sufficient engines became available. Then again, certain aircraft stored as reserves for operational squadrons had become out of date during their period of inactivity and had to be modified to the latest standard before they could be issued. In the case of Blenheim bombers, action had been taken to provide armour for this type of aircraft employed on the Continent, the installation being carried out by manufacturers' working parties. Unfortunately, however, no action had been taken to modify the aircraft in storage, consequently those despatched by the A.S.U.s to the Continent to replace wastage were unacceptable to the squadrons and were sent back to be armoured.

During the middle of November 1939 the Group was ordered by the Air Ministry to assume the responsibility of allotting from operational units all aircraft that were redundant to their requirements, whether serviceable or not. This, of course, meant another addition to the work of the Group and a further restriction of the valuable storage space which was already showing signs of being inadequate to meet requirements.

As previously stated, the planned storage capacity of the Group was approximately 9,600 aircraft contained in 24 storage units, but only nine units were

functioning on the outbreak of war. Two more commenced to take in aircraft during September 1939. In that month the eleven units between them received a total of 739 aircraft and issued 694, the majority of which were for training and required little work to be performed on them. The total stock in the Group at the end of September was 2,515. On 14 September the Group was informed that the estimated war wastage of aircraft in the Metropolitan Air Force was approximately 620 per month and the A.S.U.s must therefore be prepared to issue up to this number at short notice. During the weeks that followed, however, owing to the lack of air activity, there was little indication to show when this figure was likely to be reached, and issues to replace wastage were only slightly higher than they had been under peace conditions. This, coupled with the fact that the despatch of aircraft to units overseas had been stopped by the Air Ministry on the outbreak of war, resulted in an accumulation of aircraft in the A.S.U.s at the rate of 400 a month. Under these conditions it was estimated that unless additional covered accommodation could be made available the Group would have to arrange for at least 1,000 aircraft to be stored in the open by 1 April 1940. Pending information on the storage programme it was decided to provide space in the open for 500 aircraft by the end of December 1939.

During October 1939, 833 aircraft were received and 369 issued. The stock held rose to 3,324. In December the twelfth aircraft storage unit was opened—No. 23 Maintenance Unit, Aldergrove—but gave little relief as receipts during the month were 527, issues 309 and stock 3,572. Very few of the issues during these months were for the replacement of wastage and were mainly for the re-equipping of units with new types and for the formation of new units.

Bad weather during December 1939 and January 1940 caused the aerodrome landing services of several storage units and the roads leading to them to become unserviceable for varying periods, with the result that not only were receipts and issues restricted but the preparation of aircraft at the end of January was reduced to 60 per cent of the normal due to employees being unable to reach their places of work and the transportation of equipment from the supply depots being impossible. In January 694 aircraft were received and 500 issued, including 284 operationally equipped, which was the utmost possible with the equipment available. The stock at the end of the month was 3,766. In addition, a large number of aircraft were awaiting collection from the manufacturers and a still larger number were awaiting test. An improvement in weather conditions in February enabled the preparation of aircraft to reach 90 per cent of normal. 728 aircraft were received and 507 issued, including 317 equipped operationally. The stock rose again to 3,990.

During February Nos. 1 and 2 Ferry Pilots Pools were transferred from the control of the Air Ministry to No. 41 Group, although they remained positioned as 'lodger' units at the Fighter Command stations at Hucknall and Filton respectively. Temporary arrangements were also made for the R.A.F. Component Field Force to collect their own aircraft from the A.S.U.s pending the formation of a Ferry Pilots Pool for the purpose of flying aircraft to the Continent. The second packing depot (No. 52 Maintenance Unit) for despatching crated aircraft overseas was opened at Cardiff on 3 February 1940.

On 8 March 1940 the capacity of No. 41 Group to meet the full war requirements in aircraft wastage was reviewed by Headquarters Maintenance

Command. It was estimated that with the initial equipment of the operational units at home and on the Continent at approximately 2,000 aircraft, the wastage for the following two months at sustained effort was 800 per month or 190 per week. For periods of intensive effort this might be increased to 280 per week and at maximum effort to 370 per week. The capacity of the Group to prepare operational aircraft at that date was, however, only 400 a month, the limiting factors being the rate of supply of operational equipment, contractors' ability to modify aircraft and, to a lesser extent, the storage accommodation available. If output was to be improved it was necessary to increase the production of equipment, restrict modifications to those really essential and improve contractors' capacity for embodying such modifications. A 25 per cent increase in the supply of equipment was expected within the next few months which, of course, would greatly facilitate the preparation of aircraft. Even, however, if the number of aircraft issued by the A.S.U.s approached the estimated sustained rate of 800 a month, a limiting factor would be applied by a shortage of the number of aircraft supplied by the manufacturers. According to the production programme the number of operational types forecast for June 1940 was 600 only. Therefore, a number of reserve aeroplanes would have to be used to meet the requirement. With a combination of new production and reserve aircraft it was calculated that the full sustained rate of 800 aircraft per month could be maintained for two months, followed by 650, 550 and 600 for the following three months, i.e. an average of 680 per month. In addition to operational aircraft the Group had also the task of issuing an approximately constant figure of 300 trainers per month to replace wastage and for issues overseas to Dominions, etc. In order to fulfil its commitments, the aim of the Group was to build up a reserve of prepared aircraft amounting to a month's wastage at sustained rates, an achievement which, however, was restricted by the Air Ministry policy of giving priority to meet expansion and re-arming.

As a means of utilising the available equipment to the utmost extent it was decided in March that the Group Headquarters would indicate periodically to the A.S.U.s the types of aircraft in batches of about a hundred which were required in order of urgency. This enabled the A.S.U.s to demand from No. 40 Group supply depots and the depots to provide the equipment required in the correct sequence, thus avoiding many delays which had occurred in the past.

Further developments during March were the opening of the thirteenth A.S.U. (No. 48 Maintenance Unit, Hawarden) and the receipt of information that 1,270 American aircraft (Brewster, Douglas, Lockheed, Harvard and Hudson types), additional to the 400 Harvards and 250 Hudsons ordered at the outbreak of war, were being sent from the United States. This brought the number of types of aircraft on order for the Royal Air Force to 48 and the number of variations to be stored in the Group to 71.

The total number of aircraft equipped operationally during March (five weeks) was 513 or 102 per week, an increase of 45 per cent over the December/January figures. This improvement was largely due to an increase in the supply of equipment and, to a small extent, to the method introduced of controlling the hastening of outstanding demands in order of priority of requirements. The number of aircraft received during March was 1,101; issues were 620, including

44 equipped operationally. The stock at the end of the month was 4,480 of which 600 were picketed in the open.

The arrival of April saw the opening of four more aircraft storage units, bringing the total to 17. The new units were :—

- No. 15 Maintenance Unit, Wroughton (civilian manned).
- No. 37 Maintenance Unit, Burtonwood (service manned).
- No. 38 Maintenance Unit, Llandow (civilian manned).
- No. 46 Maintenance Unit, Lossiemouth (service manned).

The number of aircraft equipped operationally by the Group during April was 448 of which 341 were issued and the remainder taken into storage towards building up the reserve of one month's wastage at sustained rates which the commitments of the Group necessitated. The reserve at the end of the month stood at 228 against the requirement of 800. Ten days later Germany invaded Holland and Belgium, the British Air Forces in France went into intensified action and incurred rates of aircraft wastage which for some days averaged four or five times the assessed rates for sustained effort. The total number of aircraft received by the Group during April was 1,001. Total issues were 772.

The Air Council Enquiry into the Shortage of Aircraft Operational Equipment, February 1940

The concern felt by the Commands and squadrons after the outbreak of war over the difficulty in obtaining aircraft fully equipped for operations came to a head on 13 February 1940 when the Air Officer Commanding-in-Chief, Bomber Command, drew the attention of the Deputy Chief of the Air Staff to the serious position that had arisen through the shortage of equipment items necessary for aircraft to be used operationally.

An investigation into the situation was made forthwith by the Air Member for Supply and Organisation and on 19 February 1940 a special meeting to discuss the matter was held under the chairmanship of the Secretary of State for Air which was attended by members of the Air Council and representatives of the various Commands.

The Secretary of State said that the meeting had been summoned to consider the position revealed by the letter from the A.O.C.-in-C., Bomber Command, regarding inadequate supplies of operational equipment. A paper explaining the situation had been prepared and circulated to those present by the Air Member for Supply and Organisation and the matter was so urgent as to warrant immediate attention. Urgent consideration would need to be given to what steps could be taken to remedy the position as speedily as possible.

After considerable discussion it was agreed that :—

- (a) The Director of Equipment should, in the light of the circumstances, consider the adequacy of the six months' pool of operational equipment.
- (b) The Director of Aircraft Equipment Production should, as a matter of urgency, investigate the possibility of accelerating the supply of electrical and other equipment by taking special action on particular

contracts by way of overtime, extra shifts, etc., and report to the Secretary of State within a week, if possible.

- (c) D.A.E.P. should also investigate the possibility of giving A.O.C., Maintenance Command, and D. of E. advance warning of the possible failure by a firm to fulfil its delivery obligations.

During March 1940 two reports were forwarded to the Secretary of State by the Director of Aircraft Equipment Production giving details of progress made, and on 2 April the former called a second meeting to review the position.¹ On this occasion the Commands were not represented. Regarding the adequacy of the pool of aircraft equipment, which at the time of the last meeting consisted of six months' requirements for a programme of 2,250 aircraft per month, the Director of Equipment stated that orders for equipment had originally been restricted to items common to all types of aircraft with a margin in the case of other items of 20 per cent above the aircraft orders already released. He had now been authorised to order sets of equipment for all types of aircraft due for production under the programme up to 1 July 1942. He was also authorised to call for delivery twelve months in advance, i.e. by 1 July 1941. In the circumstances he was satisfied as to the adequacy of the pool and it was now possible to place bulk orders which would facilitate the planning of production.

After discussion the meeting was of the opinion that no further action regarding the adequacy of the pool could be taken at present other than to await the results of the regular conferences that were to be held by the Director General of Production.

No. 43 Group (Repair)

On 3 September 1939 No. 43 Group Headquarters assumed control of the three Service repair depots:—

- No. 13 Maintenance Unit, Henlow.
- No. 30 Maintenance Unit, Sealand.
- No. 32 Maintenance Unit, St. Athan.

These depots, particularly Nos. 30 and 32, were in the formation stage only and were fully occupied in endeavouring to obtain a smooth working organisation. Insufficient quantities of equipment and tools were available and although the numbers of personnel were adequate there were surpluses and deficiencies by trades which required adjustments.²

Throughout September both Henlow and St. Athan were called upon to mobilise maintenance units for service on the continent of Europe in accordance with the 'Western Plan.' On the 18th of that month Henlow, Sealand and St. Athan assembled personnel and equipment for the formation of five Service and one civilian Salvage Centres to undertake the salvage and disposal of crashed aircraft in the United Kingdom. Sites for the location of these salvage centres had been reconnoitred previously and they moved to their stations described on the dates stated.

¹ E.P.M.47.

² No. 43 Group O.R.B., 1939.

No. 1 Salvage Centre (afterwards renamed No. 49 Maintenance Unit) to Faygate, Horsham, on 3 November 1939.

No. 2 Salvage Centre (afterwards renamed No. 50 Maintenance Unit) to Cowley on 22 September 1939.

No. 3 Salvage Centre (afterwards renamed No. 54 Maintenance Unit) to Cambridge on 24 September 1939.

No. 4 Salvage Centre (afterwards renamed No. 58 Maintenance Unit) to Newark on 24 September 1939.

No. 5 Salvage Centre (afterwards renamed No. 60 Maintenance Unit) to York on 24 September 1939.

No. 6 Salvage Centre (afterwards renamed No. 63 Maintenance Unit) to Carlisle on 28 September 1939.

A seventh salvage centre was planned in October 1939 to cover the more westerly part of England but it was not until March 1940 that the centre which was named No. 34 Maintenance Unit came into being at Monkmoor near Shrewsbury. No. 50 Maintenance Unit at Cowley was civilian manned except for officer personnel.

On 27 September 1939, No. 43 Group became responsible for the technical administration of 15 emergency W/T fitting parties, the functions of which were the repair of communications damaged by enemy action. These parties were located at R.A.F. Works Depots situated at various stations.¹ They were handicapped during the first three months of their existence by the lack of trained personnel, hutments and equipment but fortunately were not called upon to undertake any repairs. While waiting to perform the work for which they had been formed the personnel of the parties were employed on important duties in connection with the installation of R/T at Radar stations in Fighter Command.

On 1 November 1939 it was decided to fit all combatant aircraft operating from the United Kingdom with one or another of three different types of radio equipment, and arrangements were made for aircraft to be flown into No. 32 Maintenance Unit, St. Athan, for the work to be done. Considerable difficulties were experienced owing to the state of the aerodrome at St. Athan which became very soft in wet weather. It became necessary, therefore, to form mobile fitting parties and detach them to operational units to fit the special installations into aircraft at their home stations.

The three repair depots continued to suffer throughout October and November 1939 from the lack of equipment and tools. A further drawback was the fact that large numbers of personnel were either untrained or were reservists who were out of practice in their trades and had no experience of modern R.A.F. equipment. The following work was, however, carried out :—

- (a) All depots undertook the repair of miscellaneous ground equipment from 'B' Maintenance Unit, Hammersmith, and aircraft parts from No. 3 Maintenance Unit, Milton.

¹ R.A.F. Works Depots were under the control of the Director of Works, Air Ministry. The depots were responsible for the construction and upkeep of buildings. No. 43 Group O.R.B., 1939.

- (b) No. 13 Maintenance Unit, Henlow, carried out the repair and overhaul of automatic controls and 'Link Trainers.' (This work was of special importance as the repair of these items was not being undertaken by any other Service unit or civilian contractor in the United Kingdom.)
- (c) No. 30 Maintenance Unit, Sealand, commenced the manufacture of airscrew spinner cases at the rate of 150 per week, and the repair of large quantities of hand tools for reissue to the Service.

During December small quantities of equipment and tools arrived at the depots and it was decided that all engine repair sections should concentrate on the repair of Bristol engines, but Nos. 30 and 32 Maintenance Units were unable to commence the work owing to the lack of tools and test rigs. No. 13 Maintenance Unit commenced the repair of Pegasus engines but were compelled to despatch other types to civilian contractors. This depot also received seventy aircraft (Hart Variant, Hurricane, Moth and Lysander types) for repair but the work could not be undertaken owing to a lack of spares and trained personnel. Towards the end of the month arrangements were made to form mobile repair parties at all depots to effect repairs to damaged aircraft on site when the work was beyond the capacity of units but not sufficient to warrant transport of the aircraft to a depot or contractor. Ten such parties were operating by the end of 1939.

An improvement in the supply of equipment and tools during January 1940 caused a corresponding increase in activity at the repair depots, but engine overhauls at Nos. 30 and 32 Maintenance Units still could not be undertaken owing to the lack of suitable tools and test equipment. The allocation of repairable equipment to the depots and civil firms by the Civilian Repair Organisation commenced to function during January, but, as the work came from a variety of sources, allocation of tasks was difficult to control and co-ordinate. Meanwhile, all three depots continued to mobilise maintenance units for service on the Continent.

On 9 February 1940, No. 43 Group assumed technical control of the workshops at No. 1 Maintenance Unit, Kidbrooke, and No. 4 Maintenance Unit, Ruislip. These maintenance units remained under the administrative control of No. 40 Group, so that the repair group was only responsible for the input and output of work to and from the workshops. This increase in repair capacity and the allocation of considerable quantities of ancillary equipment for overhaul from the Civilian Repair Organisation resulted in the stimulation of the activities of the repair depots during February. Electrical and wireless equipment awaiting repair at No. 1 Maintenance Unit was diverted to the depots at Henlow and Sealand and the manufacture of engine packing cases, of which 28,000 were required, was transferred from No. 4 Maintenance Unit to the St. Athan depot as the former was only capable of an output of 50 per week. All depots were engaged upon the removal of engines from unserviceable aircraft. The engines were despatched either to Training Command for instructional purposes or to the makers for modification and reissue. It was not possible to repair the majority of airframes as the aircraft repair sections at Nos. 30 and 32 Maintenance Units were not yet functioning. Progress was, however, made on the repair of 46 airframes in the aeroplane repair section at No. 13 Maintenance Unit.

The mechanical transport repair sections at all depots were fully occupied during February but owing to the shortage of spares it was only possible to turn out a total of 13 vehicles. Lack of tools and special jigs also severely handicapped all the engine repair sections. Thirteen mobile repair parties completed repairs to crashed aircraft on site during the month.

The organisation of and the output from the depots improved during March and April and the majority of the sections were fully occupied in the repair of ancillary items although shortages of spares and equipment were still experienced. Closer co-operation was maintained with the Civilian Repair Organisation and considerable quantities of repairable equipment were received. By the middle of April 37 aircraft of seven different types were undergoing repair or complete overhaul at No. 13 Maintenance Unit. The other depots were still engaged on the removal of engines, and the repair of complete airframes and engines had still not commenced. The output of repaired M.T. vehicles increased during March to 29, and owing to a betterment in the supply of spares the improvement was maintained during April.

The work of fitting special installations in aircraft by the mobile parties continued during the early months of 1940 and was speeded up considerably, although progress was at times retarded by delays in the supply of equipment. By the end of April a total of 1,062 operational aircraft had been fitted. The parties formed for the repair of communications were also not idle. Although by March they had only been called upon to carry out nine repairs a considerable amount of work was performed in fitting ground station transmitters and receivers at various units throughout the country.

The salvage sections continued to increase in efficiency during the end of 1939 and the beginning of 1940. When they commenced operations they were considerably handicapped by a shortage of trained personnel and transport vehicles. By the end of December the initial difficulties of the centres had been mastered, although none was as yet working to its full strength of ten mobile sections. The following is a summary of the salvage operations carried out from the outbreak of war to the end of April 1940 :—

<i>Month</i>	<i>Crash reports received</i>	<i>Inspections carried out</i>	<i>Aircraft repairable on site</i>	<i>Aircraft repairable in factories</i>	<i>Aircraft fit only for strike-off</i>	<i>Aircraft dealt with by other units</i>	<i>Enemy aircraft salvaged</i>
1939							
September	122	—	—	—	—	—	—
October ..	348	336	39	183	114	—	—
November	328	345	25	94	136	86	—
December ..	333	378	26	72	92	196	—
1940							
January ..	419	420	47	80	110	161	—
February ..	302	294	29	59	93	115	—
March ..	550	533	54	75	170	172	—
April ..	501	500	54	41	150	175	3

Supply of Fuel and Ammunition¹

On 4 September 1939 Headquarters of No. 42 Group moved from Andover to Burghfield Common near Reading. Only three of the Group's proposed five ammunition depots were in existence when the war commenced. They were No. 2 Maintenance Unit, Altrincham, No. 11 Maintenance Unit, Chilmark, and No. 21 Maintenance Unit, Fauld. Prior to the outbreak of hostilities, the demands for the supply of ammunition and explosives were submitted by all units in the United Kingdom to No. 2 Maintenance Unit. This cumbersome centralised procedure was unavoidable on account of the disposition of stocks. Immediately after the outbreak of war, however, the completion of certain building programmes, combined with dispersal and balancing of stocks on a universal basis, enabled decentralisation of supply to be effected and Nos. 11 and 21 Maintenance Units to be made self-accounting. It was also decided to make the fourth ammunition depot (No. 28 Maintenance Unit, Harpur Hill), which was under construction, similarly self-accounting in all respects as soon as it was formed. A Master Provisioning Office for ammunition and explosives on the lines of those introduced in the equipment depots of No. 40 Group was established at No. 21 Maintenance Unit, Fauld, for the maintenance of stocks at all the ammunition depots.

On 5 September 1939 the first four of the proposed seven air ammunition parks were formed at the following places:—

- No. 91 Maintenance Unit, Southburn.
- No. 92 Maintenance Unit, Brafferton.
- No. 93 Maintenance Unit, Swinderby.
- No. 94 Maintenance Unit, Barnham.

In addition, a small arms ammunition sub-store was established at Ruislip. The air ammunition parks were all situated east of a line drawn approximately from Edinburgh to Southampton, i.e. in the neighbourhood of the operational stations based in the east of England. The ammunition depots were placed west of the line in areas as remote as possible from enemy bombing. The R.A.F. operational stations based upon the ammunition parks drew all their supplies therefrom. The parks in turn replenished their stocks from their parent ammunition depot.

No. 91 M.U. } were based upon No. 2 M.U., Altrincham, but it was intended to transfer the second named to No. 28 M.U., Harpur Hill, when the new depot was opened.

No. 92 M.U. }

No. 93 M.U. } were based upon No. 21 M.U., Fauld.

No. 94 M.U. }

S.A.A. Sub-store, Ruislip was based upon No. 11 M.U., Chilmark.

It was also arranged to base a fifth ammunition park (No. 95 M.U. to be formed at Lords Bridge) upon No. 11 M.U., Chilmark.

Many of the existing R.A.F. operational stations were, of course, situated in locations beyond easy reach of the ammunition parks, and on 1 October 1939 these were based geographically upon one of the ammunition depots as follows:—

¹ No. 42 Group O.R.B.

- (a) Units (other than those based upon No. 95 M.U., Lords Bridge, and S.A.A. Sub-store, Ruislip) in the area south of a straight line drawn from Aberystwyth to Birmingham, thence to March, south-east to Braintree and east to Walton-on-the-Naze were based upon No. 11 M.U., Chilmark.
- (b) Units (other than those based upon No. 93 M.U., Swinderby, and No. 94 M.U., Barnham) in the area north of the line given in (a) and south of a line drawn from Formby through Wigan, Oldham, thence to Scunthorpe and Spurn Head were based upon No. 21 M.U., Fauld.
- (c) Units (other than those based upon No. 91 M.U., Southburn, and No. 92 M.U., Brafferton) in the area north of the line from Formby to Spurn Head as indicated in (b), including all units in Scotland, N. Ireland and Isle of Man, were based upon No. 2 M.U., Altrincham.

Demands for ammunition and explosives to meet the requirements of overseas Commands, the Continental contingent and special issues to contractors were dealt with in the first instance by the Master Provisioning Officer who instructed the maintenance unit holding the largest stocks at the time the demand was received to effect the supply.

Immediately the air ammunition parks were formed they also assumed the responsibility for supplying operational stations with breathing oxygen. Under peace conditions, R.A.F. units obtained their oxygen requirements direct from the British Oxygen Company who delivered the oxygen in large-capacity, high-pressure transport cylinders, from which R.A.F. units filled their aircraft cylinders. Aircraft cylinders were of 750 litre capacity at a pressure of 1,800 lb. Transport cylinders were of 16,000 litre capacity at a pressure of 3,600 lb. and each was capable of filling 10 aircraft cylinders, an action which reduced the pressure in the transport cylinder to 1,800 lb. It was then necessary to return the half-filled cylinder to the filling station for 'topping up' to the 3,600 lb. pressure. On the outbreak of war there were 11 filling stations established for the supply of breathing oxygen to the Royal Air Force. These were situated at Southampton, Greenwich, Wembley, Witham, Coventry, Wolverhampton, Derby, Rotherham, Leeds, Hull and Stockton-on-Tees. On 4 September 1939 the oxygen supply arrangements were switched from direct supply between the contractor's filling station and the R.A.F. operational station to supply from the contractor's filling station through the air ammunition park to the R.A.F. station, or through the parent maintenance unit (ammunition depot) in the case of stations not served by ammunition parks. As regards the Continental expeditionary force it was intended that the supply of oxygen would be maintained by mobile plants but none of these plants was available when the war commenced and it became necessary to deliver cylinders to France by air from the British Oxygen Company's filling station at Southampton. Returning aircraft brought back the empty cylinders for replenishment.

On 9 September 1939 the air ammunition parks took over the supply of anti-aircraft shell to Army anti-aircraft units situated in the vicinity of the R.A.F. units based on the parks. This additional duty plus that of the supply of oxygen had not been provided for when the war establishments of the air ammunition parks had been worked out, consequently the parks found themselves con-

siderably handicapped when they commenced operations by an insufficiency of personnel, transport and other equipment. One of the major difficulties of the parks resulted from the fact that gravity rollers and tarpaulins in the required quantities were not obtainable on the outbreak of war.

The supply organisation of the air ammunition parks was as follows :—

- (a) Parent Maintenance Units were responsible for delivering, by rail, ammunition and explosives to the park.
- (b) Contractors were responsible for delivering, by road, oxygen to the park.
- (c) Operational stations were responsible for collecting ammunition, explosives and oxygen from the park.

The belting of small arms ammunition in the early days of the war was not carried out at the air ammunition parks but at No. 2 Maintenance Unit, Altrincham. The methods used were at first somewhat elementary, hand-operated machines being employed which could only belt 300 rounds per hour. During September, however, a number of power-operated 'Plessey' machines, each capable of producing approximately 3,000 per hour with unskilled labour, were obtained. Eventually twelve of these machines were installed at each of the ammunition depots at Altrincham, Fauld and Chilmark respectively and at the ammunition sub-store at Ruislip.

The fifth air ammunition park (No. 95 Maintenance Unit) was opened on 16 November 1939 at Lords Bridge, near Cambridge. On 15 December the fourth ammunition depot (No. 28 Maintenance Unit) commenced to function at Harpur Hill. Additional storages were provided at Ridge for No. 11 Maintenance Unit, Chilmark, and at Holywell for No. 21 Maintenance Unit, Fauld. The possibility of opening an air ammunition park to feed the units in Scotland was explored.

A conference held on 8 March 1940 at Maintenance Command Headquarters to review the position as regards the supply of ammunition, explosives and liquid oxygen by the units of No. 42 Group under sustained war conditions showed that the air ammunition parks were holding more than the stocks laid down,¹ and that they were ready for their war task. Should it be decided to form an A.A.P. in Scotland it was considered that it could be ready for action in ten days. The new ammunition depot at Harpur Hill although functioning was not yet complete and consequently had not taken over the responsibility for supplying its ammunition parks (Nos. 91 and 92 Maintenance Units). The arrangements for the supply of breathing oxygen appeared to be satisfactory.

The arrangements made during peace for the supply of aviation petrol and oil underwent a complete change when the war commenced. On 5 September 1939 all the stocks in the United Kingdom were acquired by the Air Ministry and held in the Air Ministry depots and petroleum companies' storages; the companies at this juncture being merged into a Petroleum Board, an organisation which operated as agents for the Air Ministry.² The Petroleum Board took over control of the existing commercial fuel depots, the R.A.F. reserve and

¹ S.D.112 and Maintenance Command O.R.B., 1940.

² No. 42 Group O.R.B., 1939.

distributing depots, the R.A.F. rail cars and the stocks of T.E.L. Strategic dispersal of bulk stocks was made by means of large tanker vessels berthed in outlying northern areas of the British Isles. The plan for the supply and distribution of aviation fuel to R.A.F. stations in the United Kingdom during the period of hostilities was amplified to permit issues from certain commercial depots in addition to the Air Ministry aviation fuel reserve and distribution depots. All these depots were renamed 'Distribution Points' and each Command was allotted a number of these D.P.s from which the aviation fuel requirements of their stations were obtained. The procedure was for units to forward their demands for fuel direct to the distributing point but the accounting of issues to the Service was undertaken by Headquarters No. 42 Group Central Accounts Office, which was notified by both the distributing point and the unit concerned of the demands and issues made. The checking and maintenance of stocks of aviation fuel and oil was carried out by checking officers detached from Headquarters No. 42 Group who were each allotted a number of distributing points within defined geographical areas.

A review of the aviation petrol and oil position in the United Kingdom held on 6 February 1940 showed that the total Royal Air Force stocks of aviation fuels (all types) was 509,189 tons and the ultimate total to be built up was 800,000 tons.¹ The total tankage available for the storage of aviation fuels was for 616,700 tons of which 254,500 was hired from the Petroleum Board, 50,563 was in underground tankage hired at Backford, Cheshire, and the balance in tankage belonging to the Air Ministry. It was anticipated that additional tankage under construction at Air Ministry fuel reserve depots would be completed by the end of March 1940. The stock of lubricating oil on 8 February 1940 was 34,219 tons. By the end of April, stocks had risen to 607,343 tons (186,460,647 gallons) of aviation fuel (all types) and 35,899 tons (8,974,872 gallons) of lubricating oil. The total weekly issues of aviation fuel and lubricating oil at this period, which included the requirements of Royal Air Force units, the Admiralty, flying training schools, national air communication units, the War Office and aircraft contractors and civilian firms, was :—

<i>Week ending 25 April 1940²</i>	Aviation fuels (all types) 6,469 tons (1,929,443 gallons).
	Lubricating oil 212 tons (53,032 gallons).
<i>Week ending 2 May 1940</i>	Aviation fuels (all types) 5,044 tons (1,528,846 gallons).
	Lubricating oil 121 tons (30,304 gallons).

¹ No. 42 Group O.R.B., 1940, Appendix 60.

² Consumption figures before this date are not available.

CHAPTER 4

THE AIRCRAFT MAINTENANCE ORGANISATION IN FRANCE AND THE LOW COUNTRIES, SEPTEMBER 1939 TO JUNE 1940

Pre-war Arrangements for the Maintenance of a R.A.F. Expeditionary Force¹

It was decided in 1927 that the organisation for the maintenance of a R.A.F. Expeditionary Force would, during the early stages of a European campaign, be of a mobile character. In consequence the establishments of squadrons in personnel, mechanical transport and stores would have to be kept down to the absolute minimum, and as a means to this end the squadrons would be relieved of all repair work. It was proposed that squadrons would carry a three days' supply of spares only, but behind the squadrons and within 25 miles approximately of them a number of mobile Air Stores Parks would be provided, each carrying one month's stores for the units they served. Behind the Air Stores Parks it was intended to organise a non-mobile Aircraft Depot holding anything up to a six months' stock of spares, etc., for the force and providing for the repair of airframes, engines and mechanical transport. When moves of the squadrons were frequent it was proposed that they would not normally undertake maintenance which would take more than four hours to complete, and work beyond this capacity would be undertaken by advanced repair detachments sent forward to the vicinity of the squadrons from the base repair depot. Tasks incapable of being performed by these sections would be returned to the depot.²

As the progress of the 1939-1945 war eventually showed, the principles of this scheme of maintenance for an expeditionary force were sound, but in 1931, when the various departments of the Air Ministry concerned were engaged in working out the details of the organisation, the proceedings were interrupted by the Director of Organisation and Staff Duties who proposed that squadrons forming part of an expeditionary force should be provided with sufficient personnel, equipment, stores and spares to enable them to be self-supporting, and consequent upon this change in the proposed war organisation the establishments of the repair and maintenance organisations at the base and on the line of communication should be reviewed.

The proposals were put before the Chief of the Air Staff in May 1932 by the Deputy Chief of the Air Staff (Air Vice-Marshal C. S. Burnett). D.C.A.S. said that he was not at all convinced that the proposal to abolish advanced repair facilities and substitute repair sections in squadrons was sound. He considered that in war it was most important that squadron commanders should be freed from the restrictions of maintenance and their clogging effects on mobility. The Chief of the Air Staff agreed on 6 September 1932, after considerable discussion, to leave the 1927 war organisation as it was for a period of two years, by

¹ A.M. File S.30202.

² War Manual, Part II, Chapter IX, 1927. (A.P. 1301.)

which time he hoped that more experience on the subject of advanced repair sections would have been gained.

During the latter part of 1933 Air Chief Marshal Sir Edward Ellington succeeded Air Chief Marshal Sir John Salmond as C.A.S., while Air Vice-Marshal Sir Edgar Ludlow-Hewitt replaced Air Vice-Marshal Burnett as D.C.A.S. Thereupon, on 13 October of that year, the Director of Organisation and Staff Duties re-submitted his proposals to make squadrons self-supporting in the event of war, and to adjust the field maintenance arrangements on those lines. This time the new Chief of the Air Staff approved the proposals on 13 July 1934.

The Maintenance Project in France at the Outbreak of War

The air forces destined for transfer to France in the event of war were in two distinct entities, possessing clearly separate functions—the Advanced Air Striking Force and the Air Component of the Field Force. The former was to be a bomber force only, comprising squadrons of Bomber Command based in France because of the comparatively short range of their aircraft. The Air Component, on the other hand, was a mixed formation designed as an integral part of the Army Expeditionary Force for which it was supposed to supply air reconnaissance and protection. It thus consisted of aircraft for bomber reconnaissance, strategical reconnaissance and tactical reconnaissance work, together with some fighter squadrons, all of which, through the A.O.C. Air Component, were under the operational control of the Commander-in-Chief, British Expeditionary Force. In addition to these air formations, two air liaison missions were also scheduled to proceed to France. No. 1 Air Mission was to represent the Chief of the Air Staff at the Headquarters of General Vuillemin, the Commander-in-Chief of the French Air Forces. No. 2 Air Mission was to represent the Air Officer Commanding-in-Chief, Bomber Command, at the Headquarters of General Nouchard who commanded the French Air Forces on the North-East front.

The 'Western Plan' for a war in Europe provided for the Advanced Air Striking Force to proceed to France in two echelons. The first echelon was to be No. 1 Bomber Group with its ten squadrons organised into five wings. The second echelon, to follow some eighteen days after the first, was to be No. 2 Bomber Group with a similar number of squadrons and organisation. It was intended that the Headquarters of No. 1 Bomber Group, with an increased establishment of personnel, should function as Headquarters, Advanced Air Striking Force, until the second echelon arrived in France, after which both Nos. 1 and 2 Groups would come under H.Q., A.A.S.F.

This plan was in the early stages of organisation when the September 1938 crisis started a more hurried preparation. In that crisis the Air Officer-in-Charge of Administration designate for the A.A.S.F. and a small staff were sent with a War Office staff to make a reconnaissance in France and to supplement arrangements which had been made previously between the two Air Ministries. One of the results of this mission was to stock selected aerodromes in France with bombs, ammunition, petrol and oil prior to the war.

Included in the plan to send the A.A.S.F. to France was a 'Quick Despatch Scheme' in which provision was made to fly to the allotted aerodromes on the

Continent a 'Servicing Flight Section' for attachment to each of the five wings to be ready within 24 hours of their arrival for the maintenance of aircraft until the main bodies of the squadrons arrived. In addition, arrangements were made for a French 'Air Company' to be installed on each aerodrome to receive the squadrons and to provide certain essential services until our administrative and supply organisation was complete. Apart from these arrangements for the initial period of the A.A.S.F. the maintenance project for both this force and the Air Component rested upon the squadrons, who in accordance with the decision of 1934 were alleged to be established for all routine inspections of their own aircraft and mechanical transport and for the carrying out of repairs occupying not more than 200 man-hours. Complementary to this squadron organisation were three Air Stores Parks for each force to which were attached special sections for supply and transport, for salvage and for railhead handling. Finally there was No. 21 Aircraft Depot at the base which was planned to carry out major repairs up to 400 man-hours, the reissue of repaired engines and airframes to the squadrons, and the holding of equipment to meet all the needs of the Royal Air Force in France.

Maintenance Difficulties of the R.A.F. on Arrival in France

The Advanced Air Striking Force moved to France before the Air Component. Both forces were mobilised before the war commenced and the executive order for the move of the former was given at p.m. on 1 September 1939. At dawn on 2 September the servicing flight sections left by air for the Continent in civil aircraft which also carried kits and essential stores. They were followed by the air part of the Headquarters of the A.A.S.F., under Air Vice-Marshal Playfair, and then by the squadrons themselves. When the squadrons arrived they were refuelled and bombed up by the servicing flight sections and were ready for operations by the time war was declared on 3 September. Apart from this, however, many difficulties were experienced and had operations been commenced immediately it appears doubtful whether the squadrons could have remained efficient for any length of time. With one or two exceptions there were no permanent buildings on the French aerodromes, which for the most part were remote from all save tiny villages. The absence of the bulk of the transport in this stage was thus acutely felt and the billeting arrangements proved awkward. In the case of No. 71 Wing the French Air Company was quite unprepared for the arrival of so many personnel and no arrangements had been made for the accommodation and feeding of the majority.¹ The organisation as laid down in the aerodrome dossier was practically non-existent. Two tents only were provided on the aerodrome, one of which was occupied by the French guard. Three petrol filling points were available but two of these became unserviceable soon after they were used. The other Wings experienced a similar situation in varying degrees and No. 74, in particular, had many complaints to make. The Wing operation record book states that on the arrival of their squadrons it was found that the French Air Company had made no arrangements at all for the reception of the formation, apart from the installation of a highly inefficient telephone system. From 2 to 9 September the entire time of all the officers of the Wing was devoted to the constant struggle with the administrative problem due to the complete breakdown of the organisation

¹ No. 71 Wing O.R.B.

which should have been available for the accommodation and feeding of the troops.¹

The arrival of the main bodies of the first echelon of the A.A.S.F., which took place between 13 and 19 September, also suffered from inadequate planning. The despatch of the mechanical transport appears to have been unduly delayed, and the A.A.S.F. Headquarters operations record book speaks severely of this aspect of the move. Considerable difficulty was experienced during unloading operations and in the despatch of vehicles from the ports. Little organisation existed and no arrangements whatever had been made for feeding the personnel other than through the imprest account of the embarkation staff at St. Nazaire. No facilities were available for guiding vehicles to their destination, and no instructions were issued for refuelling, staging or billeting. The safe arrival of the convoy was entirely due to the resourcefulness of its personnel and the extreme helpfulness of the French civil and military authorities.

In the absence of immediate operations the servicing flight sections were fortunately not called upon to do a great deal in the early stages otherwise the flaws in their organisation would soon have placed them in difficulties.

The second echelon of the A.A.S.F. did not arrive in France according to plan. This was due to the fact that although arrangements had been made with the French for ten aerodromes with ten satellites to be provided for the force in order that not more than one squadron should occupy each airfield, the first echelon found on arrival that the satellites had not been prepared. In the interests of adequate dispersion as a protection against enemy air attack the first echelon decided to occupy the ten aerodromes instead of restricting themselves to five. This arrangement enhanced the maintenance difficulties as the wings had been designed to handle two squadrons on one aerodrome and the number of transport vehicles provided was insufficient to meet the additional requirements involved.

The transfer across the channel of the Air Component, under the command of Air Vice-Marshal C. H. B. Blount, did not take place on a single day. Being related to Army movements the move was spread over a period of 5½ weeks, i.e. from 4 September to 12 October. The arrangement was for the ground parties of the squadrons and Wing Headquarters of each wing to proceed some four or five days in advance of the aircraft and crews in order to be prepared to maintain the aircraft on their arrival and for the main rail and road convoy parties of the squadrons to join their advanced sections a few days later. Unfortunately, however, owing to the lack of detailed planning and the incorrect routing of vehicles, the rail parties arrived at their destinations several days before the road convoys turned up with the equipment. (In the case of No. 50 Wing there was a delay of 13 days.) Not only was considerable inconvenience caused to squadrons through lack of transport but the men suffered much hardship because blankets and other essentials were not forthcoming immediately.

No. 21 Aircraft Depot experienced every kind of difficulty. When mobilisation of the depot commenced it was found that there was not sufficient equip-

¹ No. 74 Wing O.R.B.

ment and skilled personnel available to organise it to perform its intended functions. In consequence of this it was decided to establish it in an attenuated form, which meant that the equipment section, instead of being a holding unit, acted only as a transit pool, and the various repair and salvage sections could deal with nothing more than work of a minor nature.

When the depot, under the command of Group Captain McCrae, arrived in France it found no adequate accommodation for its work because the hangars allocated were not vacated by the French until the beginning of November. Equipment arrived with no means of unpacking it and nowhere to store it. The depot personnel had to be employed on erecting Bessoneau hangars and tentage, making roads, constructing drainage and carrying out a general struggle for existence. Few sites were available for the various sections and much of the ground turned out to be unsuitable. As late as the first week in January, personnel were still living in tents. Moreover, even the administrative status of the depot was unsatisfactory. Intended to serve both the A.A.S.F. and Air Component, it was administered by the former.¹

The failure to establish a base depot capable of providing for the needs of the air forces reacted on the efficiency of the Air Stores Parks. The parks arrived in France stocked, according to plan, with one month's supply of equipment. They were then mobile. When it was found impossible to make No. 21 Aircraft Depot a stores holding unit, the parks were maintained direct from the United Kingdom and under these conditions their holdings had to be increased from one to two months' supply. The mobility of the parks then almost completely disappeared.

Before the Air Stores Parks were established all non-technical supplies and rations were obtained from French sources, either by purchase or transfer. Units dealt direct with their home stations for technical equipment and such equipment was flown out. Petrol for aircraft and mechanical transport was obtained locally from French Army sources.

The Early Modification of the Maintenance Services

On 10 October a small detachment of engineer and equipment officers arrived by air at G.H.Q., British Expeditionary Force, for liaison duties. This detachment was known as 'Q' R.A.F. It was posted to the Air Component for purposes of R.A.F. administration and attached to 'Q' (Maintenance) G.H.Q., B.E.F., for duty. The responsibilities of 'Q' R.A.F. were :—²

- (a) The co-ordination of demands by A.A.S.F. and Air Component for bombs, ammunition, pyrotechnics, aviation fuels and oil, and thereafter the rendition of weekly demands to Air Ministry for stock replenishment purposes.
- (b) Liaison with the appropriate Army authorities in regard to the storage and movement to railhead of all stocks of R.A.F. ammunition, bombs, pyrotechnics, fuels and oils.

¹ B.A.F.F., O.R.B., Appendix D, Attachment A.

² A.H.B./II H2/414, Appendix M.

- (c) Liaison with G.H.Q., B.E.F., in regard to accommodation, movements and similar questions affecting those R.A.F. units for which services the Army was responsible.

Meanwhile, the absence of suitable arrangements in the forward area for the repair and salvage of aircraft outside the squadrons compelled the A.A.S.F. to take steps to remedy the deficiency. The solution adopted was the formation of Repair and Salvage Units, each comprising a mobile repair section sent up from No. 21 Aircraft Depot, and a railhead handling party and three advanced salvage sections previously attached to the Air Stores Parks. These Repair and Salvage Sections were made responsible for repairing or salvaging all aircraft crashed or forced landed away from their squadron and for repairing aircraft beyond the capacity of squadrons. Damaged aircraft which would be patched up for one flight to the United Kingdom for subsequent repair were so treated ; while all airframes and engines beyond the capacity of the Repair and Salvage Units to deal with were to be sent to No. 21 Aircraft Depot, although this was, in fact, in no position for many months to undertake the work.¹

On the supply side, adjustments were made to certain sections of the Air Stores Parks to place them on a geographical basis so that they could more easily meet the demands of the squadrons in their areas. Petrol and oils were distributed by the Supply and Transport Sections attached to each park. The plans drawn up prior to the war envisaged petrol and oils being drawn by units direct from railheads. In practice, however, it was clearly seen that to supply continuity and to guard against breakdown of the lines of communication it was necessary to form reserve dumps forward of railheads and in the rear of aerodromes.² These dumps were located adjacent to the parks and their maintenance proved an extremely heavy commitment to the S. and T. Sections of the parks which had not been provided with the labour and vehicles necessary for the work.

The Formation of Maintenance Control³

As a result of the first few months' experience in France it became clear that the organisation for repair and salvage, while it might serve for the very limited operations of the opening phase of the war, would be quite inadequate for a period of intensive operations. It was also clear that it was dangerous to overload the Air Stores Parks in the forward areas and render them immobile. In fact, the whole supply position would be considerably better if a full equipment holding section at No. 21 Aircraft Depot could be developed as originally intended. To achieve these two ends the Air Ministry decided in December 1939 to form a Maintenance Control under a Maintenance Officer-in-Chief and with an appropriate staff. The new organisation was charged *inter alia* with the special task of developing No. 21 Aircraft Depot and establishing more and larger repair and salvage units. Maintenance Control absorbed 'Q' R.A.F.

On 31 December 1939, Air Ministry instructions were issued for the formation of a Command under Air Marshal Sir A.S. Barratt to take over the British Air

¹ A.A.S.F., O.R.B., 1940.

² A.H.B./II H2/6/183, p. 47.

³ A.H.B./II H2/414, p. 12.

Forces in France with effect from 15 January 1940. When British Air Forces, France, came into being, therefore, the new Maintenance Officer-in-Chief had only just started work. The Maintenance Officer-in-Chief with his staff was then located in close proximity to G.H.Q. and was too far away for the daily contact which the A.O.C.-in-C. and his staff required, in order to keep in touch with the urgent problems of maintenance and supply. Consequently, on 29 February 1940, Air Marshal Barratt brought the M.O.-in-C's organisation over to his own Headquarters, leaving a Wing Commander at G.H.Q. for liaison purposes.

The responsibilities of the Maintenance Officer-in-Chief were defined to the following effect :—

- (a) He was responsible to the A.O.C.-in-C. through the Air Officer-in-Charge of Administration for the technical administration and control of the maintenance services in France, his direction being effected through his representatives at A.A.S.F. and Air Component Headquarters.
- (b) He advised the A.O.C.-in-C. on the formation of a broad maintenance policy, keeping in touch with the A.O.C., A.A.S.F. and the A.O.C. Air Component to ensure that their special requirements were taken into account.
- (c) He was responsible for representing air force needs to the Quartermaster General at G.H.Q. where their supply and movement was an Army responsibility.

The Maintenance Officer-in-Chief also represented the Director General of Maintenance (Air Ministry) in France, dealt directly with Air Ministry on technical matters and was to pursue close contact with Maintenance Command ; it was thus hoped that good co-ordination would be obtained between the maintenance organisation in France and in the United Kingdom.

At the time of the appointment of the Maintenance Officer-in-Chief no real start had been made towards building up the Equipment Holding Unit of No. 21 Aircraft Depot, apart from the erection of some Bessoneau hangars.¹ It had, however, been decided that the unit should be formed with an initial issue of six weeks' supply for the British Air Forces in France. By the end of January 1940, the equipment unit was being brought up to the necessary strength and some of the large Bellman hangars to house the stocks had arrived. A month later the erection of one of these was nearly complete, and the unit was in a position to issue items of equipment in the clothing section. As the depot reported readiness to issue in any particular section, so the holdings of the forward Air Stores Parks in those items were reduced and the necessity for the parks to draw stocks direct from the United Kingdom was avoided.

During February many of the sections of the Equipment Holding Unit were receiving items and by March about 175 tons of incoming stores were being handled each week. By the end of April it was prepared to receive from the United Kingdom all items of the ' Vocabulary ' up to a six weeks' stock, and to issue, in France, clothing, barrack stores and M.T. spares. By 14 May—

¹ B.A.F.F., O.R.B.

four days after the German attack opened—the Equipment Holding Unit was at last in a position to issue items from all sections.

Side by side with the completion of the Equipment Holding Unit went the development of the repair and salvage facilities of No. 24 Aircraft Depot. By the end of January some aircraft salvage had been carried out together with some repair of mechanical transport and construction of gun mountings. This was on a very small scale, however ; very little repairable material had been returned to the United Kingdom, and it had not been possible to achieve any output of repaired airframes or engines. As the result of proposals made by the Maintenance Officer-in-Chief in February, within a broad framework previously determined at the Air Ministry, the following policy for the depot was then finally decided upon :—

- (a) Limited repair to airframes up to 400 man-hours per job for a complete airframe, or 150 man-hours for fuselage. Limited repairs to engines, light repairs to mechanical transport, in particular by replacement, and light repairs to ancillary equipment. No complete overhauls or major repairs for airframes, engines, M.T. or ancillary equipment.
- (b) Repair *in situ* of slightly damaged aircraft which could be flown off after repair, in areas outside those of the forward Repair and Salvage Units.
- (c) Salvage of aircraft in France outside the areas covered by the Repair and Salvage Units.
- (d) Despatch to the United Kingdom of all repairable equipment beyond depot capacity.
- (e) Reduction to scrap and disposal of all equipment damaged beyond economical repair.

This policy was not, however, issued with full Air Ministry authority until 27 March, and there was further delay in filling the new establishments deemed necessary ; this in itself, apart from the other innumerable difficulties, made for slow progress. It was not until May that the engine repair section was in production on a small scale, three engines having actually been overhauled, while the airframe repair section at this period had managed to complete the repair of four airframes. The M.T. section was rather more advanced—41 vehicles had been overhauled since January.¹ The machine shop was almost ready to operate, but, in the absence of the long-deferred connection with the French electric mains, awaited a full quota of power-trailers. The armament repair section was working satisfactorily and had overhauled 38 guns. The salvage section had handled and classified 78 trucks of salvaged components during April and had reduced 20 airframes to produce. Forty-eight of the fifty-two repairable engines received from the forward areas during April had been sent on to the United Kingdom.

As regards the development of the Repair and Salvage Sections in the forward areas, the task to be faced was, in fact, probably more important than that happening at the base. It has already been mentioned that Repair and Salvage Units had been improvised from the repair, handling and salvage sections

¹ M.O.-in-C. Progress Report.

attached to No. 21 Aircraft Depot or to the Air Stores Parks. The intention, as advanced by the Maintenance Officer-in-Chief and promulgated by the Air Ministry on 27 March, was that this impromptu arrangement should be confirmed and strengthened. To this end the amalgamation of the repair, handling and salvage sections into Repair and Salvage Units was to be regarded as permanent, and the sections were therefore divorced administratively from the Aircraft Depot and the Air Stores Parks which had originally been responsible for them. The R. and S.U.s were to be given more equipment, more M.T. and an increased establishment of personnel, and thus were to become self-contained. It was considered that three of these units should function under the A.A.S.F. and three under the Air Component ; but owing to the greater estimated wastage in the Air Component, the R. and S.U.s with that formation were to possess a greater number of mobile salvage sections than those with the A.A.S.F. The composition of a Repair and Salvage Unit was to be :—¹

Headquarters,
Inspection and Repair Section,
M.T. Repair Section,
Handling and Despatch Section,
Mobile Repair Sections (Two),
Mobile Salvage Sections (One, two, or three).

The function of the unit as a whole was defined as :—

- (a) Repair of airframes, engines and M.T. beyond the capacity of squadrons up to a limit of 200 man-hours per job.
- (b) Repair of slightly damaged aircraft *in situ*.
- (c) Salvage of aircraft and M.T. damaged beyond repair *in situ* or beyond the capacity of squadrons to repair.
- (d) Relieving squadrons of major inspections of aircraft.
- (e) Assisting squadrons with repair and modifications.
- (f) Conditioning salvaged equipment and components.
- (g) Return to Air Stores Parks, for reissue, of serviceable equipment and components not required by Repair and Salvage Units.
- (h) Return to No. 21 Aircraft Depot, or the United Kingdom, of repairable airframes, engines, M.T. and components beyond the capacity of Repair and Salvage Units.
- (i) Return of scrap to No. 21 Aircraft Depot, the United Kingdom, or Army Salvage Centre as appropriate.

The full development of these units was never completely achieved. A certain degree of progress was made but the full establishment of M.T. and personnel as approved by the Air Ministry had not been provided by 10 May, and when the German advance commenced the R. and S.U.s were still in a state of reorganisation. There were many other reasons for this delay, the most important being the shortage of equipment of one kind or another. A clear instance of this was the difficulty of equipping units with machine-tool trailers. These were to be released from No. 21 Aircraft Depot, but the depot

¹ A.H.B./II H2/259.

could not release them until its permanent machinery was installed, and the depot's permanent machinery could not be installed until a Bellman hangar to receive it had been erected. Thus an action which had been agreed on early in January was still not achieved in May. Similarly with the provision of power-trailers which were also to be released from No. 21 Aircraft Depot; but the depot could neither get connected to the French power and light mains, nor could it secure other power-trailers in replacement if it surrendered its own.

Although the scarcity of equipment and our commitments in Scandinavia may have accounted for much, the Maintenance Officer-in-Chief was of the opinion that some of the delay in bringing the Repair and Salvage Units on to a proper footing was caused by the limitations of his own executive authority. Indeed, in the A.A.S.F. there seems to have been some disagreement with the policy itself, for the reduction in the number of salvage sections in the new units was considered unwise. In fact, the A.A.S.F. apparently did not attempt to give effect to the new establishment in this direction; and it appears that even though some five months had elapsed since the subject was broached there was in respect of it a lack of close co-ordination between Air Ministry, Maintenance Staff and B.A.F.F. Headquarters and the A.A.S.F.¹

Several additions were made to the supply arrangements. Reserve petrol dumps were established within 'lorry carrying' distance of railheads to ease the position created by the great length of the lines of communication. These dumps held 14 days' supply of all aviation and M.T. fuels and oils for the units they served. Forward Air Ammunition Parks were also formed for the same reason. The functions of the parks were:—

- (a) To hold two weeks' supply of all explosives required by squadrons and other units.
- (b) To clear explosives from the ammunition railhead.
- (c) To deliver to squadrons explosives to replace expenditure.

Lack of Mobility Resulting from Underestimation of Mechanical Transport Requirements²

In the original organisation the Air Component was established to a greater degree of mobility than the A.A.S.F., for squadrons (but not ancillary units) were completely mobile in the former, while in the latter neither squadrons nor ancillary units were completely mobile. Supply and Transport Sections were attached to the Air Stores Parks of the A.A.S.F. and were available for the general transport requirements of the force, but not in such strength as to render the whole force mobile at any one time. The early events in the life of the A.A.S.F. also somewhat upset the organisation—in particular the decision to base not more than one squadron on each aerodrome—and in general the force found itself short of vans and cars for domestic needs. Something was done to alleviate this position by the local purchase of forty Renault vans in October, and the provision of a few buses in November. When the question of the insufficiency of mechanical transport vehicles was taken up with the Air Ministry the latter expressed the opinion that the force was not economically

¹ Report on A.A.S.F., Part I, p. 16.

² Air Marshal Barratt's Despatch.

organised in 3-ton tenders, and the formation of B.A.F.F. Command and other reorganisation provided a suitable opportunity for a review of the whole transport position. In January 1940 arrangements were made for the Air Ministry Establishments Committee to visit France to examine the subject.

The intention of the investigation was announced beforehand by the Director of Organisation. It was 'to try to effect economy in M.T. pooling where possible, to ensure proper maintenance and also to adjust establishments to include more suitable types of vehicles.' Its aim was thus not to increase mobility but to effect the most economical organisation.¹ The ideas with which the Committee began are contained in a paper which was sent in advance to A.A.S.F. and B.A.F.F. Headquarters, and since the opening paragraphs of this paper contain a clear statement of the historical background on the degree of mobility considered necessary for the A.A.S.F. they are quoted in full :—

'Owing to the strategical position of the A.A.S.F. behind a strong fortified line, the degree of mobility required for the units is small. Although individual units may move from time to time, the movement of the whole force at one time is regarded as improbable. The A.A.S.F. was organised, in the Administrative Plan, on a two squadron wing basis following closely on the home organisation. Most of the M.T. and administrative facilities were established on the Wing H.Q. and the squadrons themselves kept as small as possible. It was assumed that both squadrons of each Wing would operate from the same aerodrome. As regards the Air Stores Parks it was realised that any attempt to make them fully mobile would defeat its own object owing to the very large number of vehicles which would be required to put this into effect. It was therefore decided to keep only 50 per cent of the normal holdings of the Parks on wheels, and to establish sufficient load-carriers on the Headquarters to enable one of the three equipment sections to be made fully mobile at short notice.

Since the arrival of the A.A.S.F. in France the following factors have contributed towards making the force even less mobile as a whole :—

- (i) The nature of the land line communications.
- (ii) Provision of bomb and fuel dumps in the forward areas.
- (iii) Provision of hutting and other accommodation.
- (iv) Increases in scales of clothing, blankets, etc.
- (v) Establishment of an A.A. Brigade which has only a very limited degree of mobility.

It has now been decided on other papers that the A.A.S.F. is to be re-organised on the system of small operational Wing H.Q.s controlling three or four self-contained squadrons; as it has been found necessary for each squadron to be located on a separate aerodrome in a widely dispersed area.

In view of the foregoing, it is now proposed to adopt an administrative policy whereby the mobility of the A.A.S.F. is limited to the moving of not more than four of the squadrons at any one time. To do this it is proposed to

¹ A.H.B./II H2/262.

take most of the load-carrying vehicles from A.A.S.F. H.Q. and the forward units, and to organise Wing M.T. Companies which will consist of load-carriers to be used to assist squadrons and other units as necessary.

The two fighter squadrons in the A.A.S.F. are regarded in a different light to the bomber squadrons, and it is not proposed to reduce their mobility or include them in this reorganisation. They will, however, be able to obtain assistance from the Wing M.T. Companies if necessary owing to the length of their L. of C.'

With the formation of these two Wing M.T. Companies (each to be capable of serving four squadrons, one Air Stores Park and ancillary units) it was calculated that the existing Supply and Transport Sections could be abolished. Altogether it was hoped by these proposals to achieve a reduction of nearly 150 3-ton tenders with the A.A.S.F., and to use these principally to replenish the 15 per cent reserve holding in No. 21 Aircraft Depot, which had been virtually exhausted. It was also hoped to apply similar proposals to the Air Component.

The Air Officers Commanding in France, while accepting the idea of pooling some of the heavy transport in Wing M.T. Companies, found it very difficult to agree to every detail of a scheme which would have considerably reduced the mobility of their forces. Air Marshal Barratt was by no means inclined to accept the proposition that the A.A.S.F. was in a completely safe locality.

The A.O.C.-in-C.'s views on the degree of mobility necessary were urged on the investigating committee at B.A.F.F. Headquarters on 5 February; and, according to his own statement, they were accepted. It was then left to the Air Ministry to produce their revised scheme.

On 25 February, the Air Ministry issued their proposed new establishments of M.T., but the full scheme for its reorganisation was not yet forthcoming, nor were personnel establishments issued. Consequently, Air Marshal Barratt represented to the Air Ministry that the matter had now been under consideration for six weeks, and requested despatch of the scheme at an early date. The scheme was eventually issued by the Air Ministry on 8 April though without the personnel establishments for the new Headquarters M.T. Companies in the A.A.S.F.

The Air Ministry scheme listed, amongst others, the following conclusions on the existing position in France :—

- (a) There was insufficient transport reserve to render all units adequately mobile.
- (b) There was a definite requirement for a much larger number of light vehicles for day-to-day use.
- (c) Heavy vehicles not required for day-to-day use if withdrawn from units and held in pools could be maintained more efficiently.
- (d) M.T. pools were required which could supply transport for fuel and explosives for units and also provide vehicles necessary to squadrons to enable them to move complete.
- (e) The holding of the whole of the 15 per cent reserves at No. 21 Aircraft Depot was not satisfactory owing to the large distance to be covered

The scheme therefore allowed for a large increase in light vans ; the reduction of heavy tenders within squadrons to numbers which would enable them to move essential stores and personnel for 3 days' operations, or within other units to numbers necessary for day-to-day use ; the introduction of M.T. pools in the Air Component on a Group, Wing and H.Q. basis ; the introduction of three M.T. pools (explosives, fuel and general) under A.A.S.F. Headquarters to serve the A.A.S.F. bomber squadrons ; the retention of the complete mobility of No. 67 (Fighter) Wing ; and the splitting up of the 15 per cent reserve previously held at the base among No. 21 Aircraft Depot, A.A.S.F. and the Air Component.

It was reckoned that the general effect on mobility of these arrangements would be as follows :—

AIR COMPONENT

Squadrons. All squadrons could move their essential personnel and equipment at once with their own M.T. Remaining personnel and equipment could be moved and the squadrons kept supplied with fuel and explosives by the M.T. in pools.

Air Stores Parks. Essentials for two weeks' consumption of two of the three parks could be moved by M.T. in the Headquarters pool.

A.A.S.F.

Squadrons. Fighter Wing H.Q. and two squadrons would be completely mobile. Bombers could move all essentials at once, plus non-essentials of four squadrons by H.Q. pool, i.e. four squadrons could be completely mobile but the remaining six would have to await the return of the M.T. to move their non-essentials.

Air Stores Parks. Could move essentials for two weeks' consumption with own M.T. plus vehicles in H.Q. pool.

The degree of mobility to be achieved by this scheme was, in fact, considerably less than that recommended by Air Marshal Barratt at the conference on 5 February, which he thought had been approved by the investigating committee. Even this degree of mobility, however, was not attained. On 17 April, Air Marshal Barratt wrote to the Air Ministry complaining that the reorganisation in the A.A.S.F. was held up because the new establishments for Headquarters M.T. Companies had not yet been received. He listed the following deficiencies in vehicles :—

<i>Vehicle Type</i>	<i>Deficient on existing establishments</i>	<i>Reserve Pool not yet established</i>	<i>Total Deficiencies</i>
Staff cars	23	30	53
Tenders, 3-ton	116	200	316
Tenders, 30-cwt.	36	20	56
Vans, 15-cwt.	69	40	109
Vans, 10/15-cwt.	66	40	106
Trailers, petrol (450 gallons) ...	28	25	53
Trailers, power. 7 kW.	31	15	46
Trailers, W/T Receiving	22	10	32

Thus the deficiencies on 17 April in these classes, of which the large tenders and vans were the most serious, totalled some 771 vehicles. In a letter to the Air Member for Supply and Organisation two or three days later, Air Marshal Barratt emphasised the gravity of the position in these words :—

‘ If operations break out in the near future my ability either to move squadrons or to keep them properly supplied gives me considerable concern. If any of the M.T. which I do possess is damaged by air action the position is going to be even worse.’

The fact that the B.A.F.F. figures were not overstated is confirmed by the Air Ministry data passed from W.O.3 to E.8 during April. The figures do not correspond exactly, but in the above classes they totalled 708 vehicles while other classes not mentioned by B.A.F.F. Headquarters totalled a further 300 or so vehicles, making a total deficiency of about 1,000 vehicles in all.

On 7 May, Air Marshal Barratt asked the Air Ministry to state what steps were being taken to make up the deficiency, and on 11 May an official answer from the Directorate of Organisation vouchsafed an explanation of the delay which was caused, it said, by failure on the part of contractors to deliver 3-ton tenders in accordance with contract ; the fact that the lighter type of van was a new development for the continental units, and it had only just become possible to obtain supplies to meet the new commitments ; and finally, the fact that ‘ very urgent ’ needs (presumably the Scandinavian ventures) had absorbed vehicles which would otherwise have been available for France, together with the prior attention of the maintenance units responsible for preparing transport and equipment. It was announced, however, that the establishment of the M.T. Companies for the A.A.S.F. Headquarters had now been issued, and that many vehicles had recently been or were about to be shipped. This, however, was the day after the German assault had opened. On 15 May it was calculated at B.A.F.F. Headquarters that the forces in France were still nearly 600 vehicles short in the main classes, though approximately 200 of these were in transit. The following day, both A.A.S.F. and Air Component were to need all the transport they could lay their hands on.

It thus came about that when the moment of crisis arrived the British Air Forces in France were not only established to an official basis which was but semi-mobile, but were actually 600 vehicles short of this semi-mobility. It had been possible to carry out the reorganisation into Wing and Group M.T. Companies in the Air Component but the delay in issuing establishments for the A.A.S.F. was such that the Headquarters M.T. pools projected in February were still not achieved by May. Ultimately it was necessary for the A.A.S.F. to secure mobility by borrowing transport from the French and by reducing the number of its operational bomber squadrons from ten to six.

Maintenance Difficulties during the Final Stages of the Campaign in France and the Low Countries

Details of the operations carried out by the Royal Air Force in France and the Low Countries are not included in this monograph as these have been covered adequately elsewhere. For the purpose of the history of the R.A.F. maintenance arrangements, the campaign may be separated into three phases :—

- (i) The arrival of our air forces on the Continent (September 1939).

- (ii) The static period (October 1939 to 9 May 1940).
- (iii) The period of the German attack followed by our withdrawal (10 May to 18 June 1940).

The maintenance difficulties experienced and the attempts made to produce an adequate organisation during the first two phases have been described in the foregoing pages. During the final phase most of the difficulties resulted from the fact that when the intensive operational period commenced the reorganised maintenance organisation was still far from complete.

A high degree of serviceability of aircraft was maintained by squadron personnel throughout the campaign, and it is of interest to note that during the period of least action the unserviceability figures were far higher than during periods of intense operations, the reason for this being that during the quiet phases, advantage was taken to carry out minor replacements and modifications on aircraft which resulted in their being shown in returns as 'unserviceable.' During intensive operations squadron personnel were fully employed in routine maintenance and minor repairs and serviceability was largely maintained by calling on the Repair and Salvage Units for repair *in situ*. Squadron personnel could have undertaken more repair work (thereby enabling the Repair and Salvage Units to devote more effort to salvage) if it had not been necessary to employ technical personnel on non-skilled work such as ground defence, bomb carrying, etc.

The serviceability of mechanical transport was very adversely affected through all phases by the non-availability of spare parts. It had been intended to form a M.T. repair unit in the forward area but circumstances did not permit this to be introduced.

As regards the Repair and Salvage Units, it was demonstrated during the intensive period that even if their scale of personnel and equipment had been up to the establishment intended by the Air Ministry, it would have been inadequate to keep pace with requirements. The units were made fully mobile but it was not possible for them to undertake complete salvage operations and the R. and S.U. commanders were from time to time given priority of effort to meet the changing circumstances. Generally priority was as follows :—

- (a) Aircraft repairable *in situ* for return to squadrons.
- (b) Aircraft repairable *in situ* for return to the United Kingdom for further repair.
- (c) Removal of engines and Column 7 equipment.
- (d) Salvage of airframes for return to No. 21 Aircraft Depot for subsequent repair.

In the case of (b) considerable latitude was allowed, and, provided that in the opinion of the engineer officer the aircraft would stand up to level flight to the United Kingdom, the aircraft was certified accordingly.

During the withdrawal the Repair and Salvage Units of the A.A.S.F. did excellent work, particularly in the salving of valuable equipment of all kinds, including equipment which was so urgently required in the United Kingdom.

The units were, however, considerably handicapped by the fact that many of their vehicles had not been designed to undertake the salving and transportation of R.A.F. equipment. In particular, although the establishment of a R. and S.U. included one 3/5-ton crane for each mobile salvage section, these cranes had not been supplied.

The holdings of the Air Stores Parks were cut down immediately the German offensive opened in order to make the parks as mobile as possible. The work of the A.S.P.s, however, fell off considerably, mainly due to the fact that squadrons and R. and S.U.s could not carry out repairs. During the retirement the majority of the parks, whilst on the move, commenced to function 24 hours after the arrival at a new destination, with the exception that they were not able to supply rations and petrol which were supplied from the base and consigned to selected railheads. Owing to the large stocks and insufficient transport, quantities of equipment and supplies were left behind in the forward area when the retirement first commenced, but, as the result of the efforts made subsequently, the parks completely cleared the equipment from this area with the exception of petrol and oils. The 100 octane petrol was salvaged but the remainder, with the oil, had to be handed over to the French authorities. The salvaged equipment was loaded onto trains and despatched to the base.

No. 21 Aircraft Depot, as previously explained, had not got into its stride when the German offensive opened. Between 10 May and the second week in June, however, it managed to complete the repair of eight Hurricanes. The production work of the depot really came to an end in the first week of June, and the process of cutting down commenced. In this connection it will be remembered that the equipment holding section of the depot had, at the outset of the battle, only just been completed and fully stocked. On 24 May, in view of the success of the German offensive and the evacuation of the Air Component, a reduction of stocks was ordered. Forthwith 800 tons of equipment were shipped home. On 12 June arrangements were made for a further drastic reduction and from that date onwards the process became continuous. The result finally achieved was :—

- (a) All aircraft fit to fly were flown to the United Kingdom.
- (b) All spare engines in store at the depot and those sent down from the Air Stores Parks were evacuated.
- (c) 95 per cent of the non-technical equipment and nearly 100 per cent of the technical equipment of the equipment holding unit of No. 21 Aircraft Depot was shipped before the final evacuation. Some valuable machine tools were also removed from the shops and placed on board ships which eventually reached England. Guns and parachutes were evacuated by air transport.

Material which had to be abandoned consisted mainly of the equipment which had to be retained on wheels with the squadrons and Air Stores Parks while operations continued, and the vehicles which were required to keep the force mobile under the same conditions. Much of the R.A.F. Component equipment was lost by German interception and there was no time or capacity to ship a great deal of the equipment of the A.A.S.F. which actually reached the western ports at the end of the campaign. After our air forces had returned

to the United Kingdom it was estimated by the Air Officer Commanding Maintenance Command that we had lost in France (exclusive of aircraft and equipment in squadrons and smaller units in the forward area) the equivalent of four complete Air Stores Parks, or items to the value of about £1,000,000. Fortunately, as described, evacuation priority was given to articles in short supply in England and the adverse effect on the Service was thus less severe than it might easily have been. The loss in aircraft from all causes amounted to nearly a thousand in the period 10 May to 20 June.

Part II
THE MAINTENANCE GROUPS
MAY 1940 TO MAY 1945

CHAPTER 5

No. 43 GROUP AND THE CIVILIAN REPAIR ORGANISATION

The Transfer of Technical Control to the Ministry of Aircraft Production

With the formation of the Ministry of Aircraft Production in May 1940, the technical control of No. 43 Group passed from Maintenance Command to the new Ministry. The administration of the Group, however, by Air Ministry continued as before, through normal Maintenance Command channels.¹

Movement of H.Q., No. 43 Group to Oxford²

In October 1940 it was decided, after consultations with M.A.P., to move the Headquarters of the Group salvage organisation from Andover to Oxford. The section was in future to be known as 'No. 43 Group (Salvage)' and was to be responsible for its operational control, issuing block allocations of repair capacity of all types of aircraft to the salvage centres. A civilian was appointed, responsible to M.A.P., to co-ordinate the salvage work of the Group with the requirements of C.R.O. and any other bodies interested in salvage.

Temporary accommodation at Oxford was at the Morris Motor Works, Cowley, to which the transfer was made on 16 October 1940, a further move being made to Merton College, Oxford, on 5 November 1940.

On 1 February 1941, H.Q., No. 43 Group also moved to Oxford, accommodation having been secured at Magdalen College. The H.Q., No. 43 Group (Salvage) was now merged into the one Headquarters, which was henceforward known as Headquarters, No. 43 Group.

The Expansion of No. 43 Group, 1940-1944³

The expansion of the Group really started in October 1940, when there were 15 units with approximately 13,700 personnel. By March 1942 this had risen to 29 units and 26,000 personnel, with a planned expansion for that year to 30 units and 30,500 personnel. This increase consisted of one small Aircraft Depot, seven Repair and Salvage Units, six Marine Repair Units, and an enlargement of existing units generally.⁴

The A.O.C., No. 43 Group submitted a paper on this expansion to the Director of Repair and Maintenance on 2 April 1942. This gave units and their establishments together with the comparative repair output figures of principal items for two 13-week periods, October/December 1940 and October/December 1941. It also showed that during this period the increase in H.Q. Staff Officers had been at a much lower ratio. Details of the proposed H.Q. Establishment

¹ See Diagram 5.

² No. 43 Group O.R.B., 1940.

³ No. 43 Group File S.5508/Org.

⁴ Details are given in Appendix 3.

were submitted to the D.R.M. on 19 April 1942. The main differences as regards organisation were in the addition of a Senior Technical Staff Officer with the rank of Air Commodore to be responsible for the Salvage Branch, which had now become Repair and Salvage; and the placing of the Equipment Staff under the S.T.S.O. The main increases asked for in establishment were in the Equipment Branch, but there were several requests for upgradings of posts to meet the increased responsibilities brought about by the expansion, including that of the A.O.C. from Air Commodore to Air Vice-Marshal.¹

Summary of the Group's Functions in 1944²

With the growth of the operational Commands the Group's commitments continued to increase both in number and volume until the peak year of effort was reached in 1944. At this stage the functions and activities of No. 43 Group may be summarised into the following two broad divisions:—

- (a) Repair of all kinds, as well as manufacture, modification, installation and development work at the Service Repair Depots, together with certain more specialised work, such as repair of marine craft.
- (b) Salvage of aircraft and repair on site of Category 'AC' aircraft.³

Repair and Production, 1944⁴

Although Service Repair Depots and Marine Maintenance Units provided repair and production facilities similar in many cases to those of civilian firms, one very considerable difference existed, namely, that No. 43 Group repair units were required to undertake work which, either because of its being in an early stage of development or part of an unstable programme, rendered difficult the setting up of a production flow and could not be accepted by the aircraft industry. The allocation of such programmes to Service repair capacity meant that this organisation had to remain completely versatile and flexible. This flexibility enabled commitments to be undertaken at very short notice; for example, during 1944 parties were sent on a number of occasions to aircraft civilian contractors to clear bottlenecks in production; other parties were sent to assist operational Commands in maintaining aircraft serviceability in the field during intensive operational periods, and similarly to speed up urgent modification work.

In addition, the organisation provided capacity for work which could not be given to civilian industry due to such overriding factors as security or urgency. This was particularly true of the development of radar and radio, and in this respect it is no exaggeration to say that the operational formations worked with the No. 43 Group organisation at their elbows.

¹ See Diagram 6.

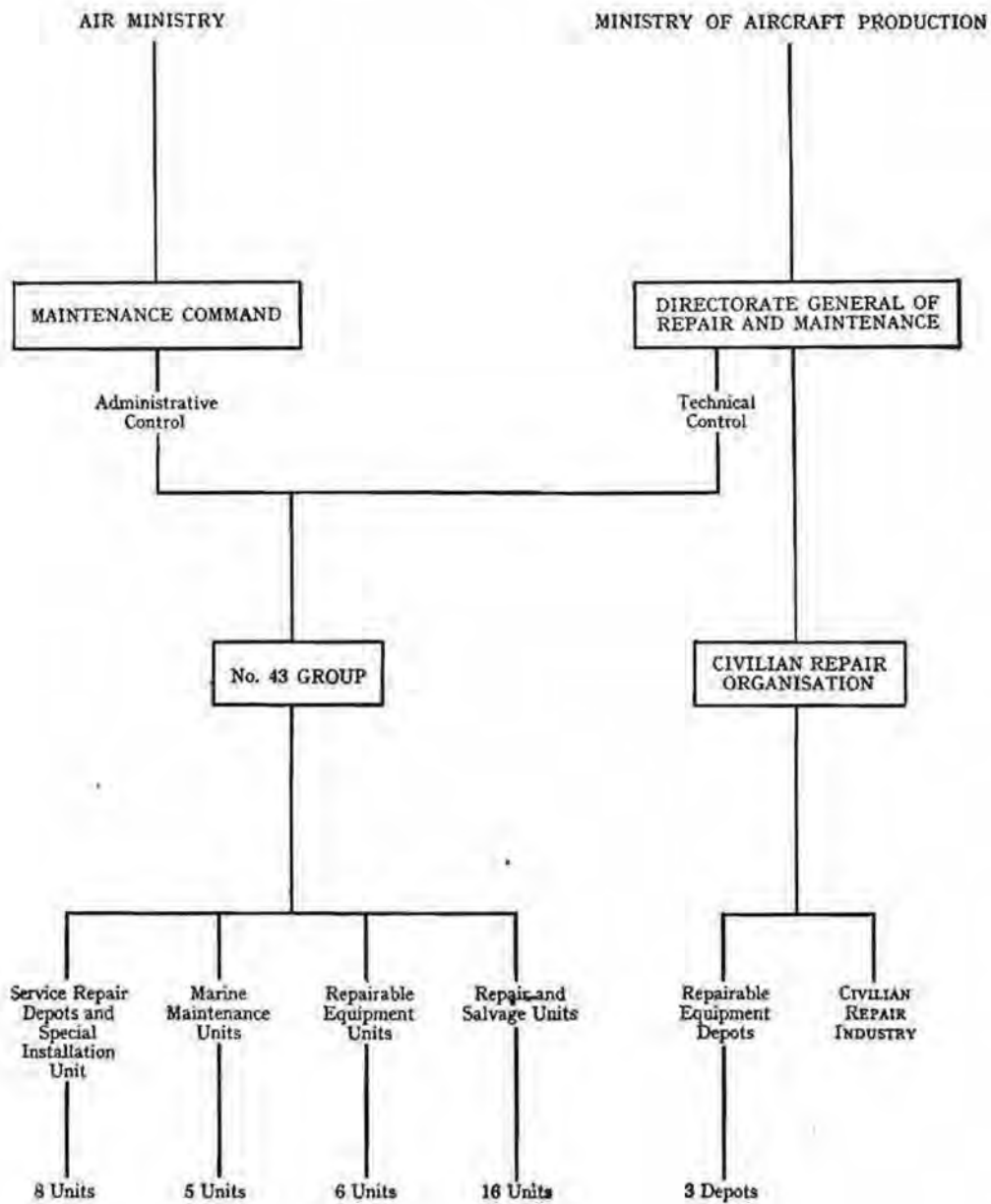
² The organisation and the establishments of the units in the Group are shown in Diagram 7. The geographical location of the units is shown in Diagram 8.

³ Another useful but secondary function of the Group, the discharge of which ran counter to the achievement of optimum output of repair and manufacture work, was the provision of training facilities for Service personnel, thus providing a pool of skilled tradesmen upon which to draw for postings to operational and other units at home and overseas. More than 2,600 No. 43 Group personnel were posted overseas in 1944 and this placed a heavy burden on those who had to maintain production with inexperienced replacements, who had to be trained before they could be used.

⁴ No. 43 Group Repair and Production Survey, 1944.

DIAGRAM 5

RELATIONSHIP BETWEEN—AIR MINISTRY—
MAINTENANCE COMMAND—No. 43 GROUP AND THE
MINISTRY OF AIRCRAFT PRODUCTION, MAY 1940



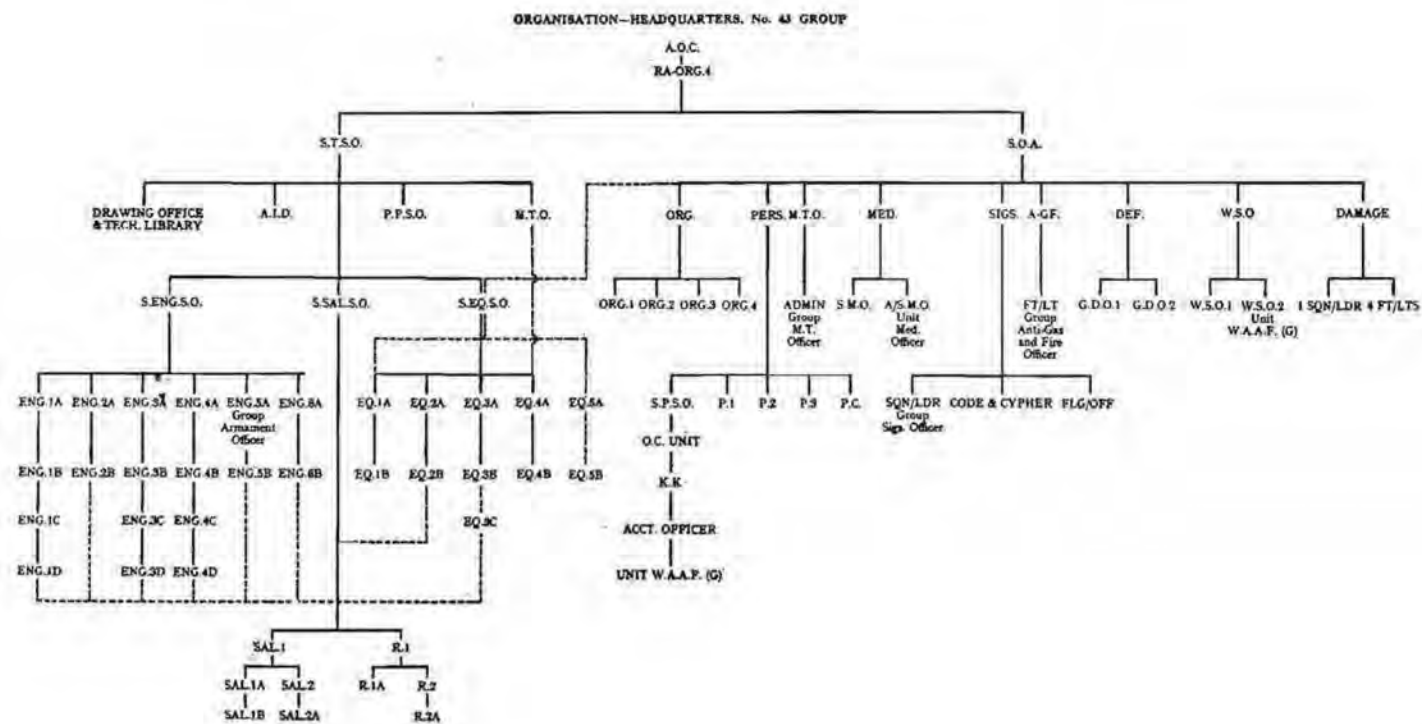
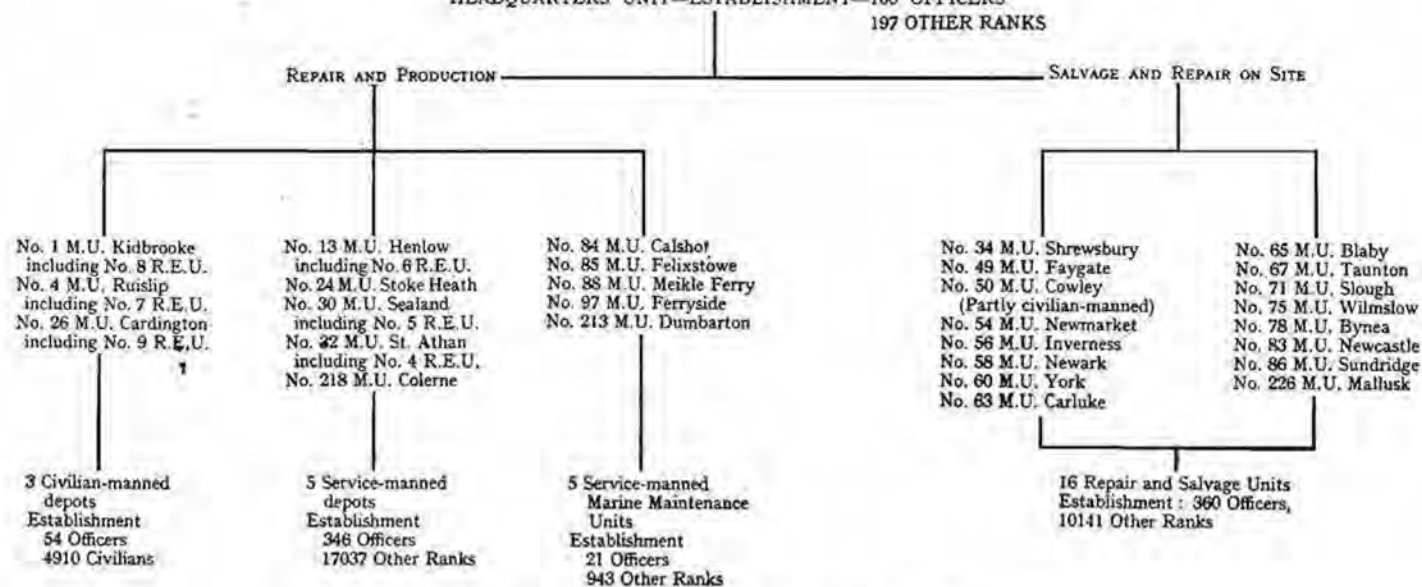


DIAGRAM 6

ORGANISATION AND ESTABLISHMENT OF UNITS,
DECEMBER 1944
H.Q., No. 43 GROUP, OXFORD
HEADQUARTERS UNIT—ESTABLISHMENT—100 OFFICERS
197 OTHER RANKS

77

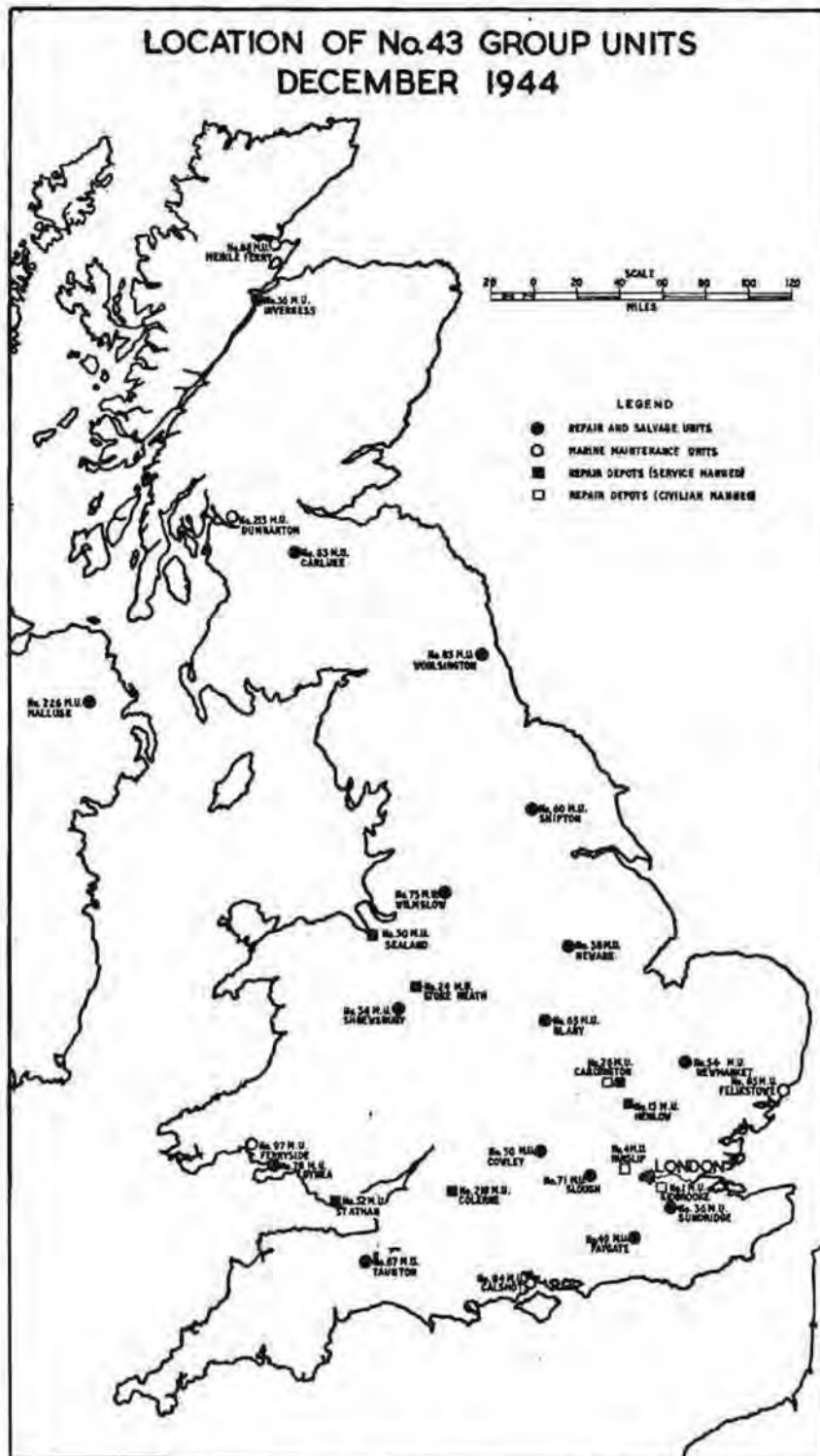


Summary :

1 Headquarters Unit Establishment :	100 Officers	197 Other Ranks
3 Civilian-Manned Units Establishment :	54 Officers	4910 Civilians
26 Service-Manned Units Establishment :	727 Officers	28121 Other Ranks
30 units	881 Officers	33228 Other Ranks

DIAGRAM 7

DIAGRAM 8



The organisation included seven Repair Depots, one Radar installation and five Marine Craft Repair Units and employed some 18,000 technical personnel, the total strength of these thirteen units being equal to about two modern army divisions. Workshop accommodation alone comprised some 2,700,000 sq. ft., and included airframe, aero-engine, and accessory repair shops, ship-yards, motor transport repair shops, foundries and machine shops, instrument repairs, manufacture and fitting sections, armament repair sections, radio manufacture, repair and fitting shops, oxygen apparatus development, production and repair shops and specialist equipment development and servicing sections.

The work carried out included major repair, modification and reconditioning of aircraft, marine craft, motor transport vehicles, engines, radio, armament, electrics and instruments. In addition the complete manufacture of a wide range of equipment was undertaken as well as extensive radar and instrument installation programmes for operational Command aircraft. There were, in fact, few classes of items in the whole extensive range of R.A.F. technical equipment whose repair, modification or manufacture was not undertaken within the No. 43 Group repair and production organisation.

Bulk statements of output in terms of manufacture convey little meaning as production ranged from repetition work running into thousands per week of a single item, to major overhauls involving thousands of man-hours as in the case of a Lancaster aircraft. Some indication, however, of a year's production output may be gained when it is visualised as being equivalent in man-hours to the complete overhaul of 40,000 Merlin aero-engines per annum.¹

The record which follows this brief summary has been divided into sections according to their broad functional aspects and is not therefore directly related to the detailed organisation of No. 43 Group.²

(a) Aircraft

No. 43 Group repair depots dealt with major repairs to specified types of aircraft whose repair was beyond unit or No. 43 Group repair-on-site capacity. The work was carried out in the airframe repair shops of the four aircraft repairing depots and amounted in many cases to completely rebuilding the aircraft concerned. In addition, extensive aircraft modification programmes were undertaken and assistance given to the aircraft industry and operational Commands.

During 1944 a total of 3,091 aircraft were dealt with by repair depot personnel, a further 331 being in course of progress at the end of the year. This showed a considerable increase over the total figures for 1943 of 983 aircraft.

The repair of Lancaster aircraft formed the largest single commitment under this heading, each rebuild consuming upwards of 25,000 man-hours. The hundredth Lancaster was completed and returned to Bomber Command during the year. Other aircraft dealt with included Dakotas, Wellingtons, Typhoons, Mosquitos, Beaufighters and Mustangs. In addition, the repair of all Typhoon

¹ A typical Service Repair Depot organisation is shown in Appendix 5.

² Output statistics for each section will be found in Appendix 6.

monocoques was met by the Group and 231 were repaired, fully modified and returned to Aircraft Equipment Depots during the year.

A repair commitment typical of the close support given to the operational Commands may be instanced by reference to a short-term programme undertaken to meet an operational need. Prior to the liberation of N.W. Europe extensive sweeps by fighter aircraft were carried out. Aircraft damaged in these sweeps which were beyond unit repair, but which were still airworthy, were flown into No. 43 Group units, repaired and returned to their respective squadrons with the minimum delay. In this way 28 aircraft, which under normal methods would have been non-operational for some time, were available to the Command at a time when every aircraft was needed to maintain maximum operational effort.

Most of the aircraft capacity during 1944 was taken up by aircraft modification, and one aspect, namely, radar installation, assumed such proportions that it has been dealt with in a separate section.

A typical modification commitment was the conversion of 61 Wellingtons for special night reconnaissance duties to meet urgent 'D' Day requirements. The work involved the design and fitting of camera hatches, fitting of vertical cameras, structural modifications to take cartridge dischargers, and the re-design and fitting of a new front turret. Another major modification commitment was that of converting Canadian-built Mosquitos to operational standard. These aircraft were ferried across the Atlantic and delivered to a No. 43 Group unit where they were stripped of their ferrying equipment, modified, and flight tested. The output for 1944 was 213 aircraft and the unit became an advisory centre for modification and repair of Canadian Mosquitos both for R.A.F. formations and the Ministry of Aircraft Production.

Other modifications included the fitting of rocket projectors to 104 Typhoon aircraft, modification of 70 Spitfires to photographic reconnaissance standard, and modification of 155 sundry other aircraft flown into No. 43 Group depots. Many of these modifications, and associate installation work, although in themselves comparatively straightforward, were complicated by the need to manufacture and, in many cases, design all or some of the fittings to be incorporated.

A total of 674 aircraft, exclusive of radar installations, were modified at repair depots during 1944.

During the same period 52 technical parties, consisting of some 800 personnel, were attached to various R.A.F. formations and civilian factories in order to supplement their capacity during critical periods or to carry out modifications which were beyond squadron facilities. This work varied in character, the largest single commitment being the modification of 1,550 Halifax aircraft for Bomber Command.

When the flying bomb attack on this country was at its peak, Headquarters, Air Defence of Great Britain asked for, and received, urgent assistance from No. 43 Group in their venture to modify the engines of 30 Mustang aircraft

in order to raise their top speed. This task was completed by the Group in 8 days. In this connection working parties also visited various Servicing Echelons to assist in improving the surface finish of aircraft, thus increasing their top speed by some 7 or 8 miles per hour.

A total of 1,733 aircraft, again exclusive of radar installations, were modified on site during 1944.

Work carried out by No. 43 Group parties detached to civilian contractors included: the clearing of congestion on the Mosquito final production line at Messrs. De Havilland, and flight testing and rectification of 197 Mosquito aircraft from the De Havilland factory; setting up at Messrs. Hawksley's aircraft factory a R.A.F. production line to increase the output of Albemarle aircraft required for glider-towing on Continental operations; the attachment of R.A.F. tradesmen to aircraft firms when their civilian counterparts were not available.

(b) Engines (Aero, Marine and M.T.), Propellers and Aero-Engine Accessories

Whilst engine repair in No. 43 Group covered the three above subdivisions, all of which had much in common, the magnitude of the task in each case was so disproportioned that the three types must be regarded separately.

The 1944 aero-engine repair programme included the complete overhaul of the Rolls Royce Merlin types 20, 22 and 24, and the Bristol Hercules XVI, the Bristol Pegasus XVIII and the American engines, Allison F3R, Pratt and Whitney Twin and Double Wasps.

Complete overhaul consisted of entirely dismantling the engine, after which the components were subjected to detailed inspection, all parts being categorised as either serviceable, repairable or scrap. The reconditioning process included the grinding and honing of sleeves of cylinder bores as appropriate and the replacement of excessive wear at the top of cylinder bores by the building up of hard chrome plating; similarly, bearings were remetalled, or in the case of lead bronze bearings scraped and lead-plated anew, crankshafts were ground and lapped. All parts of the engine subject to wear received attention, numerous processes being involved; hard chrome plating was used to face a variety of parts such as rocker pads; valves and valve seats were re-cut and ground, and re-bushing, re-turning or resurfacing of worn parts took place. During and after reassembly engines were submitted to full A.I.D. inspection after which they were removed to test bays where, after a running-in period of four to five hours, they were tested under full power and simulated high altitude conditions.

The overhaul of American engines presented a particular problem as no parent firm existed in this country. No. 43 Group assumed this responsibility and acted as a source of technical information. They also provided technical investigation facilities similar to those which would have normally been supplied by the civilian contractors.

The man-hours involved in complete aero-engine overhaul varied to some extent, but the Merlin and Twin Wasp which took 900 and 1,000 man-hours

respectively may be regarded as typical. These figures included man-hours occupied in preliminary as well as A.I.D. inspection, and test, and also the technical effort contributed by other sections of the unit such as the general engineering section.

The total number of aero-engines overhauled during 1944 was 4,695 and would have been greater but for policy changes which introduced more advanced types. The figures for 1942 and 1943 were 2,774 and 4,298 respectively.

The complete overhaul of both British and American aero-engine accessories was carried out at five units. The output during 1944, exclusive of electrical accessories which are dealt with in Section (e), exceeded 60,000 items.

The main capacity within the Group for the repair of both wooden and metal propellers was centralised at No. 24 Maintenance Unit. As the unit was extremely well equipped they were able to undertake the complete overhaul of most types of Rotol and De Havilland propellers. The unit was also able to carry out major repairs to metal blades as it possessed the equipment for heat treating and reshaping, anodising, shot-blasting and dyeing.

Due to a change in policy the output of completely overhauled propellers was well below the shop capacity and amounted to only 385 propellers; output of propeller blades was, however, 4,576. The repair methods for wooden blades greatly improved during the war years and major repairs were carried out on blades which formerly would have been regarded as useless.

Another aspect of propeller repair was the reclamation of hub parts and blades from propellers which were beyond economical repair. These were fed into the M.A.P. organisation and used in the building of new and repaired propellers; blades with broken tips were usually reshaped to smaller dimensions and converted to another type for which they were suitable.

Marine engine repair within the Group again was varied in character but certain types predominated, notably the Napier Sea Lion, the Ford 8 Marine and the Meadows 100 HP and 8/28. In all, 793 marine engines were completely overhauled during 1944, and the procedure for complete overhaul followed closely that which was carried out for aero-engines. Complete overhaul of accessories, such as Parson, Thornycroft, and Vosper reverse gears, various marine auxiliary engine generator sets and similar equipment, was also carried out.

The importance of maintaining stocks of overhauled marine engines to cover the liberation of N.W. Europe was recognised early in the year. Owing to a shortage of spares this was subsequently found to be impossible, but, nevertheless, the output from repair was maintained, so that at no time during this critical period was any high-speed launch unserviceable due to non-availability of engines.

The major repair and overhaul of M.T. engines was carried out in M.T. repair shops and, to a small extent, to supplement marine engine input in one E.R.S. The overhaul procedure was similar again to that briefly described for aero-engines, the majority of such overhauls being carried out concurrently with the

complete overhaul of the vehicle. A total of 274 engines were dealt with during 1944.

(c) Radio

Radar-W/T-Typex. Radio formed an important part of the No. 43 Group repair and manufacture organisation, and during 1944 its growth was almost spectacular. In this sphere of activity the Group gave very close support to the operational Commands, handling the most urgent commitments where speed and secrecy were the overriding considerations. In this connection the preparations for 'D' Day and radio countermeasures deserve pride of place. For repair and manufacture alone 28 officers and 957 other ranks of the appropriate radar or W/T trades were employed and the all up strength was 1,510, but, when visualising this capacity, it must be realised that the radio sections were backed up by other specialist capacity as required.

Radio commitments varied and included the repair of airborne and ground W/T, airborne Radar and Typex machines, the manufacture of radio countermeasures equipment, and then their appropriate test apparatus. It also covered the breakdown of obsolete W/T and radar equipment.

Radio repairs reached the total of 19,342 equipments during 1944 as compared with 11,030 in 1943, but these figures do not represent fully the extent of the expansion as the later equipment was much more complicated than that handled during the previous year. Equipment repaired consisted of the most modern communication and radar devices in use and included night bombing, night fighter and anti-submarine equipment. It became, in fact, the policy of D.D.R.M. (Radio) to adjust the national radio repair capacity so that the latest and most complicated equipment was dealt with in No. 43 Group; often when the teething troubles had been ironed out and the priority downgraded, the commitments were re-allocated to civilian contractors to make way for the newer types.

The repair of airborne radar achieved the most striking advances, 11,200 equipments being dealt with in 1944 compared with 4,630 in 1943. This expansion occurred at a time when equipment was becoming increasingly more complicated, the number of types having increased from 5 in 1943 to 12 in 1944. The necessary organisation to deal with this ever-changing programme of radar repair was one of the outstanding achievements of the Group.

During the latter part of 1943 new radar devices were introduced in rapid succession and taxed civilian manufacturing capacity to the limit. In order to prevent any delay in the 'supply pipe line' at a time when operational squadrons required them on the highest priority, a system was devised by No. 43 Group which became known as 'Crash Repair.' This may be defined as 'a system of repair in which speed of accomplishment took priority over all other considerations.'

In practice, a small 'float' of new equipment was given to the repairing unit, which was in touch with a central collecting point in each operational Group. Each collecting point was fed by squadrons with their unserviceable equipment which was collected daily by the No. 43 Group repair unit, who at the same time delivered advanced replacements. Thus, no piece of equipment was out of

service for more than 48 hours. This was equally true at the repair unit since the 'float' was necessarily so small that equipment had to be repaired on the day of receipt, a task which was increased by the fact that every radio repair, whether on a crash or normal basis, had to undergo full A.I.D. inspection and test before leaving the unit. Crash Repair was first introduced to deal with urgent arisings from Bomber Command but was later extended to other high priority equipment, and, during 1944, three completely different radar equipments were handled in this manner.

Radar repair was not limited to British equipment but covered some of the most complicated airborne American equipment which became a standard fitment on some types of British aircraft.

The repair of W/T airborne and ground equipment was the most long-standing commitment of the Group so far as the signals branch was concerned; the policy being to repair equipment of current operational use. The growth of large-scale operations threw an increased amount of work on the depots which in turn was reflected in the number of equipments repaired. The changes in equipment from TR.9.s, T1082.s and R1083.s to TR.1196, TR.1133 and TR.1143 necessitated an increasing amount of test gear of greater complexity. This in turn demanded a much higher degree of skill on the part of the wireless mechanic.

Woven into the pattern of radio repair were numerous manufacturing commitments which varied from the more or less routine production of test equipment to the manufacture, at exceedingly short notice, of countermeasure items to meet specific operations both at home and overseas.

Frequently radar or W/T equipment jobs were given to the Group on the grounds of speed alone as it had been proved on numerous occasions that the Group could undertake the manufacture of the most complicated equipment from sketches or a prototype in less time than that taken by civilian contractors; on one occasion equipment of the highest priority being delivered within three weeks of the requirements being known. This speed was made possible by the flexible and versatile radio organisation within the Group and the fact that it possessed almost unlimited engineering resources at units in the form of the general engineering sections. These enabled the entire equipment to be produced at a single unit, irrespective of whether it required metal work, welding, high precision fitting or turning, plating or other forms of finishing. While actual components were not normally manufactured, the Group was equipped for most types of windings and impregnations. It could also fabricate small items such as tag boards and components for sub-assemblies, chassis and dust covers and, if necessary, even transit cases. During 1944, 11,120 pieces of equipment were manufactured as compared with 5,800 manufactured in 1943.

Another important part of the capacity was taken up with the manufacture of Typex components for which at that time no capacity existed outside the Royal Air Force in view of the secrecy of this cypher machine.

Most of the No. 43 Group depots dealing with radio commitments had associated radio breakdown sections, and one depot had a special function in this connection having a complete section devoted to it.

Radio breakdown involved a reduction to component parts of Radar and W/T equipment. The supply of components used for radio repair work was very scarce and although this equipment was obsolete or unrepairable as a whole, nevertheless it contained numerous items which could be used again. These, after A.I.D. inspection, were either fed back into No. 40 Group units or else sent to operational or other formations, some being returned to civilian contractors, for the benefit of the Services at large.

(d) Special Installation

Radar. Radar installation was separated from the other radio or modification work in view of the proportions which this commitment assumed during the period under review. One unit was devoted entirely to aircraft installations and another had a section which also specialised in this work, whilst the installation and assembly of radar mobile convoys was dealt with at a third.

The two units which carried out aircraft radar installation were also responsible for retrospective installation on site by means of travelling parties. Altogether 3,509 aircraft had installations incorporated during 1944, 1,531 of which were carried out by travelling fitting parties. Over 3,000 of the kits for these installations were manufactured within the Group by the general engineering sections. Approximately 1,350 technical personnel were engaged on aircraft installation at the repair depots and an average of 150 personnel were on similar work at various operational airfields.

The reasons why it was necessary for these installations to be dealt with in No. 43 Group were threefold. First, to fill the gap between the time aircraft were received unmodified from the contractors and the time of embodiment on the production line. This could vary from six to eighteen months and in fact some items were not incorporated during the period of hostilities. Secondly, to enable technical difficulties to be overcome, both in installation and test, before handing over to other formations for fitting as a normal modification. Thirdly, the development of radar became so rapid that it was necessary to introduce new modifications in 'mid-stream' in order to maintain or raise the performance to meet specific operational requirements. Such modifications had invariably to be prototyped and manufactured, entailing considerable development work. Full approval having been obtained for these prototypes, modification proceeded, often on a 'crash' programme basis.

These rapid developments in airborne radar increased the number of possible aircraft installations, and British radar often having its American counterpart still further complicated the situation. Quite often each equipment possessed certain functional advantages, and this led quite naturally to the operational Commands requesting the fitment of both types. Five or six major installations became commonplace, and in aircraft which had not been designed for such developments the problem of where to accommodate this additional equipment, in a manner in which it could be used and serviced, reached the point where the brackets were constructed so that alternative sets could be fitted, the cables for these and the sets themselves being stowed in special containers when not in use. Practically all radar equipment was heavy but delicate and required special rubber mountings to prevent damage both on the ground and in the air. Those responsible for designing the fitments had to bear in mind, in addition to the

normal requirements of strength and lightness, the necessity for using materials which could be readily obtained. The maximum use had to be made of standard A.G.S. parts and the designs had to be such that the parts could be jig-built in quantity, within the machine tool capacity of the general engineering sections concerned.

Installation under restricted working conditions became a major problem. With a flow rate of up to three aircraft per day and man-hours running into four figures, pre-production planning necessarily became very detailed. The number of aircraft of a particular type which could be accommodated on any one production line was limited to the hangar space available, even when the line continued through more than one hangar. It became necessary to break the installation down into smaller stages by trades, in order to prevent two tradesmen requiring to be in the same place at the same time, and this was further eased by the use of night shifts. Small gangs of tradesmen, specialising in each stage, fell back down the production line as it moved forward, leave, sickness, or 'boosting' of particular stages being covered by training personnel in all stages appropriate to their trade. The output of new aircraft from parent firms fluctuated, especially during bad weather, and this, together with a shortage of operational equipment which often required extensive laboratory adjustment to make it serviceable, made it very difficult to prevent subsequent gaps in the flow of completed aircraft.

Connector sets for these installations became very complicated, taking many man-hours to make up and install. Eventually it became possible to incorporate some of these during the construction of the aircraft at the civilian constructors. This, however, proved to be a false economy as faults due to bad workmanship often did not show up until final test and the Service units requested that they be allowed to continue to fit them themselves as before. This type of trouble was frequently experienced when equipment was passed back to civilian contractors for earlier embodiment, despite detailed instructions as to the best methods, difficulties, etc., being provided. When the fitment of operational equipment was completed, the aircraft were ground and air tested and were ready for delivery to operational squadrons.

The demand for aircraft fitted with this new equipment, at one period, was so great that squadron aircrew were flown to the units to pick up their aircraft, which were sometimes used on operations the same night.¹

During 1944, 978 major installations were effected in Bomber Command aircraft as compared with 625 during 1943; much of the work being done in aircraft which became part of the main bomber force. Even greater versatility was required to deal with the varying and very complicated commitments for the Pathfinder force and for the Radio Countermeasures Group. Other installations in Lancaster aircraft included apparatus for jamming enemy radar equipment, particularly in connection with 'D' Day operations.

Installations for Coastal Command played an important part in the U-boat battle, particularly noteworthy being the continuous installation of anti-submarine radar devices. During the year, 168 Wellington and 26 Halifax

¹ No. 41 Group O.R.B.s.

aircraft were dealt with. These installations called for considerable backing from other sections of the Group, since in addition to the manufacture of the usual brackets, clips, platforms and harness inseparable from the installation of radar equipment in aircraft, a large amount of precision engineering was involved in the manufacture to very close tolerances of special components.

Work was also carried out in developing the radar installation aspect of a Flying Boat Station at Uig Bay. A special laboratory was installed and the first few Sunderland flying boats were fitted with anti-submarine radar before the station was handed over to No. 41 Group.

Throughout 1943, No. 43 Group radar installation organisation gave very close support to Fighter Command and during that year 655 night fighter aircraft were fitted with special radar devices. In the following year a further 714 aircraft were installed with both British and American radar equipment, including 415 Mosquitos for defensive and offensive roles.

A considerable portion of the available radar installation capacity was devoted to A.E.A.F. aircraft, special installations being carried out on a 'crash' basis immediately prior to 'D' Day operations, for which 430 Dakota aircraft were fitted with radar navigational aids. This was work of high priority and 200 aircraft were completed in one month alone by installation parties on operational airfields. Similar navigational aids were fitted to Albemarle and Halifax aircraft, also for A.E.A.F.

A commitment carried out on behalf of the Royal Navy was that of converting 15 Anson aircraft into flying radar classrooms for training personnel in centimetre technique. In addition, 10 Firefly aircraft were fitted with offensive radar equipment for employment as night fighters on anti-submarine patrol, this development being carried out in close liaison with Fairey Aviation Co.

Beaufighters, Mosquitos, Wellingtons, Sunderlands, Catalinas, Fortresses, and Halifax aircraft to the number of 635 were fitted with radio altimeters, most of the kits being manufactured within the Group. Various other installations to small numbers of aircraft required for special missions were also completed at short notice on behalf of numerous authorities.

A complete section of one Service repair depot was devoted to the preparation and installation of all mobile and transportable ground radar installations, to meet the requirements of the Director of Radar. At the end of 1944 320 self-contained mobile, and 720 transportable ground radar installations had been prepared and shipped to the three Fighting Services and the Allied nations. This task involved the turnover of 1,323 vehicles and 8,300 tons of radar equipment, including 21 different types of specialist vehicles and a very large variety of technical equipment.

During the early part of the year 2nd T.A.F. and U.S.A.A.F. were supplied with 200 of the most modern radar convoys, complete with waterproofing kits for all vehicles. The radio section at the unit carried out the research and development of these kits, which enabled the vehicles to wade, under power, through 4 ft. 6 in. of sea water. Three complete Air Transportable G.C.I.

Stations, capable of being carried in three Dakota aircraft, were designed, completed and shipped within five weeks to fulfil an urgent operational requirement shortly after 'D' Day.

Towards the end of the year considerable work was carried out on the tropicalisation of technical equipment for incorporation in Air Transportable Radar Installations.

(e) Electrics and Instruments

1944 saw a steady increase in the range and volume of electrical and instrument repair and manufacture. The introduction into the Service of new and improved devices relevant to navigation, gunnery and bombing increased not only the capacity but also the technical requirements.

In addition to these activities at repair depots there was an increased demand for travelling parties for fitting such devices as gyro gunsights and new-type bombsights to a wide variety of aircraft. Installation work took personnel to all parts of the United Kingdom and even as far as Gibraltar and the continent of Europe.

The repair of electrical equipment at units showed a marked increase over the preceding year, reaching a total of 92,000 separate items. In addition, 88,000 sparking plugs were repaired and 2,441,000 broken down, 52,314 oz. of precious metal being reclaimed. Repairs were performed in magnetos and starters, armatures, voltage regulators, suppressors, booster coils, complete ignition harnesses, bomb-distributors, electro-magnetic release and fusing units, switch boxes and innumerable other items. The capacity for re-winding starter and magneto armatures increased by 10 per cent. The high standard of workmanship required for this class of repair and the complicated processes for building up new commutators, baking and impregnating, were developed progressively.

The de-magnetisation of aircraft was taken over from R.A.E., Farnborough, in April 1944 and 68 aircraft were dealt with during the year.

Accumulator reconditioning was typical of numerous unspectacular activities and the number dealt with in this year was 9,238.

Manufacturing capacity became available from time to time for miscellaneous electrical equipment and was extensively used, particularly by Bomber Command, for the modification of such items as bomb-distributors, the fabrication of components for transmitters, assembly of test sets, etc.

The repair of instruments was greatly influenced by the introduction of more complicated equipment such as distant-reading compasses, air mileage units, ground position indicators, gyro gunsights and new-type bombsights. Due to the changing requirements for different types of instruments, the instrument repair sections had to maintain a high degree of flexibility. During 1944 priority was mainly allocated to navigational instruments, bombsights, gyroscopic instruments and automatic pilots. The output of navigational instruments alone was 2,230 whilst the output of 6,315 gyroscopic instruments represented an increase of more than 50 per cent. The number of automatic pilots and components dealt with amounted to 22,727.

Instrument installation in aircraft was intimately connected with operations, such commitments extending outside Great Britain to Iceland and the Middle East. As a typical instance, a special duty Lancaster squadron needed a bomb-sight suitable for use when attacking small targets with 12,000 lb. bombs. The contractor was unable to undertake this installation and the work was carried out by No. 43 Group. It was subsequently successfully used by Bomber Command in their attack which culminated in the sinking of the German battleship *Tirpitz*.

Another good example of installation party activities in assisting the operational Commands in an emergency was that of the retrospective modification of 1,200 Mark VIII automatic pilots. These developed a serious fault which was endangering life, and the parties located the faulty instruments, removed, modified and re-installed them, all within a month.

In addition to completing 4,589 installations, these travelling parties gave assistance and guidance to both air and ground crews on the equipment installed. They were also able to produce valuable data, which in time led to the improvement of the equipment, both in design and function. Much of the work was carried out at very short notice and was always arranged so as to give the minimum loss in operational serviceability.

(f) Armament

The No. 43 Group repair depots overhauled, repaired and modified power and manually operated gun turrets, bomb-carriers, cannons, machine guns and rocket projectors. They also repaired miscellaneous airborne offensive equipment, small arms and accessories of all types.

The repairs to turrets covered the complete range of British and American operational types, as well as training turrets and those fitted to R.A.F. marine craft. Work on American types was complicated by lack of schedules, tools and test equipment which had to be produced under local arrangements. For the major part of 1944 No. 43 Group was the only available repair capacity for American turrets, and when eventually additional civilian capacity was found the Group's schedules were made available for their use. During the year 87 American and 1,480 British turrets were repaired and a further 1,250 turrets of all types were broken down for the recovery of components. Eight thousand of these components were repaired, tested and returned to the Service.

Special work in connection with repair was carried out in the Turret Repair Development Section. This section was responsible for the design and development of certain ground equipment such as six demonstration trolleys used for training R.A.F. personnel in the operation and maintenance of various types of turrets.

The repair of weapons covered a variety of types from the 40 mm. 'S' gun to the Sten Carbine, although the chief commitments were the .303 Browning and 20 mm. Hispano guns and accessories. Repairs included 24,220 machine guns, 19,782 bomb-carriers, 3,647 cannons, 8,204 small arms and 7,950 belt feed mechanisms.

On numerous occasions the Group was called upon to fulfil tasks which for various reasons could not be done elsewhere. An instance of one such special commitment was the Sunderland flying boat front turret conversion. Due to the forward fire power of the Sunderland being inadequate, U-boats tended to stay on the surface when attacked and fight things out. An enterprising Coastal Command squadron improvised a local modification to a Wellington turret and fitted it in place of the one normally used. This proved so successful that the modification was passed to one of the repair depots in No. 43 Group. Here the original mock-up was drastically altered, major structural alterations were made and the single-gun turret was converted into one with two guns. Three hundred of these modified turrets were supplied in 1944, both to the Sunderland production line and for retrospective fitting in Coastal Command aircraft.

Early in 1944 Bomber Command requested a power-operated bomb winch in place of the manual winches in use at that time. A scheme was devised in which a Vane oil motor was fitted to a standard gyral winch, power being supplied by coupling to a turret training stand. By early July, 150 of these modifications had been carried out by the Group in addition to the manufacture of the necessary test equipment for the use of A.I.D.

Another example of the way in which the armament section of the Group was able to make a direct contribution to the operational Command's effort, may be seen in the modification to the belt feed mechanism of the 20 mm. Hispano gun. An inherent fault in the design was giving rise to failures under operational conditions. It was decided to fit an additional sprocket in the feed mechanism, and to effect it rapidly jigs and tools had to be designed for the purpose. The target figure of 200 mechanisms per week was reached and retrospective modification to all belt feed mechanisms completed to a total of 7,500. Close liaison was maintained with B.S.A. who were also engaged on the modification.

(g) Synthetic Trainers

No. 43 Group were responsible for the repair, overhaul and modification of the majority of synthetic trainers used in the Royal Air Force. Their responsibilities extended as far as Iceland, Gibraltar and the continent of Europe. Considerable versatility was required by personnel engaged on this maintenance work as they needed to be familiar with both the principles of the apparatus being simulated and the artificial methods of simulation. The number of different types of trainers varied and included Link, Night Vision, A.M. Bombing, Dome A.A., Edmunds Deflection, Silloth, Celestial Navigation, Turret Gun Sighting, Standard Free Gunnery (with gyro gunsight or trace simulator), Low-Level Bombsight, Fisher Front Gun, Spotlight trainers and Radar trainers types 19, 54, 549 and 70.

The Link trainer was the largest single commitment during 1944, 575 were overhauled, 2,327 serviced and 1,168 installed or transferred. The figures for the previous year were 231, 1,843 and 522 respectively. In addition, 321 of the latest type of Link trainers from America were overhauled and modified to suit British instruments.

An interesting manufacturing commitment was the Turret Manipulation Assessor which originated in Flying Training Command and was prototyped at a

No. 43 Group unit. This proved successful and work commenced on the bulk manufacture of 300 Assessors.

Synthetic trainers and day-to-day operations are not readily associated, but instances of such liaison did occur. One example was the manufacture for 2nd T.A.F. of a mobile Link trainer. The prototype was completed within 15 days and included a sound-proof power supply and air conditioning. This trainer proved to be most satisfactory and a number were subsequently built.

(h) Marine Repair

Responsibility for all repair, overhaul and modification, beyond user-unit capacity, of R.A.F. marine craft operated from the United Kingdom and the continent of Europe rested with No. 43 Group. Five Marine Craft Repair Units were devoted solely to this work. Craft dealt with ranged in size from 10 ft. flare path dinghies to 73 ft. high-speed air/sea rescue launches. In addition to repair to marine craft directly connected with aircraft, a number of seaplane tenders and marine tenders were repaired for Balloon Command who used them to tend floating balloon barrages. All craft being sent overseas were passed through a Marine Craft Repair Unit to ensure that they were fully serviceable prior to shipment and this necessitated working to a strict time-table to meet sailing dates. Repairs were also carried out to motor torpedo boats and motor gun boats at the special request of the Royal Navy. Concurrently with the repair and overhaul of a wide variety of craft the specialist equipment fitted therein had also to be dealt with, thus Marine Craft Repair Units had a variety of activities covering a wide range of trades.

Special repair facilities were organised in connection with the liberation of N.W. Europe. This involved the formation of three additional repair bases on the south coast and attachment of a R.A.F. repair party to a naval depot ship to carry out emergency repairs to marine craft in the landing area. During this period over 100 high-speed launches were stationed between Great Yarmouth and Lands End. Work continued day and night during the three months that this scheme was in operation and a serviceability of over 90 per cent was maintained. A total of 438 repairs was carried out, often in bad weather and with the added difficulty of avoiding flying bombs. Later in the year counter-measures against U-boats in the northern approaches resulted in an increase in the air/sea rescue craft stationed in this area and a special organisation was set up for their emergency repair and overhaul.

Altogether a total of 1,574 craft were repaired during the year and 60 per cent of these were high-speed launches. This represented a monthly output of 137 craft as compared with 83 craft per month in 1943.

The safety of flying boats and R.A.F. marine craft depended upon the efficiency of the mooring equipment. A special section of one unit was allocated to this work which also included target moorings and equipment, chain cable, buoys and anchors. Nearly 1,000 tons of mooring material were used during the year and it also became necessary to repair bombing targets at 3-6 monthly intervals instead of the 12-18 months which had sufficed in the earlier phases of the war.

(i) Other Activities

The activities of No. 43 Group were so wide that it is impracticable to include them all but there were, however, certain other commitments which should be mentioned. Perhaps the most noteworthy were the general engineering sections which formed the hub around which all other activities revolved.

The general engineering sections were equipped to carry out all the usual basic engineering processes. They comprised fully equipped machine shops (the largest of which covered over 35,000 sq. ft.), general fitting, carpenters', blacksmiths' and metal workers' shops. Facilities were available for press work, welding, cutting, heat treatment, sand- and shot-blasting, electro-deposition of nickel, chromium, copper, zinc, cadmium, lead, tin and silver, metal spraying, painting and fabric work. Three of the units had foundries for casting brass, iron and light alloys and were also equipped with plants for the anodic treatment of aluminium alloys.

The primary function of the G.E.S.s was to cover the basic engineering needs of the other sections already described. In addition, a continuous flow of manufacture and modification work was accepted from various sources such as M.A.P., A.M., operational Commands, U.S.A.A.F., Admiralty and civilian contractors. This work included the design, development and construction of prototypes of various tools, jigs, test-rigs, etc., which were often required at very short notice. Much of the work consisted of manufacturing modifications for the operational Commands pending their incorporation by contractors during production, and when the supplies of spares and tools for American aircraft were delayed the sections 'filled the breach.'

Among the equipment manufactured over a period of twelve months, by one unit alone, were included more than 36,000 items for Bomber Command, 1,800 for Coastal Command, 3,000 for Flying Training Command, 1,400 for Transport Command, 1,700 for the U.S.A.A.F., and 16,000 for civilian firms—a grand total of 60,000 items. Additional work was also carried out for other formations.

The repair of barrage balloons was a normal commitment of No. 43 Group, but during the height of the flying bomb attacks on the United Kingdom this work was stepped up. During 1944, 2,011 balloons were repaired as against 1,442 for the previous year. An additional commitment was the modification and test of American balloons for use in this country and the target of 60 balloons per week was achieved and maintained until the necessity no longer existed.

Parachute repair and packing was undertaken at four units within the Group and they became the leading authority for repair of such items of safety equipment. Throughout the year 22,394 parachutes, 3,757 items of associated airborne equipment and 3,746 aircraft dinghies were repaired.

The repair of the clusters of 60-ft. canopies used for dropping airborne equipment was also their responsibility.

There were four motor transport sections in the Group which carried out complete overhaul, major repairs and 10,000-mile inspections of M.T. vehicles. The Repair and Salvage Units of No. 43 Group were the largest users of M.T.

and a special capacity was allocated to cover their expected arisings from the liberation of N.W. Europe. In addition, repairs were carried out to a variety of specialised vehicles over and above urgent conversion work for Balloon Command.

The repair and replenishment of oxygen cylinders amounted to over 134,000 in the year. A development section was set up and work carried out to increase the output of oxygen producing plants. Two prototype mobile producing plants were constructed. These weighed eight tons each and were designed so that they could be dismantled in three hours, for transportation by air, and assembled at their destination in nine hours. Other work on gaseous apparatus included the test, modification and equipping to schedule of 174 new mobile plants as well as major servicing of 30 plants by travelling parties.

Salvage and Repair on Site¹

(a) Salvage

At the beginning of the war it was realised that the repair of crashed aircraft would play a vital part, second only to new production, in keeping the operational units supplied with the aircraft they needed. A salvage organisation was formed for the collection and delivery to repairers of all repairable aircraft or components, and for removal to salvage dumps those which were beyond economical repair. It was also expected to deal with any aircraft which required to be dismantled or removed. Its primary concern, however, was with the movement of damaged aircraft which could not be repaired on site or were total losses. The term salvage as used by No. 43 Group meant very much more than what is implied by the popular use of the word, and the function of the salvage organisation could perhaps better be described as removal and recovery. It included within its scope the whole of Great Britain and Northern Ireland.

For the purpose of salvage the country was divided into sixteen areas each served by one Repair and Salvage Unit. The areas in which a small number of crashes was expected were naturally larger than those with a high anticipated crash incidence, and they varied in size from 14,000 square miles in Scotland to 1,400 square miles in Kent. Nevertheless the work was still uneven and the size of the R. and S.U.s varied from an establishment of 250 to one of 1,500. Flexibility in dealing with a sudden pressure of work in one area was maintained by a centralised control which directed reinforcements of personnel and transport from one area to another.

No provision had been made for this activity in peace-time so that when war broke out the units had to be accommodated wherever space was available. Personnel of these units were billeted out, except in those few cases where it was possible to take over existing R.A.F. stations. Lack of planned accommodation was therefore one of the difficulties which the R. and S.U.s had to overcome.

The detailed procedure for the removal and recovery of crashed aircraft was laid down in Air Publication 1921, and in so far as it affected No. 43 Group, in

¹ O.R.B.s of R. and S.U.s and No. 43 Group. No. 43 Group reports on Salvage Organisation, 1945.

H.Q., No. 43 Group Salvage Staff Instructions, it is sufficient to state that all crashes within the United Kingdom and those of aircraft based in the United Kingdom were reported to No. 43 Group by a standardised crash signal (over 127,000 were reported up to the end of March 1945). The category of a damaged aircraft was decided by a crash inspector and if this category was 'B' or 'E' its removal to its appropriate destination was carried out by the salvage organisation of No. 43 Group.

The figure of 31,668 aircraft so categorised in 1944 is formidable, but to appreciate fully its significance some account must be taken of the difficulties involved. The majority of crashes naturally took place on or near an airfield, but others were on seashores, mountain sides, in bogs, moors and fens, sometimes miles from the nearest road. Others crashed on railways and thoroughfares where speed of removal became the most important factor.

Special techniques were developed for dealing with awkward crashes from difficult terrain and special road transport, fitting and loading tackle, all of which were non-existent at the beginning of the war, were designed for this purpose. Some idea of the transport involved can be gathered from the fact that no fewer than six 60-ft. articulated vehicles were required for the movement of one four-engined bomber.

When the U.S.A.A.F. first joined in operations its repair and maintenance organisation was undeveloped, so that the responsibility for the salvage of all American aircraft fell upon No. 43 Group. Eventually the Americans developed their own organisation for this purpose but the proviso remained that No. 43 Group undertook salvage for them on request, and, in fact, over 1,400 American aircraft were so salvaged during 1944.

The salvage organisation was also responsible during the war for the assessment of damage to private property caused by all the crashes and subsequent salvaging operations, and also for the settlement of the resulting claims. Over 6,000 such claims were made in 1944 and over £270,000 paid out.

With the liberation of N.W. Europe in 1944 some of the operational bases moved to the Continent, bringing fresh responsibilities.

Not only did mobile salvage and repair-on-site parties belonging to No. 43 Group assist the 2nd Tactical Air Force on the Continent, but also an important commitment was accepted for retrieving from the Continent repairable aircraft, equipment and M.T. The Salvage Ferry Service, as it was called, originally operated between Le Tréport and Gosport by L.C.T.s and considerable difficulties had to be overcome in loading and unloading the long, low loaders on to and off these craft. Later the service was organised between Calais and Dover by train ferry and between Antwerp and Tilbury by M.T. ship, and the original route was discontinued. Shipments commenced at the beginning of July 1944, and by March 1945 over 1,000 aircraft had been delivered to repairers in the United Kingdom.

(b) Repair on Site

The repair of Category 'AC' aircraft, that is, aircraft which could be repaired on site but which were beyond the capacity of the holding unit to repair, was

originally carried out by civilian contractors. Early in 1943 the scope of the salvage organisation was extended to include this work, the aim being to provide training for Service personnel, to release civilians for work on new production, and to avoid the expense and accommodation difficulties involved in the use of civilian repair gangs.

The Repair and Salvage Units thus had the two clearly distinct functions of repair on site and salvage, and were organised accordingly in two separate sections under one chief technical officer.

The number of aircraft repaired on site and returned to the Service by No. 43 Group units in 1944 was 3,687. Later, certain types of aircraft were repaired on site only by the R. and S.U.s, others only by civilian contractors, whilst a third class were repaired by either, according to convenience or repair capacity. The proportion of Category 'AC' aircraft dealt with by No. 43 Group steadily increased and by early 1945 represented more than one third of the total. No. 43 Group were responsible for progressing all repair work done by civilian contractors and for engine changing on all aircraft repaired on site.

A feature which differentiated repair on site from the salvage work of the R. and S.U.s was that whereas the latter was organised on a territorial basis, repair on site was divided according to types of aircraft, certain units specialising in certain types. Thus when an aircraft was categorised as repairable on site it became the responsibility of the nearest R. and S.U. specialising in that type of aircraft. This policy was dictated by the necessity for effecting economy in the holding of equipment and spares and by the need to take full advantage of specialised knowledge and experience of a particular type.

In certain cases as, for instance, at aerodromes with emergency landing grounds, where heavy arisings of repair were expected of certain types of aircraft not within the scope of the local R. and S.U., a permanent detachment was made from the appropriate R. and S.U.

The aim throughout was to achieve the greatest possible mobility for repair-on-site parties and for the salvage gangs. During the liberation of N.W. Europe these parties were sent to the Continent in support of 2nd T.A.F. and were provided with mobile workshops and, where necessary, with caravans for living quarters, so that they could function as mobile independent units.¹

Allocation of Equipment for Repair²

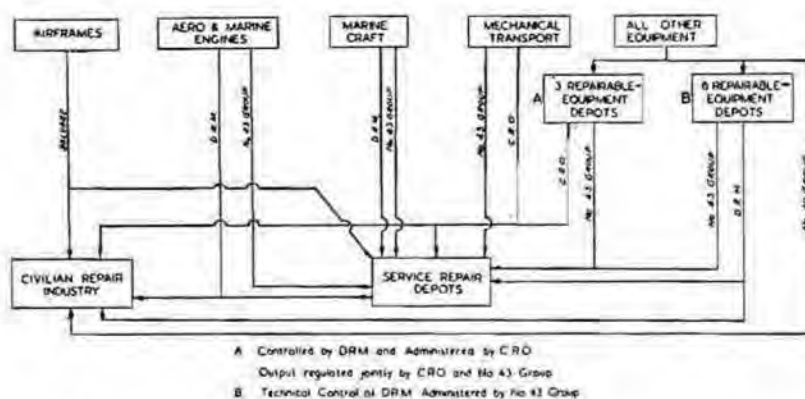
Some reference to this has already been made throughout the text but a summary of the method by which the input of work to civilian factories and Service units was regulated gives a clearer picture of this aspect.

Aircraft.—No. 43 Group salvage organisation was responsible for the collection of aircraft requiring repair. H.Q., No. 43 Group was kept fully informed by the Civilian Repair Organisation as to the capacity of all civilian repairers and made the distribution to civilian or Service units accordingly.

¹ An analytical record of salvage and repair on site for the peak year of 1944 is shown in Appendix 7. For the purpose of comparison, details of the methods of repair and salvage in the German Air Force are contained in Part 2, Chapter VIII of 'A Study of the Supply Organisation of the German Air Force, 1935-1945.' A.H.B./VD/94.

² See Diagram 9.

DIAGRAM 9



Aero and Marine Craft Engines—The Directorate of Repair and Maintenance allotted engines for repair or overhaul to the civilian or Service repairers in accordance with the available capacity. Air Ministry was kept informed of all movements so that engines, when completed, could be returned to Service as and when required.

Mechanical Transport—The Air Ministry made allocations in accordance with the repair capacity notified to them by the Civilian Repair Organisation and by the Service Repair Depots of No. 43 Group. Air Ministry was also informed when repair was complete, so that the vehicles could be returned to service as required.

DIAGRAM 10

YEARLY SUMMARY OF THE OUTPUT OF AIRCRAFT REPAIRED BY THE CIVILIAN REPAIR ORGANISATION

Year	Weeks ending	Output of Repaired Aircraft		
		At Works	On Site	Total
1940	2.3.40 to 25.5.40	Not Available	Not Available	252
	1.6.40 to 28.8.40	Not Available	Not Available	1,658
	31.8.40 to 28.12.40	1,912	1,130	3,042
1941	4.1.41 to 27.12.41	6,540	7,013	13,553
1942	3.1.42 to 26.12.42	7,695	8,979	16,674
1943	2.1.43 to 25.12.43	8,176	9,945	18,121
1944	1.1.44 to 30.12.44	8,213	10,869	19,082
1945	6.1.45 to 3.8.45	3,764	4,520	8,284
Total				80,666

Marine Craft—No. 43 Group arranged either for the movement of the craft in question to one of the Marine Maintenance Units or alternatively sent out a repair-on-site working party.

The distribution of repairable equipment other than that mentioned above was regulated in detail in accordance with A.M.O. A.736/43. From this it will be seen that a small proportion of items was despatched direct to civilian repairers but the bulk of the equipment went to a central collecting depot, of which there were nine, each specialising in a particular range of equipment. They were known as Repairable Equipment Units or Depots, and here the equipment was surveyed, classified and issued to repair units or contractors. Three of these R.E.D.s, Nos. 1, 2 and 3, were controlled by the Directorate General of Repair and Maintenance and were administered by the Civilian Repair Organisation (C.R.O.). Their output was regulated jointly by the C.R.O. and No. 43 Group in order to maintain a correct balance of distribution between repair units of No. 43 Group and civilian repairers. The remaining six were known as Repairable Equipment Units and were administered by No. 43 Group under the technical control of D.G.R.M., their location being at one or other of the Service Repair Depots.

The Output of Aircraft Repaired by the Civilian Repair Organisation, 1940 to 1945¹

The work of repairing crashed aircraft by the Civilian Repair Organisation for the Director General of Repair and Maintenance at the Ministry of Aircraft Production was similar to that performed by No. 43 Group.

¹ Diagram 10 shows the annual output of repaired aircraft.

CHAPTER 6

THE PREPARATION, STORAGE AND ISSUE OF AIRCRAFT BY No. 41 GROUP

The Types of Units, their Disposition and Development from May 1940 to May 1945

On 20 May 1940 the technical control of No. 41 Group passed to the Ministry of Aircraft Production. At that time there were some twenty-one Air Storage Units (A.S.U.s) in operation and these were mainly located in the west and west midlands. They normally consisted of five or more groups of from nine to fourteen hangars, dispersed adjacent to an aerodrome which, in the majority of cases, was shared with some other non-operational flying unit. Additionally each unit had a number of dispersals or air storage parks, situated within towing distance of the airfield, which, together with one or more satellite aerodromes, were used for the open-air storage of aircraft. The opening of No. 44 Maintenance Unit, Edzell, and No. 51 Maintenance Unit, Lichfield, brought the total number of A.S.U.s operating on 1 August 1940 to twenty-three.¹

There was only one satellite aerodrome open on 1 December 1940, namely, Slade Farm, but a decision was made on that date to disperse operational aircraft on satellites where these were available. Instructions were therefore issued to air storage units with affiliated satellites to use them for this purpose, providing that the landing strip was serviceable and a minimum of ten aircraft could be so dispersed. Unserviceable satellites were to be made serviceable as soon as possible, with the aid of civilian contractors, but tracks and buildings were to be kept to a minimum, wind indicators being of the smoke type. Provisional approval was obtained on 22 February 1941 for establishments at both Service and civilian manned satellites, based on an 'opening up' figure of twenty-five aircraft. It was also decided that satellites should be filled to capacity directly the weather improved. It was hoped that by 1 April 1941 twelve of the fifty projected satellites would be open, but this proved to be too optimistic and only Slade Farm, Middle Farm, Berrow, Hornby Hall and Aberffraw were actually functioning on that date. Further satellite aerodromes continued to come into operation as the year progressed, eleven being opened during May, four in June, seven in July and three in August, bringing the total number to thirty.²

The number of air storage units was reduced to twenty-two on 15 July 1942 when No. 37 Maintenance Unit was closed down owing to the handing over of R.A.F. Station, Burtonwood, to the United States Army Air Force. The aircraft held there were withdrawn to other A.S.U.s, the technical equipment being returned to store and the personnel posted elsewhere.

The air storage units were grouped, for administrative purposes, into three

¹ Details of the units in 1940-41 are shown in Appendix 8. No. 41 Group O.R.B., 1940-45.

² Details of these satellites are shown in Appendix 9.

regions, Northern, Midland, and Southern. On 21 April 1941 a Wing Headquarters was formed in each region, the Commanding Officer of each being responsible for the administration of the A.S.U.s in that region. This normally consisted of ensuring that orders from Group H.Q. and other higher authorities were fully implemented. They also formed a reserve headquarters in the event of Group H.Q. being temporarily put out of action by enemy attack. These Wing H.Q.s were disbanded on 21 November 1942 as it proved impracticable to find employment for more than five officers without duplicating the work of Group H.Q. There continued to be a need for the short-range supervision of units within the three regions so each Wing H.Q. was replaced by five regional staff officers who were located at the regional Air Transport Auxiliary ferry pools at Kirkbride, Hawarden and Aston Down. The houses occupied by the Wing H.Q. were, however, retained under caretakers in case a future emergency should necessitate decentralisation.

In September 1944 there were still twenty-three storage units in operation with thirty-two satellite landing grounds and eight purgatory storage units attached to them.¹ These remained comparatively unaltered until the end of the war in Europe when a redistribution became necessary to meet the changed situation.

The Supply of Aircraft by No. 41 Group during the Battle of Britain²

On 1 August 1940 the Group consisted of eleven partly developed Air Storage Units (A.S.U.s) that had been in existence since before the war. Ten of these were civilian manned and each unit had an establishment of 9 officers and about 630 other grade personnel. A further ten units were in process of forming and were sufficiently developed to take some share of the load, although buildings and other works were completed to only a fraction of the final scale. The shortage of personnel at most of the eleven original units had been made up during May and June by attaching some 800 airmen to the civilian manned units, but by August 1940 many of the same personnel had been transferred to R.A.F. formations.

From the beginning of the war until June 1941 the Group fitted all 'service fit' equipment on new aircraft, so that during the Battle of Britain, they had to fit such items as guns, sights, firing mechanisms, most of the wireless equipment, as well as making them operationally serviceable.

The ferry organisation³ for the delivery of aircraft at this time was under No. 41 Group (later controlled by M.A.P.) and consisted of the Air Transport Auxiliary (A.T.A.) formed in April 1940 to ferry aircraft overseas. In the period of the Battle of Britain the A.T.A. were primarily responsible for ferrying from factories to the A.S.U.s and the Service pilots from the A.S.U.s to the user units, but this division was by no means rigidly adhered to. The organisation had a hard but exciting time during the period of the battle. The rapid increase to nearly 4,000 aircraft movements a month in August 1940 was beyond their capacity and the Group had to call on the operational Commands to collect a proportion of their own aircraft. The fighter squadrons

¹ Details of units in September 1944 are shown in Appendix 10.

² No. 41 Group O.R.B. Appendices, January-June 1943.

³ The organisation is shown in Diagram 11.

ORGANISATION OF THE FERRY POOLS, 5 NOVEMBER 1940

HEADQUARTERS, No. 41 GROUP

CENTRAL
FERRY CONTROL
CHELTENHAM

HEADQUARTERS
SERVICE FERRY POOLS
KEMBLE

HEADQUARTERS
B.O.A.C. A.T.A.
WHITE WALTHAM

No. 7 F.P.P.
Kemble

No. 8 F.P.P.
Hullavington

No. 9 F.P.P.
Hawarden

No. 1 F.P.P.
White Waltham

No. 2 F.P.P.
Whitchurch

No. 3 F.P.P.
Hawarden

No. 4 F.P.P.
Prestwick

No. 5 F.P.P.
Hatfield

No. 6 F.P.P.
Ratcliffe

Hamble
Sub. Pool

Ringway
Sub. Pool

DIAGRAM 11

frequently moved at short notice from the station quoted the day before and extra trips were incurred in finding them. This added to the difficulties of transporting ferry pilots back to their base and of Group H.Q. in keeping track of them to allot their next task. The aircraft were armed for delivery during this period but ferry pilots were instructed to evade combat unless this was unavoidable, and in consequence there is no record of this occurring, as was the case with deliveries to France before the evacuation.

The difficulties of the Group were greatly reduced by being able to start the battle with a good reserve of fighter aircraft, a substantial proportion of which were ready and complete to operational standards. The supply of equipment, although still not in step with the supply of aircraft, had improved considerably and the controlling organisation at Group H.Q. had behind them the experience of high-speed supply to the Continent during May and June 1940.

It had been the rule to prepare aircraft to operational standards according to the rate of input, but with the start of the battle, with its high wastage rate, preparation at the rate of input was not enough. The lag had to be overtaken and aircraft prepared much faster than they were being received. The units therefore had to work seven days a week and for as many hours daily as they could. A good deal of time was lost in the early stages due to air raid warnings, and there were twenty-two actual attacks on No. 41 Group units, resulting in a small number of casualties, damage to hangars and to some 54 aircraft. There was a shortage of armourers and of ground equipment and A.S.U.s had to obtain a good deal of assistance from neighbouring flying training schools. Exceptional efforts were necessary in order to obtain the aircraft equipment quickly.

The urgent need for the aircraft, enhanced on occasions by Fighter Command pilots standing by waiting to fly them away, formed an incentive which had a remarkable effect on the spirit of the personnel, Service and civilian alike, and spurred them on to overcome difficulties, work long hours and turn out aircraft faster than they had ever done before.

In the first week of August 1940 the Group had a reserve of 5,300 aircraft of all types and the average monthly turnover for the previous three months had been 1,640 received and prepared, 1,420 issued. During August/September the turnover rose to 1,790 received and 1,970 issued, the increase consisting mainly of Hurricanes and Spitfires, the two fighters most used during the battle. On 8 August the total reserve of these two types was 572, of which 290 were complete to operational standard and ready for issue.

The demands and issues of single-seater fighters during the next four weeks was at the average rate of 212 a week, whilst receipts averaged 143 a week. The reserve fell to the lowest point on 13 September with 173 Hurricanes and 81 Spitfires, of which 93 were complete and ready. In the following four weeks demands and issues averaged 147 a week whilst receipts averaged 150. The increase in deliveries from factories, and especially from the repair organisation, was very noticeable after the first week or two of the battle. The reserve of aircraft of these two types rose slowly but steadily from 13 September, but it was not until the end of November that the commencing figures were reached.

With a reserve of aircraft, which at no stage of the battle was ever exhausted, there was no difficulty or delay in meeting demands as they were received. These demands mostly came in between dusk and midnight and were dealt with at the same time as the night staff were completing the 'daily aircraft states' from the telephonic returns from air storage units. The allotments to user units were made at once and signalled to all concerned.

At times during the first four weeks of the battle the demand rose to between 50 and 70 fighter aircraft a day. This was three times the rate of input of new or repaired aircraft and it was calculated that at that rate of consumption the reserves of aircraft would have been exhausted in 10 days. Fortunately this rate of demand was never sustained for more than three consecutive days and therefore the reserve was never exhausted.

The No. 41 Group Headquarters Organisation for Planning the Preparation of Aircraft¹

Increased production from the aircraft factories and increased demands from the Service necessitated a system of planning in order to make the best use of available storage and preparation capacity, and also to ensure that all requirements were satisfied as speedily as possible. A memorandum on the organisation of staff duties to implement the planning was issued on 17 October 1942 and planning on these lines was introduced in the following November. The system underwent several detailed modifications during the next few months before taking shape in its final workable form in February 1943, as follows.

Extent of Planning

The planning fell into two distinct phases: first phase planning, which comprised one comprehensive plan drawn up to cover the preparation of all types of aircraft over a definite period of time, and second phase planning, which consisted of a series of additions to and deletions from the first phase plan in order to meet changing requirements within the period covered. Both phases of planning detailed the quantity of aircraft which would be allocated to units from production and repair, together with the quantity of aircraft that were to be prepared by units to meet requirements.

Period of Operation

This was from the eighth of each month until the seventh of the succeeding month and this period was chosen for two reasons:—

- (a) In order to obtain the full benefit of the Ministry of Aircraft Production (M.A.P.) short-term forecast of aircraft available during the calendar month, which was not received until the fourth of the month.
- (b) To allow for the time lag between the completion of an aircraft at the factory and its arrival in No. 41 Group. The period selected ensured that the input of aircraft to No. 41 Group approximated to the output from the factory over the calendar month.

Planning Input First Phase

A conference was held on the fifth of each month under the Deputy Senior

¹ No. 41 Group O.R.B. Appendices, 1943.

Maintenance Staff Officer and attended by the regional engineer and equipment staff officers, together with representatives from the allotments, engineer and equipment branches of H.Q., No. 41 Group. The M.A.P. forecast was presented, each type of aircraft was considered in turn and a distribution arranged among the holding units for that type. The factors governing distribution were, broadly, the capacity available at any unit to store, disperse and prepare the aircraft and the necessity to maintain an even distribution among all units in order to facilitate provisioning and preserve the continuity of preparation.

The practical difficulties connected with the calculation of the best distribution were considerable as all allocations were dependent on so many different factors, with the overriding consideration that the time which could be allowed for forming the first phase plan was limited, as it had to be finished before the second phase plan could be started, and yet both plans had to be forwarded to units before the seventh of the month. A wall chart was therefore used which showed present stocks and number of aircraft prepared during the previous month, by types, at each unit. The proposed allocations were added to this chart as the conference proceeded so that the allocation of a specific type to a particular unit could always be made in relation to the distribution of all types within the group as a whole. Detailed information was supplied by the regional officers.

Planning Preparation First Phase

The preparation plan was compiled as soon as the input plan was ready, and was based on allotment staff estimated requirements for that period. This information was supplied on a special form which was subsequently returned to the allotments branch with the last column completed, thus presenting a picture of the extent to which requirements would be met. The capacity of units to prepare aircraft was assessed from past records and expressed in index points as a theoretical average.

Four-engined aircraft	..	..	..	..	3 points
Twin-engined aircraft	..	..	..	..	2 „
Single-engined aircraft	..	..	..	..	1 point
Trainer or commercial aircraft	..	..	..	..	$\frac{1}{2}$ „

All tasks were allocated and the index points continuously recorded as a cumulative total against each unit, so as to ensure that the work was within the unit's capacity and was being evenly divided. The details of the plan within these limits were worked out with the production teams concerned with each type, depending upon the amount of work to be done and the number and state of the aircraft available.

The tasks allocated under this system were notified to each unit as a 'primary target' with maximum priority. Where this did not cover estimated requirements, the less important of these tasks were notified as a 'secondary target' and the preparation of these aircraft was not commenced until the capacity became available without interfering with the completion of the primary target.

During the month it was seldom necessary to make any alteration to the first phase input plan, except in so far as aircraft had to be diverted to meet the special requirements of the second phase preparation plan.

Planning Preparation Second Phase

New requirements and cancellation of existing commitments were constantly occurring and it was necessary for these to be added to or deleted from the targets as they arose. The cancellations were straightforward and when they reduced primary targets aircraft were upgraded from the secondary targets to take their place. New requirements, however, were dealt with by one of the following methods :—

- (a) A direct addition to a primary target where this could be done without overloading.
- (b) As an addition to the primary target and, in order to provide the necessary capacity, a corresponding reduction from primary to secondary targets of some other types required on lower priority.
- (c) As an addition to the primary target with an instruction to the unit concerned to work overtime.
- (d) As an addition to the secondary target.

The selection of the most suitable alternative was dependent upon the capacity available and the urgency of the requirement.

Planning Preparation

Standing Instructions. In order to provide for unforeseen requirements, and to ensure that the efforts of units were only directed towards the preparation of aircraft that were required, a standing instruction was issued detailing the quantities of each type to be held in Class I primary and Class I secondary. The preparation of aircraft against this standing instruction was only undertaken on priority after both primary and secondary targets had been completed.

Summary of Method of Control

The control by H.Q., No. 41 Group of the flow of aircraft passing through its units may be summarised as follows :—

- (a) First and second phase input plan.
- (b) First and second phase preparation plan.
- (c) Units planned their work to comply with :—
 - (i) The primary target.
 - (ii) The secondary target.
 - (iii) The standing preparation instructions.

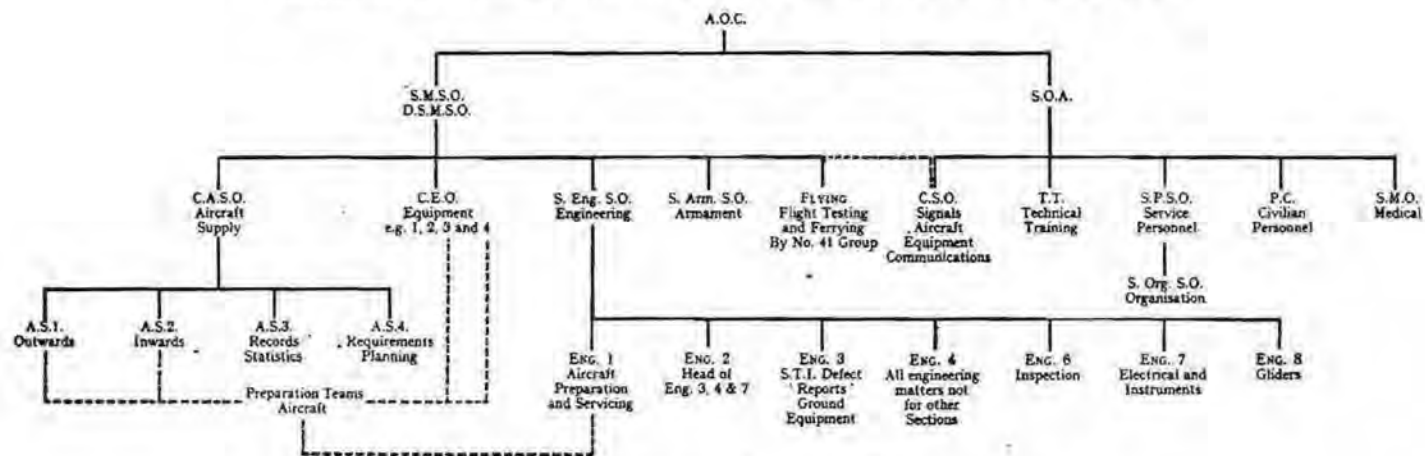
Organisation of Staff Duties

There were two branches of the policy staff controlled on behalf of the A.O.C. by the Senior Maintenance Staff Officer (S.M.S.O.) and the Staff Officer-in-Charge of Administration (S.O.A.).¹

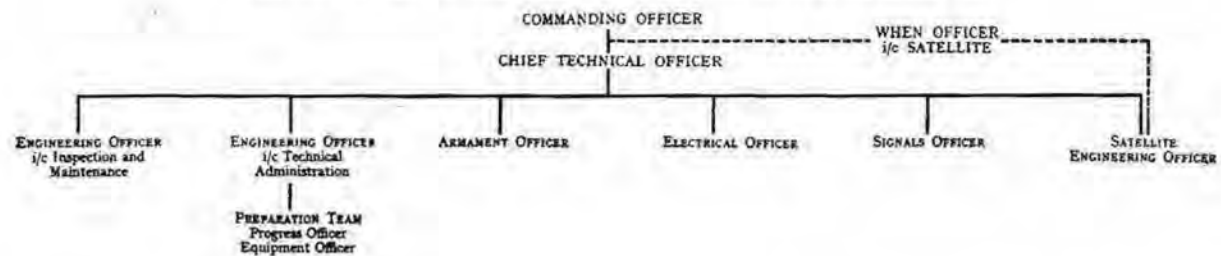
The S.M.S.O. laid down the policy for the preparation of aircraft, issuing instructions to the heads of the Services accordingly, who were responsible through their organisations for its execution. Matters affecting those services which were the concern of the S.O.A. were passed to him for action.

¹ See Diagram 12.

HEADQUARTERS, No. 41 GROUP—CHANNELS OF FUNCTIONAL CONTROL AND RESPONSIBILITY, 27 MAY 1944



TECHNICAL CONTROL AND ORGANISATION AT No. 41 GROUP UNITS, 22 SEPTEMBER 1944



The supply of aircraft was the operational function of the Group and the allotment staff therefore took the place normally occupied by the air staff (operations) in an operational group. Part of this staff was responsible for the statistical side of planning and another for progress.

Planning Section

In order to assist the development of advance planning it was decided on 25 May 1943 to form a planning section within the allotments branch. The aim of the new section was to collate and analyse available information and records for reference by all branches of No. 41 Group, and thereby form a basis upon which could be planned the various functions of the Group.

Preparation Teams

There was an internal reorganisation within H.Q., No. 41 Group on 1 May 1944, when the existing 'production teams' were superseded by what were termed 'preparation teams.' Five of these teams dealt with power-driven aircraft, each team specialising in certain types and makes, a sixth team dealt with all gliders. Their function was to deal with the aircraft for which they were responsible from the time that they left the contractors' works or other sources of supply until, after preparation, they were ferried to their operating units.

The Reorganisation of H.Q. Responsibilities¹

On 27 May 1944 the title of the branch concerned with the supply aspect of aircraft was changed from 'Allotment' to 'Aircraft Supply,' the head of which was to be known as the Chief Aircraft Supply Officer (C.A.S.O.).

At the same time Org. 4, the department responsible for flying matters, was transferred to the maintenance staff, where it functioned as a separate branch under the senior maintenance staff officer. Its responsibilities were :—

- (i) Flight test procedure.
- (ii) Aircraft handling notes—flying limitations, contractors' flight test schedules and notes.
- (iii) Ferrying of gliders and all ferrying to and from satellite landing grounds (S.L.G.s).
- (iv) Suitability of maintenance units and S.L.G.s for operation of types of aircraft.
- (v) Organisation and flying discipline of aircrews. Flying assessments.
- (vi) Flying personnel facilities and maintenance units from an air aspect.
- (vii) Supply of test pilots to meet the emergency requirement of industry and to test Category 'AC' aircraft in transit when required.
- (viii) Advice to other branches on flying accidents and log book endorsements.
- (ix) Training. (Flying and ground personnel for aircraft taxiing employment.)
- (x) Distribution of flying personnel.

All other aspects of flying and airfield control remained the responsibility of the senior organisation staff officer.

¹ No. 41 Group O.R.B. Appendices. See Diagram 13.

Amendments to the Monthly Target Scheme¹

On 30 September 1943 it was decided in the light of experience to introduce certain amendments to the monthly target scheme, in order to give units more advanced information on future targets and thereby avoid the monthly break in production which was then occurring, and to allow the system to become more flexible in order to facilitate the rapid preparation at short notice of high priority requirements. The procedure was therefore adopted of issuing the targets as usual on the seventh of each month but making the preparation period run from the fifteenth of one month to the fourteenth of the next month, thus enabling units to plan for at least one week ahead. Owing to the impossibility of anticipating production for the last week of the new period, it was also decided to make future targets cumulative, in that arrears from one period were to be carried forward into the next.

The existing system of denoting priorities by primary and secondary targets was cancelled and all requirements were henceforward sent out as one target. Unless otherwise stated the quantities of each type on the target were prepared on an even-flow basis over the whole period.

The monthly production reports from units were continued, but as the introduction of specialisation had robbed them of their comparative value publication of these figures was therefore discontinued.

The Technical Organisation of Units²

The technical control at units was carried out by a chief technical officer through the medium of the appropriate specialist officers.

The Inspection and Servicing of Aircraft in Storage³

New or repaired aircraft were inspected on arrival by the Unit Inspection Department (U.I.D.)⁴ and, except for those aircraft required for the monthly target, were then prepared for storage. Preference for storage under cover was given, where available, to aircraft of wooden, composite or fabric covered construction.

After the aircraft had been prepared for storage, routine maintenance inspections were carried out at intervals determined by the conditions under which they were stored. Where this was at satellites, dispersal fields, or in super-robins, robins and blister hangars, the period of storage was divided into inspections for each trade at daily, weekly and four-weekly intervals. On aircraft stored in proper hangars this monthly inspection was carried out only at three-monthly intervals, except for the inspection of guns and turrets which was normally carried out monthly. A four-weekly inspection was always carried out on aircraft which were moved into hangars from dispersal, after which the hangar cycle of inspections was adopted.

¹ No. 41 Group O.R.B. Appendices, 1943.

² See Diagram 13.

³ No. 41 Group O.R.B. Appendices. T.S.I./D. 16 January 1944.

⁴ Each unit had what was designated as a Unit Inspection Department (U.I.D.) whose function was to carry out independent inspections of aircraft with the object of maintaining a recognised standard of preparation and issue. The U.I.D. not only ensured that aircraft and equipment were issued to user units in the best possible condition but also formed a medium through which faults on production aircraft could be more readily detected and reported, thereby easing the work of the unit in the future.

All stored aircraft, with the exception of a list of certain types (mainly the metal aircraft), were passed at intervals to the U.I.D. who carried out the inspections applicable to a new arrival. Rectification work and air test followed after which the aircraft were again prepared for storage as before. For aircraft stored in the open the interval was a minimum of three and a maximum of six months, but for aircraft stored in hangars this was extended to six and twelve months respectively.

Picketing in the Open

The general method of picketing aircraft in the open was of a temporary nature using concrete blocks and screw pickets, the number and disposition of which were in accordance with instructions laid down for each type of aircraft. Where permanent concrete anchorages were available they were used, but no provision was made to extend them as it was considered that this type of picketing did not give the necessary flexibility required for a Group handling so many different types of aircraft. All other normal picketing precautions, as applicable, were also employed, such as chocks, locking controls, covers, etc, etc.

Functional Tests of Aircraft Hydraulic Systems

In an amendment to No. 41 Group Technical Staff Instructions on 30 May 1944 it was laid down that ground functional tests of hydraulic systems were to be carried out on all aircraft before flight if these systems had not been air or ground tested for a period exceeding two months. They were also to be carried out if any work had been done which might affect the functioning of these services.

Where this could not be done in full due to lack of equipment on satellites or for any other reason, it was brought to the notice of the collecting pilot, who signed the Form 1860 accordingly.¹ It was left to his discretion as to whether he took the aircraft or not. In all instances where the undercarriage system was unserviceable or there was no emergency system the pilot flew the aircraft with the undercarriage locked in the down position.

Aero Engines—Protection from Corrosion by Inhibiting²

Experience had shown that little more than seven days was sufficient to allow serious internal corrosion to develop in an engine which had not been run during that period, and on which anti-corrosion treatment had not been carried out. The only alternative to anti-corrosion treatment would have been repeated engine running, and as the limit for oil priming was five days this would have meant an engine run at least every five days. This repeated running would have meant an uneconomical use of man-power and waste of fuel, together with the heightened risk of engine starting failures.³

¹ A Form 1860 was made out for every aircraft in stock and comprised a complete history of that aircraft whilst in No. 41 Group. It was divided into sections covering leading particulars, engines, inspection on receipt by U.I.D. and Equipment Section, modification record, S.T.I. record, routine maintenance, record of work carried out, preparation for issue, functional tests, certificate of fitness for issue, daily inspection and final certificate. This form was retained by the A.S.U. on allotment.

² No. 41 Group O.R.B. Appendices. T.S.I./C2.

³ E.g. 'Hydraulic lock.' The mechanical failure of the engine normally caused by excessive petrol or oil draining into the lower combustion chambers and creating a hydraulic lock. Radial engines were particularly susceptible to this fault.

The policy was therefore to carry out anti-corrosive treatment on all engines which were likely to stand idle for a period exceeding seven days. The maximum periods of protection given by inhibiting, beyond which re-inhibiting or recurrent engine running was necessary, were eight weeks for short-term inhibiting and six to twelve months for normal inhibiting, according to whether the storage was outdoors or in permanent hangars. The period for American engines was six months under both conditions.

The Preparation of Aircraft at Units for Issue to the Service

The preparation of aircraft for issue to the Service consisted of restoring the aircraft to a fully serviceable condition, roughly the reverse procedure to that necessary when preparing them for storage, and at the same time making them operationally serviceable for the task which they were to perform. Whilst every attempt was made to standardise equipment throughout the various Commands, nevertheless operational requirements necessitated a certain amount of variation, which from the units' production standpoint was very nearly as bad as increasing the number of aircraft types handled per unit. A further commitment was that of incorporating such modifications as were essential to the safety of the aircraft and the rectification of routine faults. The number of man-hours necessary to prepare an individual aircraft could vary considerably within a permutation of any of the above factors.

In the early stages of the war it was often necessary to issue aircraft deficient in certain items of equipment. A shortage of modification kits was another source of delay, although where these were not essential they could be passed to No. 43 Group working parties for retrospective fitting.

Most of the preparation work at units, both for storage and issue, was centralised in order to achieve the maximum possible efficiency. Whilst it was not possible, for the reasons already given, to take full advantage of modern production-line methods, some degree of specialisation was possible, and where employed yielded rich dividends in the form of increased output.

The production plan at units for the preparation of aircraft was prepared at unit level, the controlling factor being the unit monthly target issued by H.Q., No. 41 Group. This plan was essentially flexible in order to cover variations in requirements and to suit changing local conditions at individual units. The plan for the following month was prepared during the week previous to the date on which it was due to come into effect, and by this means it was possible to preserve a certain degree of continuity from one month to the next. This was not quite so necessary when the volume of work exceeded the units' capacity, and the practice was introduced of carrying forward the arrears of work from one month to the next.

All stages of the work during preparation were inspected by the personnel of the Unit Inspection Department, who were quite separate from production, and when completed the whole aircraft was inspected by them, both before and after air test. This air test was carried out by the units' own test pilots, and if satisfactory the history sheet for that aircraft was then completed (Form 1860), loose equipment stowed, and the aircraft signalled as awaiting disposal instructions or, where these were already known, as awaiting collection.

Various complaints were received from time to time from the user formations that the aircraft they were receiving from No. 41 Group were not functionally serviceable. In an attempt to rectify this complaint units introduced a system of functional tests to be carried out on the ground during preparation and also during air test. However, these tests were not entirely successful in eliminating the trouble and in fairness to No. 41 Group allowance must be made for the fact that the aircraft being handled were mass produced in large numbers and, despite the relatively high standard for this type of work, needed a longer 'running-in' period before delivery to users than it was possible to give them. This deficiency was further accentuated by the necessity for replacement aircraft to be used operationally almost as soon as they were received.

No. 41 Group Modification Policy¹

The modification policy of the Group confined the basic responsibility for the incorporation of modifications to Class I and Class II only. No aircraft were issued for flying purposes with any Class I modifications outstanding, but in the case of Class II modifications this was sometimes permitted when the necessary parts were not available. Modifications of a lower class were not incorporated except under specific instructions.

Command modifications were not normally embodied by No. 41 Group units except under special arrangements with the Group H.Q., and there was no obligation to remove such modifications, when fitted, before reissue.

The Distribution of Aircraft at No. 41 Group Units²

Before June 1942 the rule had been to distribute the quantities of each type of aircraft over a minimum of five units. Representation to the Ministry of Aircraft Production on that date secured a reduction to a minimum of three units per type but, because of the limits then in operation on the numbers of one type in one hangar or dispersal area, and consequently at a unit, it had not been possible to take full advantage of the concession. This particularly applied to a number of types with a high storage or turnover rate. Through this, and the introduction of new types without withdrawing the old, the average number of types per unit rose in April 1943 to six operational, three non-operational and one glider. Most of these types were of many Marks and varieties.

The number of modern types of aircraft per unit had become too high for a reasonable standard of efficiency and the A.O.C., No. 41 Group, put forward to the Ministry of Aircraft Production the proposal that :—

'The distribution of each type of aircraft should be through the smallest number of units practicable and acceptable, the minimum number of all principal types being two per unit ; the exception to this being where the numbers received would be insufficient to maintain a steady flow if passed through more than one unit.'

This it was stated would result in the majority of units handling an average of three types of aircraft, one large and one medium or small operational type, and one non-operational type or glider. It would be necessary for one unit taking

¹ No. 41 Group O.R.B. Appendices. T.S.I./A8.

² No. 41 Group O.R.B. Appendices. S.3005/1.

naval types and three units who dealt with American aircraft to handle more than this average, the units erecting gliders would remain unaltered.

The Ministry of Aircraft Production approved these proposals and on 3 June 1943 Air Ministry confirmed this approval in detail.

With the approach of the end of the war in Europe and the changing circumstances which accompanied it, it became necessary to modify further this policy by concentrating the preparation of aircraft at certain units only, leaving the remainder to deal with surplus aircraft and long-term storage.

Aircraft Received Complete from Contractors and Held Ready for Issue

By 16 September 1943 certain types of aircraft were being received from contractors to an equipment and modification standard which enabled them to be issued direct to users, where such vacancies existed in their establishments. It was therefore decided to allot all such aircraft to units for temporary storage only so that they would be ready for reissue at once should requirements suddenly materialise. Previously these aircraft had been prepared according to the full Directorate of Repair and Maintenance instructions for preparation, which in addition to placing them unserviceable also entailed duplication of much of the work already carried out at contractors. On arrival they were therefore brought on charge in the normal way, given a between-flight inspection and any defects found or reported on the pilots' 'snag' report rectified. Any missing equipment was replaced and the aircraft were then picketed out and given a 'daily' inspection at least once every seven days. If they had not flown for 72 hours before they were required for issue they were given an air test, and if this was satisfactory were reported as ready for issue.

The aircraft were normally held in this state for a maximum of 14 days, after which they were downgraded and prepared in the normal manner. Where ample stocks were held it was the policy to replace wastage from aircraft held temporarily and to satisfy re-arming or increases in establishment from aircraft which had been prepared in the normal way.

Non-effective Aircraft

On the same date (September 1943) it was decided to introduce a class of aircraft to be known as Non-effective Aircraft (N.E.A.) which comprised :—

- (a) All those aircraft which were surplus to Command and formation requirements and which would normally be passed direct to repair units or contractors but for which no immediate repair capacity existed.
- (b) Those aircraft from No. 41 Group stock for which authority was held that they were either to be broken down or returned to contractor for repair, overhaul or major inspection.

Such aircraft were stored at No. 41 Group units pending the availability of suitable capacity.

The Clearing of Aircraft from Contractors to Warehouse Storage (Purgatory)¹

It was agreed at a meeting held at H.Q., No. 41 Group on 23 September 1940 that the responsibility for aircraft in storage lay with the Ministry of Aircraft Production and not the contractor. M.A.P. would indicate to the R.A.F. Purgatory Officer suitable storage premises which he then surveyed, and those suitable were requisitioned by the Lands Branch, any necessary alterations being the responsibility of the Purgatory Officer.

As aircraft became available for storage the A.I.D. at the contractors applied to Allotments who then allotted the aircraft to the appropriate A.S.U., a special endorsement being made if they were to be stored in warehouses. In the latter case the contractor prepared the aircraft for purgatory storage, and this entailed removing the mainplanes, storing the covers within the aircraft together with the sparking plugs in a special container, and where aircraft were to be stored 'tails up' removing the compass and propeller, the former being suitably crated. They were preserved so that they required no attention for the first month of storage but the aircraft had to be sufficiently accessible to permit maintenance after this period had expired.

The aircraft inventories and log books were passed to the A.S.U. concerned, who retained them until such time as the aircraft were required. If and when the aircraft were returned to the original or any other contractor for re-erection, an allotment was issued by the M.U. holding the aircraft on charge to the contractor undertaking re-erection and a copy of this was sent to the Special Accounts Section.

The Procedure for the Supply of Aircraft and the Organisation of the Ferry Pools

Allotments ex Contractors

- (a) *To Maintenance Units.* The majority of aircraft ex contractors were allotted, in accordance with a Group stock holding policy, to M.U.s within the Group, where, if necessary, they were prepared to operational standard for subsequent issue.
- (b) *To Squadrons.* Certain aircraft, which had been prepared to operational standards at contractors' works, were allotted direct to squadrons instead of via M.U.s.

Aircraft ex contractors were allotted, in advance of their actual readiness, on receipt of applications from the chief A.I.D. Inspector at the works. Local Ferry Pilot Pools of the Air Transport Auxiliary received copies of the allotments and automatically arranged delivery of completed aircraft to either M.U.s or squadrons.

At 18.00 hours daily each M.U. rendered a return showing the state of readiness of its operational aircraft to the Allotments Branch of H.Q., No. 41 Group, where the information was consolidated and recorded.

¹ No. 41 Group O.R.B. Appendices, 1939-1942.

Demands from the Commands

Every day, and/or as necessary, each Command notified its requirements of replacement aircraft to the Allotments Branch. If this was by telephone it was confirmed by signal or postagram which stated such essential details as type and Mark of aircraft, quantity, unit for which aircraft was required and its location for delivery, and particulars of any unusual equipment or modification requirements. In the absence of any notification to the contrary, demands were satisfied in the order in which they were received, multiple demands being tested in order of priority, and aircraft for squadrons and O.T.U.s were assumed to be required operationally equipped.

Aircraft to meet requirements, except when allotted direct from contractors, were selected by the Allotments Branch from those notified as suitable and ready for issue and allotted to squadrons by immediate signal. This signal was addressed to the maintenance unit holding the aircraft and repeated to Command, Group and squadron. It contained all necessary allotment particulars and indicated intended ferrying arrangements.

The Ferrying to Squadrons

The following methods were employed to ferry aircraft to squadrons.

- (a) *Normal.* Delivery by an A.T.A. ferry pilot.
- (b) *Squadron to arrange collection* (e.g. when insufficient ferry pilots were available), and collection under operational Command/Group arrangements on behalf of the squadron.

When the normal method was employed ferrying instructions were issued through Central Ferry Control, A.T.A., Andover, which worked in close liaison with the Allotments Branch.

The Emergency Advanced Headquarters

An advanced Headquarters was prepared at Cheltenham to accommodate both the Allotments Branch and Central Ferry Control in the event of H.Q., No. 41 Group being put out of action. Arrangements were made to send personnel from Andover to Cheltenham and even from H.Q. of Wings should the necessity arise.

In the event of both Andover and Cheltenham being out of action arrangements were made to decentralise the control to the three Wing Headquarters.

Communications

Both No. 41 Group and A.T.A. were included in Maintenance Command Emergency W/T Ground Station Organisation, which was intended to be used in the case of a major breakdown in the landline system. Should the W/T also fail use was to be made of neighbouring unit facilities, Despatch Rider Letter Service, etc.

The Operation of Ferry Pilots from Maintenance Units¹

It was decided on 20 January 1941 to place ferry pilots at certain maintenance units in order to gain experience in this method of ferrying to operational units.

¹ The organisation of both Service and Air Transport Auxiliary ferry pools on 5 November 1940 is shown in Diagram 11.

The maintenance units which were chosen, their monthly output of operational types of aircraft and the allotment of ferry and taxi pilots were as shown below.¹

M.U. No.	Place	Operational Aircraft			Ferry Pilots			Taxi Pilots
		S.E. ²	T.E. ³	Total	S.E.	T.E.	Total	
6	Brize Norton ..	36	20	56	3	2	5	1
8	Little Rissington	26	54	80	2	5	7	1
15	Wroughton ..	30	10	40	3	1	4	1
19	St. Athan ..	40	20	60	3	2	5	1
20	Aston Down ..	40	40	80	3	4	7	1
38	Llandow ..	6	16	22	1	1	2	1
Totals ..		178	160	338	15	15	30	6

It was hoped that by this method unit commanders would take a more active interest in the ferrying side of the work and that the delays and consequent friction between ferry pilots and units would disappear. As it was the intention eventually to fuse the duties of test and ferry pilots at units they were expected to help each other out, and whilst it was permissible to ferry all types of aircraft the highest priority was reserved for operational types.

This scheme proved a success and in March 1941 it was extended to include other maintenance units. At the same time it was decided to form ferry 'balance' pools to cover emergencies, large batches of aircraft for packing, and the ferrying of special new aircraft, etc. These ferry pools were located at Kemble, Hullavington and Dumfries, the first of these concentrating on the new large types of aircraft. In order to obtain an economy of ferrying and flexibility a scheme was evolved whereby air storage units were grouped together for liaison.

The Standardisation of Equipment Procedure at Air Storage Units⁴

In November 1942 H.Q., No. 41 Group reviewed the establishments of air storage units with a view to conserving man-power and creating an ideal establishment based on the least possible personnel which could be employed, having regard to the highest standard of efficiency in relation to known estimates of production. Every aspect of equipment procedure and administration was considered and certain personnel were allocated to each and every job. Visits to units soon revealed that some employed more men on a particular job than did others and that unless some standard method was laid down an economic but fair basis could not be achieved. A standardised procedure for units was therefore worked out.⁵

¹ No. 41 Group O.R.B. Appendices. 41G/36/Org.

² Single-engined.

³ Twin-engined.

⁴ No. 41 Group O.R.B. Appendices, April 1943.

⁵ See Diagram 14.

REVISED EQUIPMENT ESTABLISHMENT FOR A.S.U.s

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EQUIVALENT RANKS

Royal Air Force	Civilian
W.O. Equipment Assistant	Principal Foreman, Equipment
Sgt. Equipment Assistant	Foreman, Equipment
Cpl. Equipment Assistant	Leading Storeman
A.C. Equipment Assistant	Storekeeper
Maintenance Assistant	Labourer Semi-skilled
Aircraft hand	Labourer

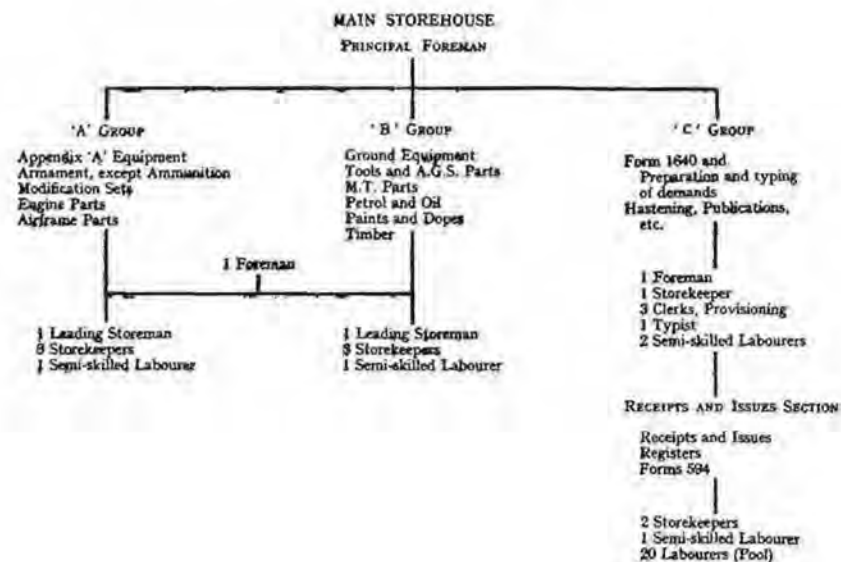


DIAGRAM 14

This was the ideal establishment, but it was found after it had been compiled that the saving in the numbers of personnel was not sufficient to satisfy the requirements of the National Man-Power Board. In view of this and bearing in mind that many units had been working much below their existing establishments, it was agreed to make a further 10 per cent reduction on the ideal establishment. No reduction, however, was made in grades or trades which were less than ten in number. Nevertheless, despite this cut the new establishments more nearly approximated to actual strengths than they did before.

The Organisation for Glider Erection, Testing, Ferrying and Storage by No. 41 Group¹

It was decided in April 1943 that No. 41 Group would commence erection of Horsa gliders and the two units selected for this task were No. 6 Maintenance Unit, Brize Norton, and No. 9 M.U., Cosford. After erection the gliders were to be air tested and ferried either to the glider storage maintenance units or direct to the user units as required.

The following maintenance units were selected for the storage of Horsa gliders:—

No. 5 M.U., Kemble.	No. 27 M.U., Shawbury.
No. 8 M.U., Little Rissington.	No. 29 M.U., High Ercall.
No. 10 M.U., Hullavington.	No. 38 M.U., Llandow.
No. 15 M.U., Wroughton.	No. 39 M.U., Colerne.
No. 19 M.U., St. Athan.	No. 48 M.U., Hawarden.
No. 20 M.U., Aston Down.	No. 51 M.U., Lichfield.

The gliders were dismantled for storage and whilst in store all modifications not already carried out were incorporated by the storage unit. On allotment they were reassembled for delivery by a glider assembly party established at each unit and then air tested. The storage of Horsa components was allotted to Nos. 5, 6, 9, 15 and 29 Maintenance Units.

The Formation of No. 53 Wing and the Aircraft Packing Units²

The control of the packing organisation, which hitherto had been carried out jointly by the Air Ministry and H.Q., No. 41 Group, was transferred to H.Q., Maintenance Command and delegated to No. 53 Wing on 27 March 1941. The Wing consisted of a H.Q., Service and civilian manned packing units, Service manned packed aircraft transit pools and twelve civilian contractors engaged in the packing of aircraft under the Air Ministry contracts.

The quantities and types of aircraft to be packed were determined by the Air Ministry, according to operational and training requirements. This programme was then allocated to the various packing units by No. 53 Wing, and where civilian contractors were involved the Air Ministry was requested to place covering contracts. Aircraft which were to be packed for shipment overseas were flown into packing units or contractors' packing sites, either direct from production or from air storage units or operational stations; the cases into which the aircraft were to be packed being manufactured at the respective

¹ No. 41 Group O.R.B. Appendices. Org. Memo No. 104, 7 April 1943.

² No. 41 Group O.R.B. Appendices.

units. The work of the packing units included the dismantling of the aircraft, removal of loose or delicate equipment, thorough anti-corrosion treatment of the whole aircraft, including engines, and finally the packing of the aircraft in such a manner as to ensure its complete protection against all foreseeable handling and climatic conditions.

If shipping space was available immediately the packed aircraft were transported by road straight to the port of embarkation, but normally this was not possible and they were delivered to the packed aircraft transit pools pending shipment, or dispersed locally at the packing unit or contractor.

Aircraft packed by No. 53 Wing included both operational and training types. They were shipped to the Dominions and Colonies, the Mediterranean, Middle East, Far East and the U.S.S.R. Approximately 35,000 single and twin engined aircraft were packed for shipment by No. 53 Wing during the course of the war.

The Output of Aircraft from No. 41 Group

The stock of aircraft within No. 41 Group on 30 September 1939 amounted to some 2,515 aircraft, a figure which by the end of May 1945 had reached a peak of 12,399. During 1941 the number of aircraft received was 21,270, as compared with 22,310 prepared and issued, an increase over the figures for 1940 of almost exactly 50 per cent. Receipts, which were 4,800 in the first quarter, rose to an average of 5,450 in each of the last three quarters, whilst issues exceeded receipts during the two middle quarters by 2,000 aircraft.

This heavy demand for aircraft still existed at the end of 1941, the last two months of which saw preparation delayed and output reduced below intake by bad weather, unserviceable aerodromes and shortage of production items such as engines, propellers and modification parts. The aerodromes were actually in a worse condition than in the previous two winters owing to delays in the laying of runways.

Arrears of aircraft at the end of September and December 1941 represented 3·7 and 4·8 weeks' delivery for the two quarters respectively, as compared with 4·3 and 5·1 weeks for the same quarters of 1940. This improvement was mainly due to increased supplies of operational equipment.

In 1942, 28,636 aircraft were received and 24,109 issued, an increase over the figures for 1941 of 33 per cent and 9 per cent respectively. In consequence, the stock in the Group rose to 8,346, an increase of some 4,000 aircraft. The production of certain types of aircraft was in excess of early requirements, and in order to avoid the wasteful employment of labour in maintaining all aircraft in a 'ready to issue' state it became necessary to depart from the existing policy and limit such complete preparation to the aircraft most likely to be required in the near future.

The turnover during 1943 was 28,356 aircraft received and 27,830 issued, which represented an increase of approximately 6½ per cent over the previous year. The direct delivery of aircraft from factories, to Commands at home and to packing depots for overseas, commenced in May 1943 and by the end of the

year 8,315 machines had been delivered in this manner. The stock in the Group rose to 9,000 aircraft by April, but fell away to 7,300 in October, rising again to 8,466 by the end of the year. Whilst preparation during 1943 was relieved by the substantial increase in the numbers of aircraft delivered direct, this was more than counterbalanced by an increase in the number of special installations to be fitted and by a greater variation in operational equipment, mainly due to an increase in the numbers of aircraft despatched overseas.

At the beginning of 1944 a detailed examination of the arrears of aircraft required by No. 44 Group for fly-out overseas indicated that, in order to supply the requisite number by the target dates it would be necessary to increase the working stock and reserve of aircraft within No. 41 Group, so as to cover the time lost during ferrying between air storage units. The arrears of fly-out aircraft at the end of December 1943 were 131, whilst those for January and February were 105 and 82 respectively, but March showed an improvement as all but 20 of the 355 aircraft required were delivered.

The number of aircraft ferried by the Air Transport Auxiliary during March 1944 was 7,569, whilst the number of gliders ferried by No. 41 Group for that month was 217. Ferrying continued at this high rate throughout the year reaching a peak in June when A.T.A. ferried some 7,725 aircraft.

As from 'D' Day, 6 June 1944, an aircraft supply night staff was established at Group Headquarters in order to allot ready aircraft against Commands' demands during the night. This enabled Central Ferry Control to notify the A.T.A. pools immediately, and the ferrying of aircraft allotted could then commence early the next day.

The demands for aircraft to replace operational wastage during the first few days of the liberation of N.W. Europe were only 10 per cent over those for the previous three weeks, although this represented an increase of 30 per cent over the average for previous months. The modesty of this increase may have been due, at least in part, to the fact that some of the units engaged were overborne on their aircraft establishments. The heavier demands for the three weeks before 'D' Day were partly due to the policy of holding three reserve aircraft per squadron at A.E.A.F.¹ Group Support Units. The majority of aircraft demanded were available from the ready reserve which had been accumulated in the three months previous to 'D' Day, but due to a lag in production of certain types and a shortage of modification kits, the final reserve of ready aircraft available at air storage units did not conform at all closely to replacement requirements and in some cases was non-existent. The preparation of aircraft that were not ready and could not be supplied at once to meet the nightly demands had therefore to be accelerated, and at the same time any delays due to allocation and delivery had, as far as possible, to be eliminated.

During the first two weeks after 'D' Day, demands to replace wastage in the 2nd Tactical Air Force (2nd T.A.F.) and the Air Defence of Great Britain (A.D.G.B.) remained at approximately the same average daily level, being largely met from ready stock. At this date the cumulative inability was averaging about 20 aircraft, spread over some four different types, and this fortunately

¹ Allied Expeditionary Air Force.

was not sufficient to cause a serious drain on the operational units' own reserves. The actual rate of wastage did not vary very much from that previously estimated, and future rates of preparation were therefore assessed accordingly.

On 16 June 1944 the Chief Aircraft Supply Officer and the Director of Operations, A.T.A. visited H.Q., A.E.A.F. to discuss the ferrying of replacement aircraft for No. 85 Group squadrons based on the Continent, No. 85 Group having no Group Support Unit. It was therefore agreed that A.T.A. should ferry aircraft direct to No. 85 Group airfields in either the British or American zones on the Continent, and this was continued throughout the year.

During the third week after the invasion the wastage remained at about the same level but the cumulative inability to meet demands from ready stock increased to an average of 25 due to a reduction in the availability of Spitfire VB.s and VII.s, production of which had ceased. It was therefore decided to re-arm a proportion of the squadrons as and when Command reserves fell to a point where it would be liable to lead to squadrons being below establishment. By July 1944 demands to replace wastage were considerably reduced, and every demand was met as it was received.

Mention has already been made of the reduction in output caused by bad weather. On 23 January 1942 severe winter conditions developed over most of the country and lasted for the whole of the week. This reduced movement by air to less than a quarter of the normal and the number of aircraft outstanding for ferrying rose to 951, including 505 from contractors (almost exactly the same figure as in the same week of 1941). Hurricanes and Airacobras had to be moved by road from air storage units to packing depots in order to meet the monthly targets of aircraft required for shipment to the U.S.S.R. and the Middle East. The extent of road deliveries from factories was sufficient to keep the number of aircraft dispersed there to within satisfactory limits. These conditions were repeated again on 6 February 1942, reducing movements by air and air testing to little more than half of the normal. In the period of bad weather lasting from 1 to 5 November 1943 an 'open allotment scheme' was adopted for Lancaster aircraft. Instead of allocating a particular aircraft to a particular unit, all the units and aircraft were pooled. This enabled A.V. Roe Ltd. to prepare the maximum number of aircraft for flight each morning, which A.T.A. could then deliver to any of the 'weather free' units for which an allocation existed.

No. 41 Group after the Conclusion of the 1939-1945 War

In 1949 a report was made by the Senior Air Staff Officer at No. 41 Group on the changes that were introduced in the Group organisation after the conclusion of the 1939-1945 war as the result of the experience gained in that war. Although the report covers a period outside the scope of this narrative it has been mentioned because it shows what steps were taken to dispose of the enormous stocks of aircraft which accumulated as the result of the war, and how the group was reorganised in the light of the war experience. The table at the end of the report is particularly interesting as it shows how the rate of aircraft production per man-power available was practically doubled by improved methods of organisation.¹

¹ The report is filed in the Air Historical Branch under reference A.H.B./VA 100/1/1.

CHAPTER 7

No. 42 GROUP—AMMUNITION, CHEMICAL WEAPONS, OXYGEN, AVIATION FUEL AND OIL

The Planned Expansion of the Group¹

As the war progressed a planned expansion of the Group took place, based on the estimated ammunition consumption requirements of the operational and training Commands for the years that lay ahead. At the beginning of 1942 the stock holdings of the three main parks were increased to 10,000 tons, and in due course the other parks' holdings were also enlarged to that figure. In February 1943 the holdings of high explosives and incendiaries amounted to 192,486 tons, but this had been increased, in preparation for the liberation of N.W. Europe, to 275,000 tons by the end of February 1944.

The depot storage capacity was also extended at the end of 1943 and this was accompanied by a change in storage policy. Whereas previously the Services' main explosives stocks had been held at the rear in underground units and main depots, stocks of all the main items in use were moved forward into the parks. It became the policy to by-pass the depots in so far as receipts from contractors were concerned and this necessitated still further increases in the parks' storage areas. No. 42 Group now had a number of parks right down the East Coast of England, each with its self-contained storage satellites, together with miles of public roads on the verges of which large stocks were stored.

The turnover of the Group from 3 September 1939 to December 1940 was 350,000 tons, but this had increased to 1,059,696 and 3,068,127 tons for the years 1943 and 1944 respectively.²

In the first twelve months of the war the 250 lb. general purpose bomb was the principal weapon in use, but these were superseded by heavier bombs, which while reducing the number to be handled in proportion to the 'turnover tonnage' nevertheless presented new handling, transport and storage problems.

Fortunately, chemical weapons were never required for operations, and the main difficulties encountered were those of obtaining adequate dispersal of stocks, leakage during transit and decanting of leaky weapons.

The filling of aircraft oxygen cylinders was carried out either at British Oxygen Company installations or at the special filling plants set up at selected parks or depots. At one stage of the war during peak operations the demand for oxygen was so heavy that it was only with great difficulty that supplies were maintained and curtailment of operations prevented.

Whilst No. 42 Group were responsible for the bulk storage of aviation fuel and oil, the operation of installations and delivery to units were undertaken by the Petroleum Board on an agency basis.

¹ The formation, function and early development of No. 42 Group up to May 1940 are described in Part I, Chapter 3.

² No. 42 Group O.R.B.s.

The Provision of Depots and Parks

The planning for storage and distribution was the responsibility of the Air Ministry, under the Deputy Director of Equipment. The information necessary to carry out this planning was supplied to the Air Ministry as follows¹ :—

- (a) The Ministry of Aircraft Production provided forward estimates of aircraft intake from home and overseas production (including U.S.A.) to cover a period from two to three years ahead.
- (b) The Air Staff provided estimated 'Orders of Battle' for home and overseas Commands showing the build up of the Royal Air Force by squadrons and role in six-monthly stages for two to three years ahead.
- (c) The Air Staff provided details of airfields planned, under construction and completed. These details included locations, date of completion, Command, etc., etc.
- (d) A.M.S.O. (Organisation Forecasting) provided information regarding bomb loads, aiming, rates of expenditure, rates of effort, etc., in S.D.98.²

Estimates were prepared from the above information, showing the probable build up by six-monthly stages of explosives stocks and consumption rates within the various Commands. From these budgeted figures 'consumption areas' were charted and the necessary supply units planned.

Pre-war planning paid little attention to the vital question of handling capacity and a review of all existing units revealed that in every case considerable improvement was necessary. Steps were then taken to ensure that the storage and handling capacity of units was directly related to their functional and distributional obligations.

This 'storage-distribution ratio,' as it was termed, was arrived at as follows :—

Reserve Ammunition Depots. Assuming that six months' reserves were to be held based on consumption at the calculated sustained rates of effort which was equivalent to three months' consumption at maximum effort. Taking the capacity of a depot at 20,000 tons H.E., 5,000 tons incendiary, 5,000 tons S.A.A. pyrotechnics, etc., making a total of 30,000 tons or three months' intake. Equivalent output during the same period brought the total turnover for the three months to 60,000 tons. An average railway wagon held eight tons, therefore 7,500 wagons would have to be dealt with in three months giving an average of 84 wagons per day at a maximum.

Forward Ammunition Depots and Air Ammunition Parks. Assuming a total capacity at 20,000 tons represented one month's supplies at maximum effort for the squadrons served plus 25 per cent to cover outgoing traffic, making a total monthly rail turnover of 25,000 tons or an average of 104 wagons per day at a maximum. Unlike the reserve ammunition depots the rail handling capacity was mainly affected by receipts, issues to local airfields being made mostly by road transport. However, some issues were made and the bulk of

¹ Maintenance Command and No. 42 Group O.R.B.s. Report from Grp. Cpt. Starling, No. 42 Group, 1946.

² Data for calculating consumption and wastage in use.

the 25 per cent consisted of unwanted obsolete or obsolescent weapons, return of empty containers, transit bases, etc., much of which had the same volume empty as full.

The Siting of Supply Units. Having charted the consumption areas and planned the capacity and number of units within the areas, the next problem was to find suitable sites for these units. The main difficulty here was that the rail handling capacity in some districts was already so overloaded that even if new sidings had been constructed the railway companies could not have accepted further traffic on the line. Some form of priority for explosives was therefore necessary if new units were to be constructed and operated, and this priority was eventually obtained. The siting of new units and the expansion of existing ones to conform to storage regulations soon proved impossible and the regulations were considerably relaxed. Second class roads with wide verges were used to form the high explosive and incendiary areas and thus suitable sites were usually found within the areas selected and used to their optimum capacity.

Construction of Units. Owing to the heavy works programme on airfields in the forward area, great difficulty was experienced in getting work done and the construction of forward ammunition depots at one period was about twelve months behind schedule. Fortunately, however, this was not serious, as the build up of the air forces, construction of airfields and the formation and conversion of squadrons was equally delayed. The forward ammunition depots were usually formed and operated before completion, unit labour being used to supplement the works personnel wherever possible, particularly in the preparation of hard standings.

The Forward Ammunition Depot Scheme

The method of distribution used prior to 1942 necessitated nine stages of handling within the Group, so that despite the negligible consumption the turnover was high. It became obvious that if the demand of Bomber Command's projected heavy expenditure of bombs for the years 1943, 1944 and 1945 was to be met, some modification in the distributional methods was necessary. Preliminary discussions early in 1941 with Air Ministry, Works movements, Finance and Manning Directorates indicated the urgent need for a more flexible rapid system of supply, involving less constructional work, less railway transport and, above all, less stages of handling to save man-power, motor transport, etc.

A new system was therefore worked out, known as the 'Forward Ammunition Depot Scheme,' but although some progress was made in 1941 to provide the necessary facilities, its final adoption was delayed until later that year by a proposal to expand and slightly modify the existing scheme. Eventually it was realised that this would not meet the case and the full development of the new scheme commenced.

The Control of Distribution by the Master Provision Officer¹

The distribution of explosives was the responsibility of the Master Provision Officer, Fauld. The No. 42 Group M.P.O.s differed from those of No. 40 Group

¹ No. 42 Group and Maintenance Command O.R.B.s Appendices.

in that, beyond keeping provision control record cards and the rendition of periodical returns of stocks, receipts and issues to the Air Ministry, no provisioning action was undertaken, their main task being the detailed distribution of stocks and traffic control.

To carry out this task efficiently the M.P.O. needed to know where stocks were held, where they were wanted and where they were coming from, plus an accurate and up-to-date assessment of the ability of units to handle the traffic. It was therefore necessary for the M.P.O. to maintain records and statistics upon which he could draw for this vital information. The methods of obtaining these statistics were as follows :—

- (i) Provision control record cards (P.C.R. cards) were raised for every item for which the M.P.O. was responsible, each reference number being given a separate card for serviceable, unserviceable, repairable, red carded and unclassified stocks. For example, nearly 250 separate cards were held relating to various Marks of 500 lb. bombs alone, as the type of body, filling, Marks or type of pistol fitted, necessitated a separate reference number. The P.C.R. cards were kept up to date from maintenance units' posting slips, forwarded daily by despatch rider, giving the movement of stocks and final stock balance for the previous 24 hours. This gave an up-to-date detailed record of the disposition of stocks within the Group.
- (ii) Pattern cards were raised for all active items where stocks were held under several reference numbers. They consisted of a consolidation on one card of the stocks and distribution of, say, various Marks of 500 lb. bombs, together with the components necessary to make those stocks 'ready-to-drop.' They were made up daily from the corrected P.C.R. cards and presented a picture of the latest stock figures in a form in which they could be readily assimilated and used.
- (iii) Bomber Command stock returns took the form of a daily signal giving stocks of bombs and components on airfields as at 1100 hours. It consisted of a list of items in short supply and/or under heavy consumption, varying according to the type of operations being carried out.
- (iv) Forecasts of bomb filling at Royal Ordnance factories, with production estimates, were received periodically from the Air Ministry, Ministry of Supply and the Ministry of Aircraft Production, giving detailed programmes of output from various sources.
- (v) Shipping advice notes (Form 1681) were received 7 days before convoys docked and gave the details of intake into British ports from the U.S.A. together with a request for consignment instructions. It stated the number and type of bombs, the vessel number and approximate place and date of arrival. The M.P.O. would then allocate the particular consignment to where it was most needed.
- (vi) The daily traffic signals were received from maintenance units showing, under code, the number of wagons held filled, number loaded and unloaded during the day, standing overnight, filled and empty, etc.

- (vii) A traffic control board was maintained in the M.P.O.'s office giving details of daily traffic signals under various units and a summary of traffic allocated from ports and factories to the units.
- (viii) Constant telephonic liaison was maintained with various Commands who provided advance information of pending operations.

This information enabled the M.P.O. and his organisation to place the right stocks in the right place at the right time, and the manner of distribution to, and the operation of, the three types of units used in the forward ammunition depot scheme was as follows :—

- (a) *Reserve Ammunition Depots.* These depots were provided with a capacity of 20,000 to 40,000 tons H.E. Their function was to store, receive, issue, modify and maintain reserve stocks of explosives to provide against breakdown in the forward supply programme. They also covered shipping requirements and the detailed distribution to forward ammunition depots of small items such as pyrotechnics which could not economically be distributed direct from factories and ports.
- (b) *Forward Ammunition Depots.* These depots were tactically sited in the forward area and had a capacity of 10,000 to 20,000 tons H.E., enabling them to handle the requirements of 15 to 25 heavy bomber squadrons, operating from 10 to 15 airfields situated within a radius of 25 miles.

They held a stock of ' active ' explosives of sufficient size to provide a ' cushion ' to cover any breakdown in the supply. As a Command withdrew stocks from this cushion to replace their expenditure the type of weapons in the pipeline was adjusted accordingly. So when a sudden switch was made, say, from strategical to tactical weapons, the expenditure was replaced from the tactical cushion stocks, whilst the flow of strategic weapons was maintained in the pipeline until the strategical cushion had been replaced. The flow was then adjusted to whatever tactical bomb load was being expended. This permitted the direct routing of bulk consignments from ports and factories, mainly by complete trainloads, thus obviating all but the last four of the nine handling stages previously necessary. About 25 per cent of these bombs were off-loaded onto squadron motor transport, thereby reducing the handling to only one stage within No. 42 Group. The smooth flow of supplies was greatly assisted by the ability of these units to store any production which was temporarily surplus to operational requirements.

- (c) *Air Ammunition Parks.* The third type of unit had a capacity of 500 to 1,000 tons H.E., and were known as air ammunition parks. These were sited in outlying areas to cover the comparatively small and infrequent demands of Coastal and Fighter Commands. Their airfields, scattered as they were all around the coast of the British Isles, were difficult to supply. However, this was largely overcome by building up station stocks in advance of any pending operations.

The nomenclature of maintenance units was later altered and reserve ammunition depots (R.A.D.s) became ammunition depots (A.D.s), forward ammunition depots (F.A.D.s) and air ammunition parks (A.A.P.s) both became air ammunition parks, but the functions of the individual units remained essentially unchanged.

The Development of Satellite Storage

Early in 1940 satellite storage units of from 1,500 to 4,000 tons capacity were constructed adjacent to all the A.A.P.s and held duplicate stocks to the parent park, so that in the event of enemy attack making the parent park unusable the satellites could be occupied and operated. As the danger from enemy attack lessened these satellites were absorbed into the general storage plan of the parent park, thereby providing much-needed extra capacity to meet increasing storage commitments. In practically every case these satellites were constructed by unit labour. A large number of sawdust roads were constructed and these proved to be so satisfactory that they were still in use in 1945.

The Difficulties in Maintaining Supplies

The maintenance of the whole supply organisation involved considerable work and the prevention of any breakdown was only possible by the use of considerable pre-planning and close co-operation on the part of all concerned. The issue was further complicated by the fact that each type of aircraft had its own particular aiming and bombing pattern and that whilst bombs were allocated from ports and factories most of the remaining components came from divers sources of supply.

During the heavy operational period 1944-45, practically every item required was in short supply and components came from production at a rate only just sufficient to match up with bombs. These were being expended at the same rate as they were being replaced, so that every allocation made had to be considered in relation to the overall supply situation. The Master Provision Officer had in many cases to decide the highest priority requirement between United Kingdom, the continent of Europe and overseas theatres. The flow in the pipeline to Bomber Command was interfered with as little as possible, allocations elsewhere being made against stocks which did not exist, the items being diverted from production at the last moment to phase in with the estimated time of call forward.¹

Supplies to the 2nd Tactical Air Force

The supplies to the 2nd Tactical Air Force operating from the United Kingdom were effected from the southern maintenance units. For some time before operations commenced for the liberation of N.W. Europe, stocks of explosives and packed aviation fuel were built up at Longparish, Chilmark and Charlwood. Detailed estimates of consumption through the various stages were, however, provided later to the Master Provision Officer by H.Q., 2nd T.A.F., and stocks at the units were adjusted, as far as possible, to cover this expenditure.

¹ Detailed statistics are shown at Appendix I3.

Several of the most important items were in very short supply and road transport from the factories was used to ensure that every item was available to the airfields immediately manufacture was completed.

When operations commenced, 2nd T.A.F. aviation fuel and ammunition parks were formed and operated in order to gain experience before proceeding to the Continent. Demands for day-to-day requirements were telephoned to the Master Provision Officer and he allocated the demands to the unit most suited by virtue of location and stock, 2nd T.A.F. transport then collected by road. The issues of packed aviation fuel to the Continent, the Channel Islands, Norway and Denmark were normally by means of air transport, and up to the end of May 1945 amounted to 397,598 Jerricans (each containing 4.58 gallons) and 14,908 barrels.¹

Major Incidents Involving the Loss of Explosives and Aviation Fuels

On Sunday, 25 January 1942, the roof of the underground storage tunnel at No. 31 M.U., Llanberis, collapsed. This blocked the main entrance and both the railway siding and Decauville track, and either buried or rendered inaccessible the total contents of the tunnel comprising some 14,277 tons of explosives, bombs, depth charges and T.N.T., representing about one-seventh of the total stocks of these items held at ammunition depots in the United Kingdom. There was no loss of life or serious casualties, although 22 airmen and one civilian were working in the tunnel at the time. The commitments of this unit were dispersed among other depots in the Group and storage of stocks of high explosives transferred to a No. 31 M.U. satellite at Rhiwlas. As a result of this accident and matters arising out of the inquiry, a thorough inspection was made of similar depots. A number of cracks were found to be appearing in the tunnel at Harpur Hill and arrangements were made to have all oversea issues made from this unit to enable permanent preventive work to be carried out. The inquiry at Llanberis exposed a number of technical deficiencies in this type of storage depot and steps were taken to rectify them.

An even more serious incident occurred at No. 21 Maintenance Unit, Fauld, on 27 November 1944, when an explosion occurred in the new area of the high explosives mine. Twenty-six R.A.F., civilian and Italian personnel were killed and ten injured. The loss of high explosives destroyed in the actual explosion was estimated at 3,500 tons, to which must be added the stocks damaged in the old area. There were five hundred and eighty-four 4,000 lb. bombs in the new area and these formed six-sevenths by weight of the stores lost. All underground storage had to be closed, but issues and receipts on a reduced scale were continued from the three outside storage sections.

In June 1942 an aviation fuel tank was hit by a stick of 500 kilo bombs during a general attack on Poole Harbour, but the fuel did not catch fire. The tank contained 1,300,000 gallons of fuel and much of this found its way into an adjacent lake from which it was possible to salvage 260,000 gallons.

¹ The technical operation of bulk installations (Pluto, etc.), the storage of packed aviation fuel, and the delivery of bulk requirements to airfields on the Continent were Army responsibilities and lie outside the scope of this narrative.

The Preliminary Education of the U.S.A. Ordnance Corps and the Handing over of Depots to the Americans¹

The Group were responsible for what may be termed the preliminary education of the U.S.A. Ordnance Corps in the storage and handling of explosives under field storage conditions. On 22 May 1942, representatives from this corps visited H.Q., No. 42 Group to discuss the disposition of United States explosives reaching the United Kingdom and the training of the first draft of American personnel. Further discussions on 19 June 1942 covered the possibility of having to store 100,000 tons of American ammunition during the next 3 months. On 4 September 1942 storage at Braybrooke was loaned to the U.S.A. Services of Supply and stacking of bombs commenced. It was decided to move R.A.F. stocks from Grovelly Wood and make immediate arrangements for the opening of an additional site at Melton Mowbray, which, together with road extensions to No. 220 Maintenance Unit, Wortley, could then also be used for American stocks. All units serving U.S.A.A.F. airfields were eventually taken over by them.

Chemical Weapons²

At the end of 1940 it was decided to increase considerably the stocks of chemical weapons which were held forward at the parks, and separate storage areas were sited for this purpose. The first of these was at No. 94 Maintenance Unit, Barnham, where a large wood was utilised; and so that the unit could accept weapons coming off production, storage had to be improvised and sawdust roads constructed to give access for road vehicles. These improvisations were so successful that they were still in use four years later.

In 1943 underground storage for bulk stocks of war gases was introduced, and this type of storage, in conjunction with forward filling plants, was constructed.³ The method of storage and filling was also adopted by the U.S.A. Chemical Warfare Section at the same time.

Chemical weapons presented special handling, transport and storage problems on account of their proneness to leakage. There was a small percentage of leaky weapons even under ideal storage conditions and great care therefore had to be taken to isolate stocks. Leaky weapons had to be rendered harmless by means of special decanting equipment and courses of instruction were therefore given to personnel handling these weapons. Leakage during transit was finally reduced to a minimum by improved manufacturing methods and rigorous inspection at the factory.

Supply of Aircraft Oxygen⁴

In March 1941 the estimated total requirements of Bomber and Fighter Commands for breathing oxygen were 23,500,000 litres per week, rising to 32,250,000 litres per week by December of the same year, and 40,650,000 litres per week for July 1942. These figures were calculated on the basis of intensive operational effort by day and did not include reconnaissance or Army Co-operation squadrons.

¹ No. 42 Group O.R.B.

² No. 42 Group O.R.B.

³ Nos. 80, 93 and 95 Maintenance Units.

⁴ Maintenance Command O.R.B., 1941, Appendices A, I and G.

THE ORGANISATION FOR SUPPLY OF BREATHING
OXYGEN TO OPERATIONAL UNITS DURING THE
LIBERATION OF N.W. EUROPE, D-14 TO D+41

LEGEND

- | | | | |
|---|---------------------------------------|---|--|
| ⑤ | LIQUID OXYGEN DEPOT | — | 1. OF C. LIQUID OXYGEN |
| ⑩ | BREATHER OXYGEN PLANT (VENTURON TYPE) | — | 2 ND I.A.F. AEROSOLITES |
| ● | A.F.A.P. AND T.A.F. | □ | A.D.G.B. AEROSOLITES |
| ● | No. 42 GROUP | ● | No. 45 GROUP AEROSOLITES |
| — | LI. OF C. GAS IN CYLINDERS | ○ | 9 TH U.S.A.A.F. AEROSOLITES |

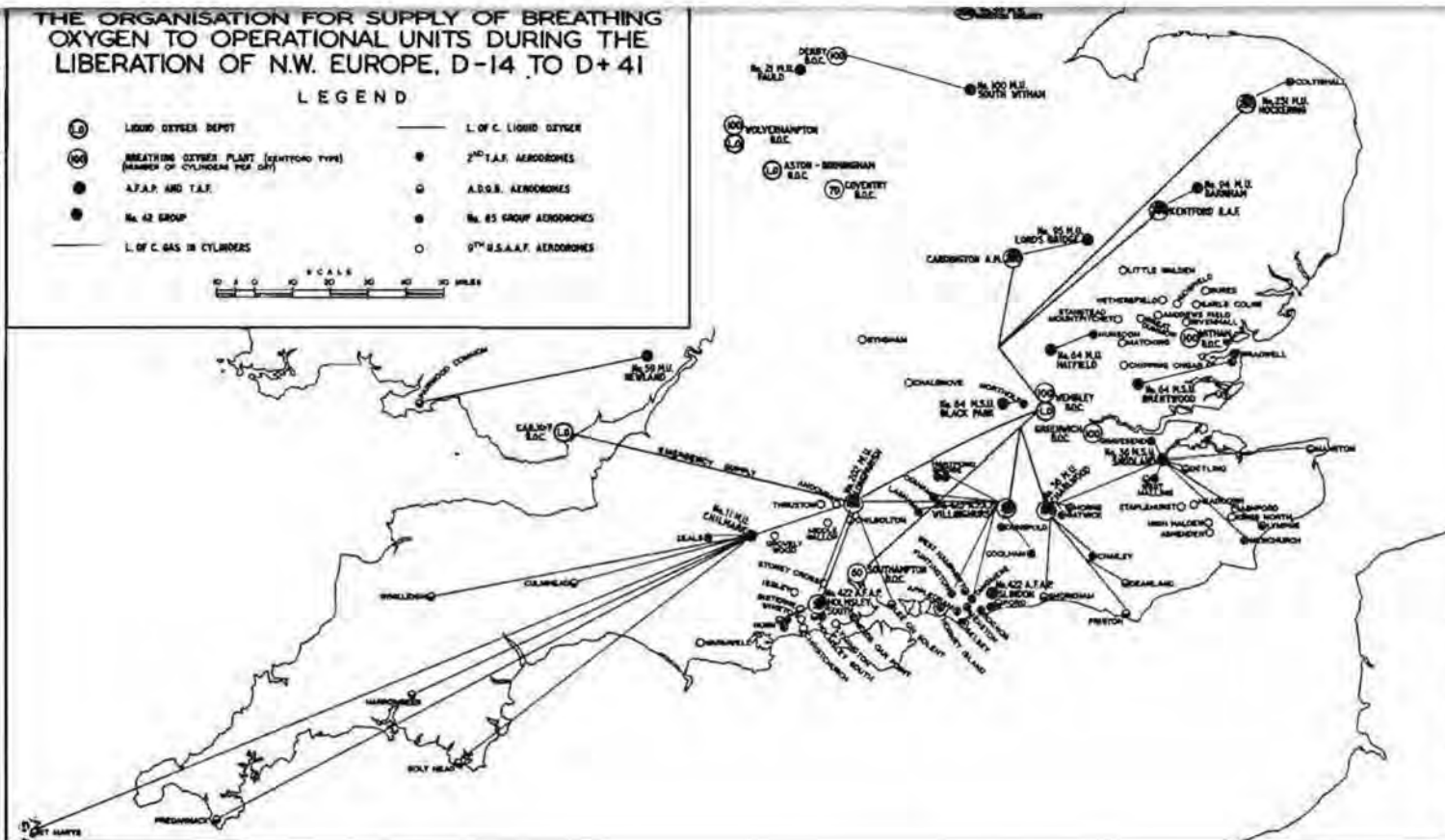


DIAGRAM 15

THE ORGANISATION FOR SUPPLY OF BREATHING OXYGEN TO OPERATIONAL UNITS DURING THE LIBERATION OF N.W. EUROPE, D-14 TO D+41

LEGEND

- | | |
|--|---|
| (L) LIQUID OXYGEN DEPOT | — L. OF C. LIQUID OXYGEN |
| (O) BREATHING OXYGEN PLANT (LIGHTNING TYPE)
(NUMBER OF CYLINDERS PER DAY) | ● 2 ND T.A.F. AERODROMES |
| ● A.F.A.F. AND T.A.F. | ○ A.D.S.R. AERODROMES |
| ● No. 42 GROUP | ● No. 83 GROUP AERODROMES |
| — L. OF C. GAS IN CYLINDERS | ○ 9 TH U.S.A.A.F. AERODROMES |

SCALE
10 20 30 40 50 MILES

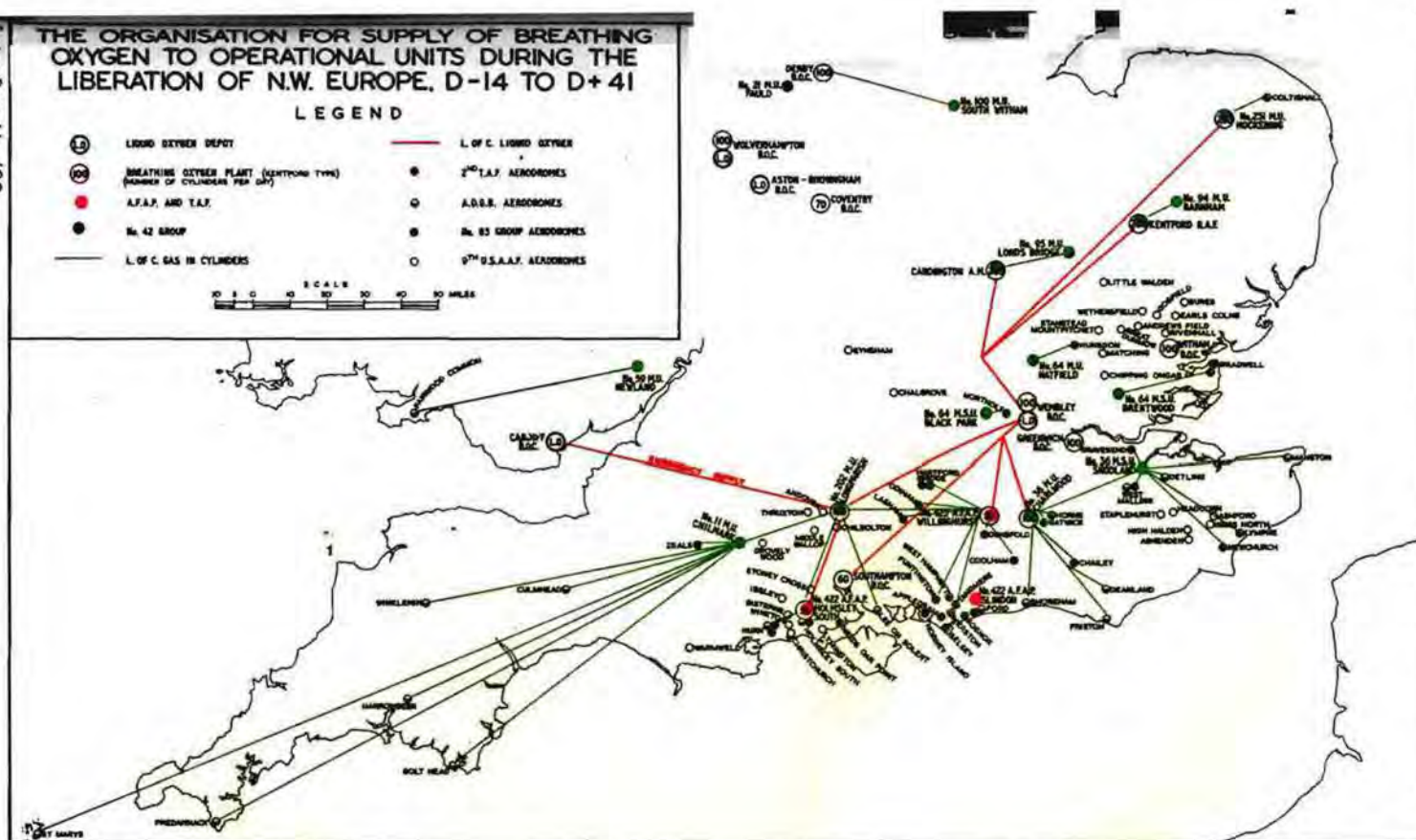


DIAGRAM 15

The combined filling capacity of all the plants within the oxygen organisation in March 1941 was :—

Working one shift	11,105,000 litres per week
Working two shifts	22,210,000 " " "
Working three shifts	33,315,000 " " "

It was therefore recommended that the capacity of existing plants be increased to meet the budgeted consumption figures for July 1942, and that 4 spare compressors and driers be held in reserve to cover damage by enemy action or for expansion purposes.

On 13 May 1942 the scale of issue of oxygen transport cylinders was altered making it necessary to allot additional quantities of cylinders to F.A.D.s, A.A.P.s and to the B.O.C. filling factories.¹

The rapid expansion of Bomber Command and the increasing number of sorties being made, together with the large number of U.S.A.A.F. squadrons being based in the United Kingdom, necessitated the construction of new (Kentford) type oxygen plants at No. 42 Group units, the first of which was scheduled to be installed at No. 202 M.U., Longparish, by March 1943. With the installation of these plants the major production of breathing oxygen was taken over and became the responsibility of No. 42 Group.²

No. 42 Group Aviation Fuel and Oil Branch

The development of the arrangements for the supply of aviation fuel and oil up to April 1940 will be found in Part I, Chapter 3.

The supervision of the functional work of the aviation fuel reserve and distributing depots was delegated to No. 42 Group. They were responsible that proper records were maintained, that adequate stocks were available when and where required, and that the quantities of fuel discharged from ocean tankers into port installations were fully checked.³

The operation of the fuel installations, and also of the road tankers for delivery to units, was undertaken on behalf of the Air Ministry by the Petroleum Board.

Distribution by the Petroleum Board of Aviation Fuels and Oils in the United Kingdom⁴

The development of the arrangements for the supply of petrol and oil to the Royal Air Force during the war may be divided into six phases.

The first stage in the story is the pre-war planning. Then comes the stock-taking of the static war period from September 1939 to April/May 1940. Then follows the Battle of Britain (July and August 1940) and the period of counter-invasion arrangements. 1941 saw the expansion of the bombing programme ;

¹ Details of the old and new scales by units are shown in Appendix 11.

² Details of the supply organisation for breathing oxygen to operational units during the liberation of N.W. Europe are shown in Diagram 15.

³ No. 42 Group O.R.B.s.

⁴ Brief history of the war-time distribution of aviation fuels and lubricating oils to the R.A.F. and the U.S.A.A.F. in the United Kingdom. Prepared by the Petroleum Board, 1945.

1942 the entry of the U.S.A. into the war and the beginning of the problem of peak deliveries ; 1943 the peak planning and the growing air offensive ; 1944 the year of fulfilment and ' D ' Day ; 1945 the final heave and the knock-out—the period of acute stock shortages.

Pre-war Planning

Planning for war between the major oil companies and the Air Ministry began in 1935-36. Under peace-time conditions the Air Ministry's requirements of petrol and oil were supplied on contract by the various oil companies, each through the medium of its supply depots. The increased requirements of the Royal Air Force during war-time, together with the necessity for strategic reasons to hold larger reserves of stocks, particularly at main installations at the ports, made it essential that a special war-time aviation petrol and lubricating oil system should be planned and built to supplement the oil companies' own facilities. Decisions as to the size, number and locality of aviation main storages and local distributing depots were taken by early 1937 and the selection of sites and actual building began. The contracts for building were placed with the major oil companies.

Although discussions took place as to whether the Air Ministry would operate their own distributing system under war conditions or whether the oil companies would do so, no final decision was, in fact, taken until the day war broke out.

The question of who was to undertake the distributing ultimately made no difference whatever to the closeness of the co-operation between the Air Ministry and oil companies. The most detailed plans were prepared of how the approximately 100 stations operating at the beginning of the war were to be supplied and the alternative methods to be adopted to meet the emergencies of war. The first scheme assumed stocks available on the east coast, the second scheme assumed the closing of the east coast to shipping and the supply of the east coast areas (the real operational areas) by rail from the west. A large number (about 60) oil company depots were earmarked for use as Aviation Depots, either to supplement the Air Ministry's own depots or to operate should war come before all the Air Ministry's depots were ready. The beginning of the organisation for emergency railhead operations in the event of enemy damage was also laid down.

A meeting had been arranged with the Air Ministry at 1030 hours on 3 September 1939 to decide who would do the job of distributing aviation petrol. In the light of the previous planning, and in order that the full facilities of the oil companies could be immediately at the disposal of aviation fuel distribution to meet any emergency, the Air Ministry asked the oil companies to undertake the task. The fact that the oil companies had completed the most detailed plans to join together and become the Petroleum Board, which had similar responsibilities for the Army and the Navy, weighed considerably in making the decision. The question of the terms and charges under which the scheme would work was left until later—getting on with the job was the first consideration.

The Petroleum Board had undertaken to provide 700 railcars of the 1,000 likely to be required within the first year of war, the Air Ministry having

ordered the remaining 300 before war began. About 100 road vehicles were also required which the Board undertook to provide together with the necessary driving personnel—also storages at ten main installations as well as 56 inland distributing depots. Most of these inland depots (not required for the peace-time supply of aviation petrol) were cleared and filled with aviation petrol prior to the outbreak of war and were ready to meet aviation requirements from zero.

Peace-time aviation requirements were about 6,000 tons per month, little more than the consumption of one of the largest stations in the later years of the war. The estimated war consumption was expected to begin at about 43,000 tons per month, to rise eventually to 70,000 tons and perhaps ultimately to 100,000 tons per month. There were 100 stations to be supplied, only eight of which were expected to require 1,000 tons per month or more. There were at the end of the war about 600 stations, about 40 of which consumed 3,000 tons per month or more.

There were only two grades of petrol required initially, 87 and 77 octane. Ultimately there were six grades with many additional experimental grades. There was only one grade of lubricating oil initially—eventually there were eight grades, apart from additional experimental grades.

At the beginning of the war the number of depots handling and distributing aviation fuel were :—

Air Ministry (14 Aviation Fuel Reserve Depots and 15 Aviation Fuel Distribution Depots)				29
Petroleum Board (10 installations and 56 inland depots)				66

At the end of 1944 there were :—

Air Ministry and Government storages (35 A.F.R.D.s, 35 A.F.D.D.s and 8 Government storages)				78
Petroleum Board (13 installations and 59 depots)				72

Stocktaking of the Static War Period

During the static war period up to April/May 1940 there was a period of stocktaking and perfecting the original plan. The consumption in the early months was only about one-third of the estimates. The chief incidents of the period, apart from the completing of more A.F.D.D.s, were the completion of an inspection plan in November 1939, the taking over of lubricating oil distribution in February 1940 and the successful organisation at speed of the first of many complicated grade changes from 87 octane to 100 octane at operational Fighter and Bomber Stations.

Apart from United Kingdom distribution of aviation fuel, the Board organised during this period, in conjunction with the Air Ministry, large shipments of its own barrels filled with petrol to France.

The Battle of Britain and Counter-Invasion Arrangements

The Battle of Britain in July/August 1940 was the Board's first battle test—not only of their civilian drivers making deliveries to stations under enemy fire but also of their flexibility in meeting a sudden concentration of demand, of

providing further 30 ft. x 9 ft. tanks to improve station storage and of the organisation of barrel and tin supplies to keep stations going even when their storage (e.g. Eastchurch) had been destroyed.

The latter half of 1940 and the early months of 1941 also saw the introduction of the emergency arrangements to deal with the possibility of invasion—the withdrawal of road vehicles, drivers and depot personnel to back areas should the necessity arise, the daytime running of trains (the loss or damage to a large number of railcars would have seriously affected the Board's ability to keep the Royal Air Force supplied so as to counter the invasion), the detailed planning with the Military Movement Control Officers and the Ministry of War Transport Road Engineers to enable vehicles to get through to stations irrespective of road damage, the organising in conjunction with the Air Ministry Signals Branch of a detailed communication system which would ensure unbroken contact with stations, the preparation of railheads with necessary personnel and pumps to take over supplies in the event of any key A.F.D.D.s being put out of action; also the building up of package dumps. The consumption in 1940 of aviation petrol was 306,000 tons. The consumption in 1941 was 676,000 tons. By the end of 1940 five grades of lubricating oil were already being handled.

With Britain the garrison and the strategic base for continuing the fight against Germany, it was clear that eventually the maximum figure of 100,000 tons a month of aviation fuel previously contemplated would be largely exceeded but by how much it was impossible to foretell. It did not seem that the distributing organisation would require to be *radically* improved even if that were feasible.

The Expansion of the Bombing Programme

In 1941 the R.A.F. bombing programme began to expand and the problem of organising for the fluctuating R.A.F. requirements began to require very special attention. The new estimates indicated 100,000 tons per month by the end of 1941 and 135,000 tons per month by the summer of 1942. Six additional distributing depots were suggested as well as additional petrol and lubricating oil railcars. The beginning of the problem of peak deliveries prompted the Board to suggest the introduction of the special ullage system for controlling supplies to stations and for emphasising the necessity for the closest co-operation between distributing depots and stations if the highly fluctuating requirements at stations were to be met, especially in view of the small station storage—but the time for its introduction was not yet. The Air Ministry were also at this time proceeding with their plans to increase station storages. Complicated 'Contact Sheets' for stations were introduced to give all concerned the alternative routes of communication whereby contact between stations and the Board could be ensured under any emergency.

The Entry of U.S.A. into the War

1942 saw the arrival of the Americans—they took over four stations. It was clear by now that the consumption figures were going to exceed any previously known calculation. The actual consumption peaks during 1942 approximated closely to the estimated peak of 135,000 tons per month. With the arrival of the Americans, the 'hotting up' of the pace of the war and the possibility of

a Second Front, not only was it certain that much larger peaks would have to be dealt with but the hotter the pace the more difficult it was going to be to ensure accurate forward estimates.

An additional 400 railcars was agreed at the beginning of 1942 and one or two more depots. But new consumption figures over the 200,000 tons per month mark were beginning to be mentioned. In order to avoid increasing the burden on rail transport which the increased consumption would otherwise involve, a new pipeline was built in 1943 to enable a new peak of 220,000 tons per month to be met.

At the end of 1942 a proposal was agreed to provide an additional 300,000 tons of aviation petrol tankage. Of this some 40,000 tons were set aside to provide additional tankage at distributing depots, but the scheme was mainly intended to provide as near as possible the 6 months' overall aviation stock the Air Council required in view of the risks of the U-boat campaign and the anticipated but somewhat unpredictable increases in consumption.

1942 and early 1943 produced the first crises in meeting the special difficulties of peak demands at stations provided with inadequate storage. Bombing could only be done in suitable weather by Bomber Command (at this stage) on moonless nights, and by the Americans on suitable days. Even if a station had its planned storage of a week's consumption, during a peak period the average storage of a week became no more than the requirements for 2 or 3 days; and, as many stations had not got their planned storage, there were many where the storage represented a day or two days' storage at peak expenditure and in certain cases even less. The station equipment officer was continually on tenterhooks depending on the Board's vehicles to maintain an unfailing flow, and never at any time did he have any real reserve in his storage. The Board, for their part, were in considerable doubt as to what was the exact position at the stations, and the task of ensuring an unfailing flow, on the arrival of which the continuance of flying depended, was a terrible strain. Various methods of intensifying the deliveries to meet the peak requirements were explored and eventually a daily ullage return, to be rendered by aerodromes to their supplying depots, was introduced to replace the previous block-order system; the transport arrangements were reorganised and enlarged; a system of traffic control was brought into being and the facilities at the depots for discharging railcars and loading road vehicles were increased.¹

1943—The Year of Planning

The original estimates for 1944 called for peak monthly deliveries of 300,000 tons and provided for an expenditure of £25,000 on improving the rail issuing facilities at Air Ministry depots and £60,000 for improving the pumping capacities and loading bays at the distributing depots. These improvements were necessary to avoid delays in the loading of vehicles scheduled to do 6-8 loads and 250 miles per day and in handling railcars which were to deal with 85-100 tons per month against a former figure of 50 tons per month.

In October 1943 the Petroleum Board were advised that the Quebec Conference had estimated that the intensification of the war on Germany decided

¹ A note prepared by the Petroleum Board showing how these improvements were developed is at Appendix 12.

upon would result in the peak consumption of aviation fuel in the United Kingdom being increased from 300,000 to 420,000 tons per month. Following a number of urgent meetings it was decided to lay an additional pipeline to carry the extra 120,000 tons. (This new line was eventually called upon to deal with 300,000 tons per month by itself.)

Further extensions to depot facilities costing £200,000 were agreed in November and the paper work was completed by the end of December. The Board had 3-4 months, at a time of desperate labour, material and transport shortages, to produce these vital improvements, including two new 'stop-gap' depots at Ellingham and Chappel.¹

Reference has been made earlier on to the meagre station storage for aviation fuel, and in view of still-increasing consumption in the heavily loaded East Anglia and Lincolnshire areas the Board proposed towards the end of 1943 that selected stations, i.e. key stations some distance from their supplying depot, should have their storage increased to the level of 216,000 gallons (no more than two days' stock at peak rate) at the expense of a number of operational training units in the middle and west of the country where at many points 72,000 gallons of extra storage was about to be installed to bring them up to the standard 144,000 gallons level. The Board's proposals in this respect were eventually agreed and the majority of the additional storages in the vital areas were built and commissioned in time to be of substantial use during the latter part of 1944 and early part of 1945. The new peaks of the early months of 1944, however, had to be met without these improvements being available—another crisis in deliveries.

The Year of Fulfilment and 'D' Day

In March 1944 the Petroleum Board were faced with one of their most difficult tasks of the war. It had been decided previously that the advanced landing grounds (A.L.G.s) on the south coast, which had been prepared for the liberation of Europe, were to be provisioned with packed aviation fuels and oils, but at the eleventh hour the Board were requested by the Air Ministry to furnish supplies in bulk of both fuel and oil. The A.L.G.s were equipped with only two 30 ft. x 9 ft. tanks at the outset and with only one concrete apron for the discharge of vehicles into storage and the issuing of supplies to aerodrome refuellers. It was visualised that these A.L.G.s would have a peak daily consumption according to areas of 10-45,000 gallons. Once the decision had been taken that they were to be supplied in bulk, it meant that with the short time available an intensive programme was necessary to provide extra facilities in the way of additional storage at the heaviest points coupled with additional discharge arrangements, provision of auxiliary pumping units and separate bulk storage for lubricating oil. Only by the Board's engineering staff coming to the rescue was the additional work completed in time, and it is true to say that without the extra facilities the A.L.G.s could not have handled in bulk the heavy daily quantities.²

During discussions with the Air Ministry, the R.A.F. Movement Control had serious doubts as to whether the Board's transport would be adequate to cater

¹ Details of this extension programme are given in Appendix 12.

² The manner in which the many difficulties were overcome is described in Appendix 12.

for the deliveries in view of the likelihood of enemy bombing and restricted freedom on the roads. Detailed planning, however, with the War Office Movement Control had the desired results.

'D' Day went off as planned with the highest daily peak of deliveries—25,000 tons—so far reached.¹

It was thought that the peak had been reached and that thereafter deliveries would diminish, but it was not so. The peak for June (the 'D' Day period) was 550,000 tons and 557,000 tons in August; the figures for March and April 1945 were 640,000 tons and 631,000 tons respectively.

Conditions were not improved by an acute shortage of vehicles, drivers and railcars to meet aviation consumption in 1944, but with the help of the Air Ministry and War Office 200 additional Bedford 'Scammells' were secured. Also, through the good offices of the U.S. Area Petroleum Office, the U.S.A.A.F. loaned the Board 50 of their refuellers for which British drivers had to be specially prepared. As to railcars, the Board were fortunate to be able to borrow 500 American railcars earmarked to go to France after 'D' Day. The number of vehicles employed in carrying this very considerable load was 700, with 1,800 drivers.²

The feature of the last two climax troubles of the war was the highest peaks ever in consumption, coupled with the lowest ever stock. Against the target of six months originally suggested by the Air Council the Board had on 19 April 1945 only 14½ days of usable stock of 100 octane.³

In Appendix 12 is shown the actual consumption over a period as compared with the estimated consumption. It will be seen how almost impossible it was to predict forward consumption and shows the flexibility of the organisation required to meet that consumption.

¹ Appendix 12—Report by the Petroleum Board on the Liberation of N.W. Europe.

² A review of the intensity of performance during 1944 is given in Appendix 12.

³ Appendix 12—'Notes on 100 octane stock position, 19 April 1945.'

CHAPTER 8

No. 40 GROUP—EQUIPMENT STORAGE AND SUPPLY

The Formation of the Mechanical Transport Companies, 1940

No radical changes took place within No. 40 Group during 1940.¹ A universal supply system was further developed and Nos. 1 and 4 Maintenance Units (whose remaining functions were not generally within the scope of No. 40 Group) were transferred to No. 43 Group, Maintenance Command. It was decided, however, to form 'M' and 'P' Maintenance Units at Kidbrooke and Ruislip respectively to absorb the No. 40 Group functions hitherto carried out by parts of Nos. 1 and 4 Maintenance Units. The 'H' Maintenance Unit, Dumfries, transferred its holding to Carlisle and took over the issue of barrack equipment and clothing. Nos. 1, 2 and 3 Mechanical Transport Companies were formed within the Group and located at Darlington, Cambridge and Ightham respectively.

The Revision of the Stockholding Policy at Equipment Depots²

As a result of the large quantities of stores which were beginning to be delivered off war contracts by the autumn of 1940, it became necessary to acquire additional storage accommodation in each of the six geographical areas served by the universal equipment depots. This accommodation, which consisted of suitable requisitioned buildings, was needed to store the low priority sections of equipment and also the overflow of equipment from other sections of higher priority, thereby relieving the growing congestion in the depot sheds and permitting greater dispersion of valuable stocks.

A conference was held at Headquarters, No. 40 Group on 3 October 1940, at which Air Ministry were represented, to decide what alterations to the stockholding policy would be necessary and also to lay down the future organisation of the existing lettered maintenance units and newly acquired depositories. The following proposals were agreed to:—

- (a) To establish in each of the geographical areas a self-contained stores accounting unit to hold the barrack and clothing ranges of equipment and thereby relieve the universal equipment depots of handling and accounting for any of these types of stores. Consumers' demands and serviceable surplus returns were to be sent direct to the appropriate maintenance unit holding the range of this type of equipment.
- (b) A full range of equipment in the remaining sections would be held in each U.E.D. except at Milton, and any overflow from these sections would be stored outside in any vacant space in the depositories. Equipment so housed would remain on charge and under the complete control of the U.E.D. depositories, other than those established as self-contained units for barrack and clothing stores, which would be controlled as overflow sites of the local U.E.D.

¹ The formation and growth of No. 40 Group prior to May 1940 will be found in Part I, Chapters 2 and 3.

² M.C. File S.5579.

- (c) Owing to the limited accommodation at No. 3 Maintenance Unit, Milton, it would be necessary, as an exception to the above proposals, to establish 'B' Maintenance Unit, Hammersmith, as a self-accounting unit for a range of equipment sections in excess of barrack and clothing equipment.
- (d) With the exception of Hammersmith, all depositories, including properties requisitioned for storage, would be under the Regional Universal Depot Commander for the purposes of all major administration, i.e. matters of Works Services, defence and discipline.

It was agreed by Air Ministry that action should be taken immediately to introduce the new organisation in anticipation of their eventual approval.

As regards the two new self-accounting units to be formed in the Stafford and Heywood areas for barrack and clothing equipment, it was proposed to use the requisitioned properties known as 'Sheffield' and 'The Great World Stores, Manchester,' respectively. These would be known as 'Q' and 'E' Maintenance Units and details of their establishments, etc., were submitted in due course.

Broadly speaking, the following units were under the jurisdiction of No. 40 Group at the end of 1940 :—

- Six Universal Equipment Depots.
- Six Barrack and Clothing Depots.¹
- Three Mechanical Transport Companies.
- Eight Miscellaneous Units.

Further expansion took place during 1941, the most notable feature being the introduction of the equipment parks and an internal reorganisation resulting in the formation of the universal equipment wings.

The Introduction of the Equipment Parks

During 1940 considerable experience had been gained of delays to which rail and postal services were subject as a result of air attack, and although only one area may have been the object of the attack the interruptions to communications were found to be both widespread and cumulative. The results of a possible intensification of this enemy air attack were therefore viewed with considerable misgivings.

A further aspect which gave some cause for concern was the heavy retail load imposed on the supply system by stations demanding direct on the depots. At that time there were 478 R.A.F. units all demanding separately and each item was dealt with as one transaction throughout the process of supply. The system was already creaking beneath the strain imposed on it by the depots and by the Master Provision Office (M.P.O.) having to handle so many piecemeal demands from consumers. With the projected expansion of the Royal Air Force it was difficult to see how efficiency could be maintained unless demands were 'rolled up' in some way so as to reduce the number of separate transactions. Ten separate demands for one item took almost ten times as much time and

¹ Includes 'C' Maintenance Unit, Coventry, which was destroyed by enemy action in November 1940, but was not, however, finally disbanded until March 1941.

labour to deal with as one demand for ten times the quantity. In these circumstances it therefore seemed that the existing supply system was not altogether suited to the changed conditions of warfare in the United Kingdom ; and that furthermore, with such long lines of communication and the increasing number of stations which would have to be supplied, there was liable to be a real danger of a breakdown followed by a further loss of efficiency due to the introduction of extemporised measures.

The problem, therefore, was how to improve this position without making the supply organisation too complicated, and with this end in view the following proposals were evolved :—

- (a) To form stores holding parks located forward with the operational units and to call them equipment parks.
- (b) To supply the parks by bringing forward a portion of the available stock then held at depots, whilst at the same time absorbing some of the stock authorised to be held at stations. The parks would be required to stock only airborne stores, as other stores were common to all stations and speed of supply was not of paramount importance. The suggested stock establishments for the parks were three months maximum and two months minimum of the airborne sections of stores.
- (c) The parks were to maintain stocks by submitting monthly to the parent depot a statement showing the stocks required to bring them up to the maximum, regardless of whether the minimum had been reached. The depot would issue against this statement as stocks became available throughout the month, but would not take inability action. The statement would be closed and superseded on receipt of the next monthly statement. Any item which had not been supplied by the depot against the previous month's statement would not be regarded as ' due in ' when compiling the current statement.
- (d) If a park could not issue to stations because it was out of stock of the item or the item was new, the park could demand direct on the Master Provision Office (M.P.O.) to cover its outstanding commitments plus a reasonable quantity to cover consumption until the end of the month. Any demands so placed would be regarded as ' due in ' and would be discounted on any subsequent demands to the M.P.O. and also on the monthly statement to the depot.

It was claimed that the introduction of the above proposals would reduce delays on demands for short stock items on the M.P.O.s, save three to four days in supply, provide a daily supply of all available items to units and reduce the number of transactions at the Universal Equipment Depots (U.E.D.s). As the bulk would be taken further forward this would save much piecemeal issuing at U.E.D.s. With a reduction in labour and transport the U.E.D.s would handle no inabilities for operational units, whilst there would be a reduction in abilities on stock demands handled by the M.P.O.s. The centralisation of stocks at the parks would permit a reduction in the stocks of items seldom used by the squadrons, without seriously reducing their availability, an availability which could now be more easily extended to other areas in the event of an emergency.

It would also increase the dispersion of stocks from the U.E.D.s and the consumption would be reflected in the provisional records earlier on account of the bulk issues made to the parks.

At a meeting held at the Air Ministry on 27 March 1941 it was agreed to recommend that two or three of these equipment parks should be formed on an experimental basis. Perth and Inverness were accordingly selected and they were required to supply equipment in the airborne ranges to 14 and 8 operational stations respectively. No. 17 Maintenance Unit, Perth, and No. 79 Maintenance Unit, Inverness, were formed in June 1941, and these were followed by No. 74 Maintenance Unit, Bough Beech, No. 87 Maintenance Unit, York, No. 203 Maintenance Unit, Newark, and No. 204 Maintenance Unit, Rushton. No. 44 Maintenance Unit, Holywood, had previously been established to meet supply difficulties in Northern Ireland. Further parks were opened in 1942 and 1943 and details of the formation of these appear later.

Miscellaneous Units

A marine craft storage unit was formed at Dumbarton during the year and was designated No. 62 Maintenance Unit, and a mechanical transport storage unit, No. 99 Maintenance Unit, was formed at Derby, in ex-Balloon Command accommodation.

No. 4 Mechanical Transport Company, London (M.T. Company), was transferred to No. 40 Group and Nos. 5, 6, 7 and 8 M.T. Companies were formed within the Group during the year. 'C' Maintenance Unit, Coventry, which was completely destroyed by enemy action during November 1940, was finally disbanded during March 1941. No. 61 Maintenance Unit (in the 'projected stage' this was known as No. 57 Maintenance Unit) the seventh and last of the Universal Equipment Depots was formed in July 1941 and progressively assumed an issue load. This resulted in a further variation in the dispersal policy and adjustment of the regional areas.

'M' Maintenance Unit, Kidbrooke, and 'P' Maintenance Unit, Ruislip, ceased to exist as separate units in August 1941, and the responsibility for their administration was transferred to 'A' Maintenance Unit, Wembley. Similarly, 'A' Maintenance Unit absorbed the functions of 'B' and 'D' Maintenance Units.

'G' Maintenance Unit, Norwich, and 'L' Maintenance Unit, Salford, were also disbanded. 'F' Maintenance Unit was transferred to Kettering with effect from 13 October 1941, and 'K' Maintenance Unit, Shepton Mallet, was transferred to the Ministry of Aircraft Production.

The Formation of the Universal Equipment Wings¹

Since its inception No. 40 Group had been rapidly expanded as regards both the number of units which it had to control and the extent of its responsibilities. By February 1941 the Group comprised 20 self-accounting units and a large number of hired premises which were used for overflow stocks. Of these, 16 were directly controlled and administered by Headquarters, No. 40 Group,

¹ M.C. File S.5750.

the other four being administered by the Group and controlled operationally by the Air Ministry. The strength of the Group was 450 officers, 4,700 other ranks and 16,600 civilians. Numerous other units were either under construction or contemplated.

Owing to this rapid growth and the magnitude of the work undertaken it had become increasingly difficult to administer and control so many units from a Group headquarters. This situation was further accentuated by the widely dispersed location of the units and the impaired travelling facilities and communications. In these circumstances it was becoming impossible for the Group Commander to keep in sufficiently close touch with units, so as to ensure uniformity and a high standard of efficiency. Much of the time of his staff was spent in travelling long distances on visits of inspection and supervision.

A stage had therefore been reached which demanded the introduction of some measures of relief of the direct control of units by the Group headquarters. What was required was a strengthening of the administrative side of the headquarters, coupled with a reduction in the number of units directly controlled and the decentralisation of functional supervision to staffs in closer contact with the units.

The strengthening of the administrative staff at Group headquarters would leave the Senior Maintenance Staff Officer with the functional control of the Group and enable the Group Commander to devote more time to the operational and maintenance problems.

With regard to the decentralisation of functional supervision from Group headquarters it was considered that there were two alternatives, both of which would strengthen the Group and reduce the number of contacts. These were as follows :—

- (a) To establish three wing formations located in the Northern, Midland, and Southern Areas, each of which would be directly responsible to Group headquarters for functional supervision and defence of all the units in their area ; or
- (b) To reorganise the Universal Equipment Depots (U.E.D.s) into Universal Equipment Wings, each wing being responsible to the Group for the functional control and administration of its own U.E.D. and also the other units in its area.

These two proposals were submitted to the Air Ministry by Maintenance Command with a request that approval be given for the adoption of three independent wings as outlined in (a) above.

The Assistant Director of Organisation Establishments (A.D.O.Est.) visited Maintenance Command and discussed the proposals at great length. There appeared to be two main difficulties, first, the problem of geographical dispersal, and secondly, that the commanding officers of the Universal Equipment Depots were found to be too overburdened to assume responsibility for the detached barrack and clothing sites at the lettered maintenance units in their zone.

It was thought that it would be extremely hard to maintain in practice the division between functional and administrative control and that the wings under the three wing organisation would be bound to grow and the chain of

control might become 'post officed.' The second alternative proposal was the one favoured by Air Ministry, and it was therefore decided to hold an establishments committee meeting to decide exactly what should be done. They reached the conclusion that it would not be satisfactory to interpose wing formations, particularly as, in their opinion, they would tend to lead to delays and waste of personnel. Instead they considered that the U.E.D.s should be suitably strengthened so as to relieve the commanding officer and allow him to exercise a general supervision over all the units in his area for which he would be responsible.

The original proposals were subsequently reconsidered by the A.O.C., Maintenance Command, and the A.O.C., No. 40 Group, in the light of the committee's suggestions, and revised proposals were put forward on that basis. These were subsequently approved by the Director General of Organisation and came into operation on 1 June 1941. Under this scheme the universal equipment depots assumed responsibility for the administration of the units within their area as follows :—

<i>U.E.D.</i>	<i>Responsible for</i>
No. 3 M.U. ..	'A,' 'B,' 'D,' 'M' and 'P' Maintenance Units : Nos. 3 and 4 M.T. Companies.
No. 7 M.U. ..	'E' Maintenance Unit.
No. 14 M.U. ..	'H' and No. 55 Maintenance Units : Nos. 1 and 6 M.T. Companies.
No. 16 M.U. ..	'F' and 'S' Maintenance Units.
No. 25 M.U. ..	No. 2 M.T. Company.
No. 35 M.U. ..	'L' and 'R' Maintenance Units : Nos. 5 and 7 M.T. Companies.

In this connection it was decided that 'A' 'B,' and 'D' Maintenance Units should be telescoped to form one unit, to be known as 'A' Maintenance Unit, and proposals for a revised establishment were prepared. Similarly, 'L' and 'R' Maintenance Units were telescoped to form 'R' Maintenance Unit. It will be observed that the M.T. Companies were placed geographically under the appropriate U.E.D. for the purposes of administration.

The title of 'Universal Equipment Wings' was later changed to that of 'Wing Maintenance Units' and this organisation remained in operation until November 1944,¹ when it was disbanded and three regional wings were formed. The details of the regional wing organisation are included later.

The Formation of the Ground Equipment Depots

The main feature of 1942 was the formation of six ground equipment depots (G.E.D.s) which were located as follows :—

<i>G.E.D.</i>	<i>Location</i>	<i>Formed</i>
No. 66 M.U. ..	Cuckney	1 March 1942
No. 68 M.U. ..	Bolton	23 May 1942
No. 69 M.U. ..	Sandysike	1 March 1942
No. 70 M.U. ..	Woodcote	1 March 1942
No. 72 M.U. ..	Roads	1 March 1942
No. 216 M.U. ..	Sutton Coldfield ..	1 August 1942

¹ See Diagrams 16 and 17.

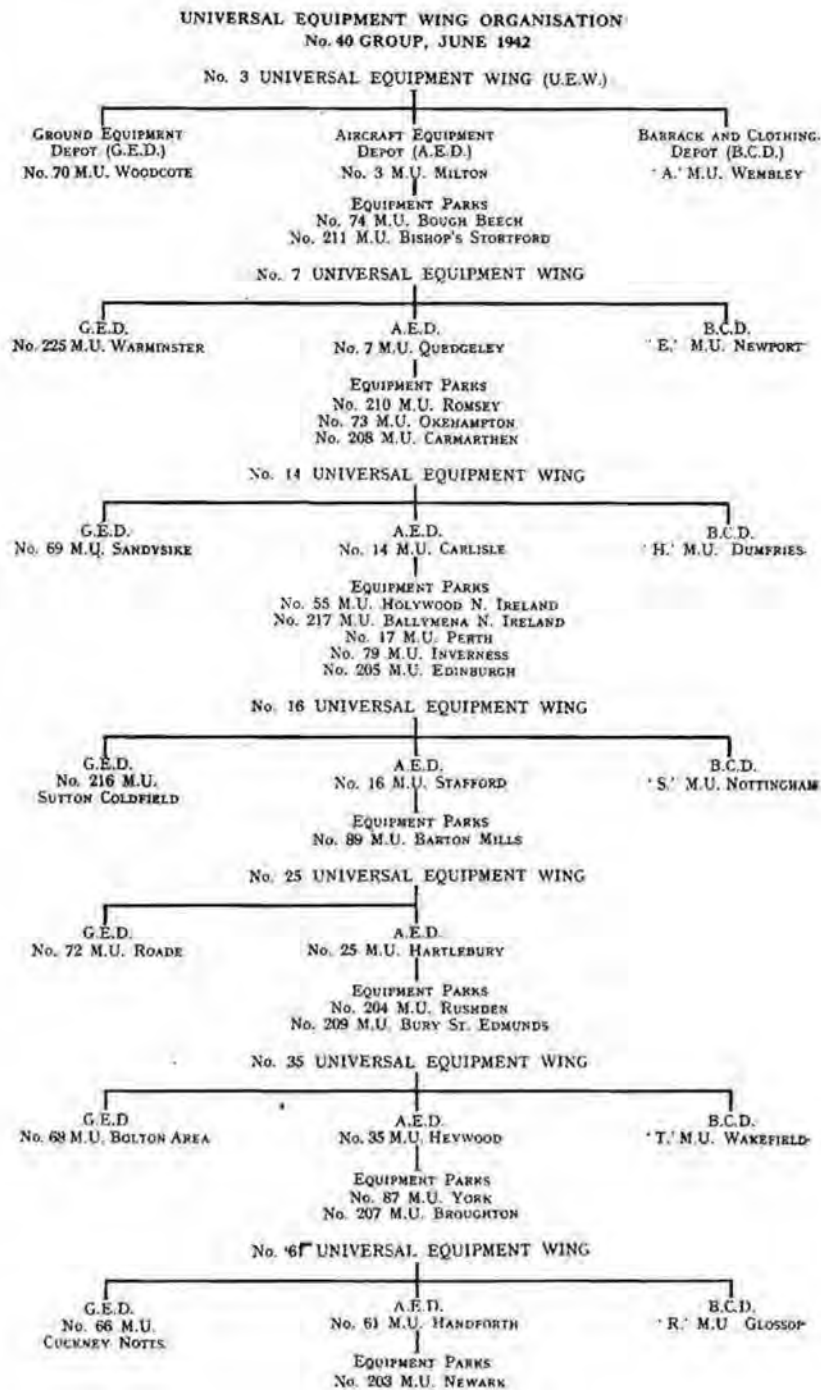
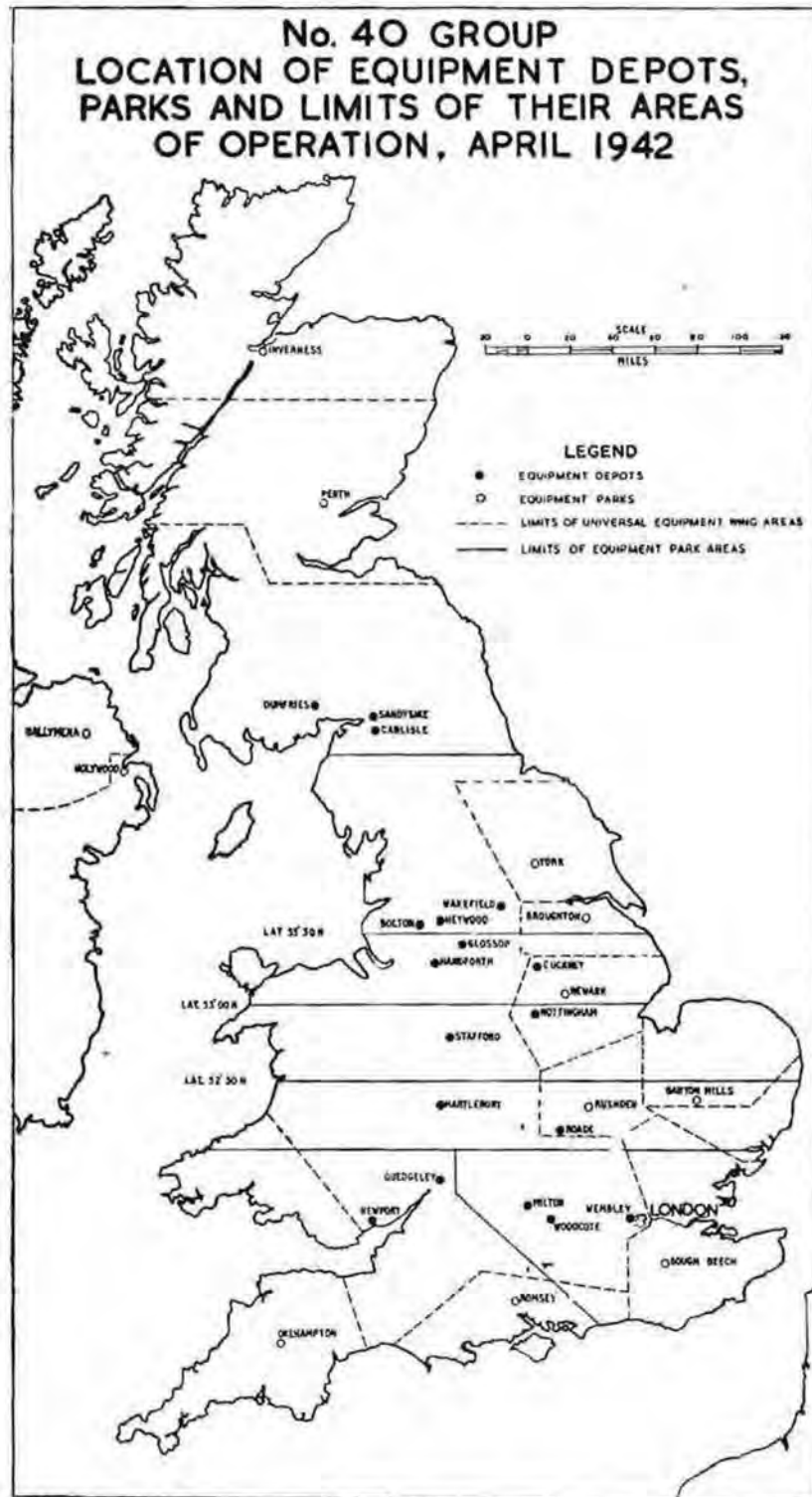


DIAGRAM 17



These ground equipment depots (with the exception of Nos. 68 and 216 Maintenance Units) were originally planned as equipment dispersal depots (E.D.D.s), each with a total of 240,000 super feet of storage accommodation in 32 sheds, each 150 ft. × 50 ft. It was intended that stocks at the equipment dispersal depots should be held on deposit to the main stock records kept in the affiliated universal equipment depots, but the equipment dispersal depots were not intended to receive demands direct from external sources.

It was apparent, however, that the universal equipment depots themselves required further relief from their retail loads, and after reconsideration it was decided to reverse the policy in regard to the equipment dispersal depots so they would be in a position to assume full responsibility for the receipt, storage and issue of items in the following sections :—

Section 1	..	..	Tools.
Section 3	..	..	Machine Tools, Spares and Accessories.
Section 13	..	..	Drawing Instruments.
Section 16B, E, G and H	..	..	Marine Craft and M.T. Stores and Tools.
Section 17	..	..	M.T. Spares.
Section 18	..	..	Marine Craft Spares.
Section 29	..	..	General Hardware.
Section 30A and B.	..	..	Metals.
Section 32A, B and C	..	..	Cordage, Textiles and Rubber.
Section 33	..	..	Paints, Dopes, Chemicals, etc.
Section 41	..	..	Marine Craft Spares.
Section 43A-R	..	..	Mobile Crane Spares.
Section 53	..	..	Spares for Specialist Vehicles.

These depots, then renamed ground equipment depots, were made fully self-accounting units and served the same geographical areas, in respect of their range of equipment, as the universal equipment depots in whose wing areas they were located. The initial stocking-up in respect of Nos. 66, 69, 70 and 72 Maintenance Units was effected by stock transfers of the appropriate sections of Nos. 16, 14, 3 and 25 Maintenance Units, the transfers being carried out in two phases. As soon as 50 per cent of the stock in any one section had been transferred to the ground equipment depot, the ground equipment depot assumed the issue load.

The change in policy in respect of the first four ground equipment depots necessitated some variation in the accommodation already under construction. The depots were designed merely to hold bulk stocks, but on their assumption of responsibility for detailed issues it was necessary to provide additional transportation facilities, heating, windows, offices and signals facilities. No. 216 Maintenance Unit was formed on 1 August 1942, the ex-Balloon Command accommodation at Sutton Coldfield being taken over for this purpose.

In June 1942 depots which had hitherto been known as universal equipment depots (U.E.D.s) were renamed aircraft equipment depots (A.E.D.s) and the newly formed G.E.D.s (sometimes referred to as general equipment depots) were designated ground equipment depots, although their function was to hold general equipment in the known airborne ranges. The barrack and clothing depots retained that title and the abbreviation of B. and C.D.

The Development of the Static Equipment Parks

Eight further static equipment parks were opened during 1942 as follows :—

<i>S.E.P.</i>	<i>Location</i>	<i>Formed</i>
No. 217 M.U.	Ballymena	1 March 1942
No. 205 M.U.	Edinburgh	15 May 1942
No. 210 M.U.	Romsey	8 June 1942
No. 73 M.U.	Okehampton	15 August 1942
No. 208 M.U.	Golden Grove	15 August 1942
No. 207 M.U.	Retford	5 September 1942
No. 89 M.U.	Barton Mills	15 October 1942
No. 211 M.U.	Sawbridgeworth	20 December 1942

These parks were designed to hold equipment in the appropriate airborne ranges.

The Formation of the Mobile Equipment Parks

In June 1942 proposals were submitted by Headquarters, No. 40 Group to provide for the formation of mobile equipment parks which it was maintained would be required :—

- (a) In the event of an invasion involving the rapid disposition of squadrons, with possible disruption of the normal channels of supply from static equipment parks.
- (b) To support squadrons forming the air contingent of an expeditionary force.

In either situation it was important, if operations were to be maintained, that the distributing units supporting the squadrons should be well organised and thoroughly efficient when called upon to fulfil their role. At that time squadrons would have been served by hurriedly organised units, designated as air stores parks, who would have had little or no knowledge of the problems with which they would have been faced. In these circumstances, therefore, it was maintained that there was every justification for the early formation of mobile air stores parks, to be equipped with the types of aircraft the parks would be called upon to maintain either in the event of an invasion or to support an expeditionary force in the field.

In July 1942 Headquarters, Maintenance Command submitted proposals to the Air Ministry to provide for the formation of two mobile equipment parks to be located in the proposed supply areas of No. 73 Maintenance Unit, Okehampton and No. 89 Maintenance Unit, Barton Mills. These units would not have been in a position to commence operations for some months, owing to the delay in the provision of accommodation. It was suggested that the holdings of the parks should be limited to the technical range and should comprise a three months maximum and a two months minimum stock. They were to be fully mobile and self-contained so that they could operate in the same manner as if they were actually in the field.

The approval to commence the formation of the two mobile equipment parks was received early in August 1942. A total of 700 other ranks was trained at these parks which were ultimately transferred to No. 83 Group, Allied Expeditionary Air Force, in 1943. The formation of further mobile air stores parks was undertaken by No. 40 Group, and details of these are given later.

The Barrack and Clothing Organisation and the Formation of No. 55 Wing

The 'T' Maintenance Unit at Wakefield was formed in May 1942, and was the sixth and last barrack and clothing depot to be established. These six depots were to serve the seven universal equipment wing areas, but, in spite of repeated attempts, efforts to obtain suitable hirings in the Hartlebury area proved unsuccessful. Nevertheless it was essential that the range of barrack equipment and clothing then accommodated at Hartlebury should be removed, in order that the storage space could be made available for technical stores.

It was considered that there was no fundamental reason why the barrack and clothing areas of supply should coincide with those of the universal equipment wings, and in view of the fact that it was necessary to arrange barrack and clothing depots in areas where properties were being made available by the Board of Trade, and not necessarily in the localities most conveniently placed for No. 40 Group holdings, to attempt to fill the universal equipment wing supply lines would frequently be inconvenient and uneconomical. Accordingly, authority was sought to split the country into six areas for the supply of barrack equipment and clothing. This was agreed and implemented with effect from 16 June 1942, and simultaneously the contract deliveries of these stores ranges to No. 25 Maintenance Unit ceased and the holdings at that universal equipment depot were dispersed.

The organisation in respect of the barrack and clothing depots was finalised by the formation of No. 55 Wing at Derby on 1 August 1942. The new wing headquarters was responsible for the administration of all barrack and clothing depots within No. 40 Group, i.e. 'A', 'E', 'H', 'R', 'S' and 'T' Maintenance Units, for all matters affecting these depots, and for interpreting No. 40 Group policy at wing level. This organisation remained in operation until the regional wings assumed control in November 1944.

Miscellaneous Units

No. 210 Maintenance Unit at Poynton opened with effect from 16 March 1942, and operated as a centralised overseas bond. This unit occupied accommodation originally constructed for No. 61 Maintenance Unit under whose jurisdiction they came, No. 201 Maintenance Unit being self-accounting for stores only.

No. 232 Maintenance Unit, White City, was formed within No. 3 Wing in September 1942, the new unit assuming responsibility for the under-mentioned commitments hitherto carried out by 'A' Maintenance Unit, Wembley. The barrack equipment in store at White City was accordingly transferred to 'A' Maintenance Unit at Wembley.

Mechanical Transport Reception Depot,
Section 4 of Ground Equipment,
Section 6D, Gas Cylinders,
Section 16G, Moorings (pending completion of transfer to No. 4 Maintenance Unit).

Nos. 1, 2 and 3 Canal Clearing Depots (C.C.D.s), at Paddington, Birmingham and Manchester respectively, continued to operate throughout the year. Where

possible the contractors, who were normally within 10 to 25 miles of the depots, were instructed by the relative Master Provision Offices to effect deliveries to maintenance units via the canal clearing depots. The equipment so transported was unloaded at convenient locations for subsequent collection by maintenance units. This method provided notable relief in the already congested railway sidings at the depots, and during 1942 the following tonnage was shipped by the C.C.D.s :—

No. 1 C.C.D. Paddington	5,049 tons
No. 2 C.C.D. Birmingham	5,181 „
No. 3 C.C.D. Manchester	4,753 „
Total	14,983 „

Full details of the canal clearing depot organisation until its closure in November 1944 are given later.

The School of Industrial Supervision was formed at No. 216 Maintenance Unit, Sutton Coldfield, in December 1942. It was at first rather in the nature of an experiment, and it was thought that such facilities as could be made available at a school would prove to be of great assistance in improving the knowledge of personnel within No. 40 Group and tend to increase their efficiency, which was being jeopardised by the poorer class of labour then becoming available. The panel of lecturers at the school was composed of both Service and civilian specialist personnel, and the school itself was in the charge of a Commandant of the rank of Flight Lieutenant, but this was later upgraded to the rank of Squadron Leader.

At the end of 1942 the following units were being administered by No. 40 Group :—

7 Aircraft Equipment Depots	(A.E.D.s).
6 Ground Equipment Depots	(G.E.D.s).
6 Barrack and Clothing Depots	(B. and C.D.s).
15 Equipment Parks	(E.P.s).
2 Mechanical Transport Units	(M.T.U.s).
1 Marine Craft Storage Unit	(M.C.S.U.).
2 Mobile Equipment Parks	(M.E.P.s).
2 Miscellaneous Units.	

The Year of Internal Reorganisation

The expansion of the Group continued during 1943, though not on such a vast scale as that during 1942. A number of small miscellaneous units were formed and disbanded during the year and much attention was directed to internal reorganisation with a view to improving efficiency.

On 16 April 1943 No. 209 Maintenance Unit at Broughton was formed and this proved to be the last of the equipment parks. No. 55 Maintenance Unit at Holywood was disbanded with effect from 13 June 1943, and its functions were absorbed by No. 217 Maintenance Unit at Ballymena. Prior to March 1943 the equipment parks were serving operational stations only with the airborne ranges of spares, but with effect from that month arrangements were made

for them to take a regional load covering all the A.E.D. and G.E.D. requirements of stations in their areas. The post of the officers commanding parks was upgraded in November 1943 to the rank of Squadron Leader.

When originally formed the ground equipment depots served areas similar to those served by the affiliated aircraft equipment depots, but in 1943 the areas served by the G.E.D.s in the Midlands and northern parts of England were rearranged so as to give better distributing facilities. The post of the officers commanding G.E.D.s was upgraded in July 1943 to the rank of Wing Commander. The last of the G.E.D.s, No. 225 Maintenance Unit, Warminster, was formed on 1 June 1943 and the unit was stocked progressively.

To meet the heavy receipts and issues of marine craft a second marine craft storage unit, No. 238 Maintenance Unit, was formed at Tewkesbury on 26 April 1943.

The Balloon Centre at Chessington was transferred to No. 40 Group on 15 April 1943 and the accommodation was utilised as a sub-site of No. 3 Maintenance Unit. Mechanical transport vehicles and components, engines and propellers and other miscellaneous items were held there on behalf of Milton. With effect from 9 November 1943, however, the sub-site took the form of a separate unit bearing the title of No. 240 Maintenance Unit. Certain balloon centre accommodation at Norton and Bishopbriggs was transferred to No. 40 Group during May 1943 and the accommodation thus made available was used by Nos. 35 and 14 Maintenance Units respectively for the storage of mechanical transport vehicles, components and other miscellaneous equipment. In October 1943 Bishopbriggs was given the title of No. 239 Maintenance Unit with independent status. Similar action was taken in respect of the accommodation occupied at Norton when in December it assumed the title of No. 241 Maintenance Unit.

The only lettered maintenance units remaining at this time were the barrack and clothing depots, and in order to accord with the policy of identifying maintenance units by numbers the depots were given the following titles with effect from 1 December 1943 :—

- 'A' Maintenance Unit, Wembley, became No. 212 Maintenance Unit.
- 'E' Maintenance Unit, Newport, became No. 214 Maintenance Unit.
- 'H' Maintenance Unit, Dumfries, became No. 220 Maintenance Unit.
- 'R' Maintenance Unit, Glossop, became No. 221 Maintenance Unit.
- 'S' Maintenance Unit, Nottingham, became No. 227 Maintenance Unit.
- 'T' Maintenance Unit, Wakefield, became No. 230 Maintenance Unit.

A number of mobile air stores parks were formed within the Group during 1943 for employment with the Allied Expeditionary Air Force. Nos. 229 and 228 Maintenance Units were transferred to the 2nd Tactical Air Force with effect from 6 April and 29 November 1943 respectively. Further parks were also transferred on the following dates :—

- No. 402 Air Stores Park transferred to No. 83 Group on 21 May 1943.
- No. 404 Air Stores Park transferred to No. 83 Group on 4 June 1943.
- No. 406 Air Stores Park transferred to No. 83 Group on 7 August 1943.
- No. 206 Maintenance Unit (Polish A.S.P.) transferred to No. 84 Group on 15 September 1943.

Thus, apart from the units which had been disbanded during the year, and those formed and transferred to the Allied Expeditionary Air Force, No. 40 Group were administering a total of 44 units at the conclusion of 1943 as follows :—

- 7 Aircraft Equipment Depots (A.E.D.s).
- 7 Ground Equipment Depots (G.E.D.s).
- 6 Barrack and Clothing Depots (B. and C.D.s).
- 15 Equipment Parks (E.P.s).
- 4 Mechanical Transport Units (M.T.U.s).
- 2 Marine Craft Storage Units (M.C.S.U.s).
- 3 Miscellaneous Units.

Note.—The canal clearing depots were operated as sites of adjacent maintenance units and are therefore not shown separately in the above list.

The Introduction of the Three Regional Maintenance Wings

When Maintenance Command in February 1941 put forward their two alternative proposals for the decentralisation of control in No. 40 Group they had strongly recommended the adoption of the three wing organisation on the grounds that it would result in greater control, reduced contact and correspondence, and an all-round improvement in efficiency. Their opinions, however, were overruled by the Air Ministry and the alternative seven wing organisation was adopted.¹ It was not until 25 August 1944 that it was finally agreed that the seven wing organisation was unsatisfactory and that a reduction in the number of wings to three should be brought about.

Instructions were therefore issued for the formation of Nos. 55, 56 and 57 (Maintenance) Wings as follows :—²

<i>Maintenance Wing</i>	<i>Location</i>	<i>Date of Formation</i>	<i>Parent Unit</i>
<i>Headquarters</i>			
No. 55	Municipal Buildings, Derby.	9 September 1944 (as reorganised)	No. 99 M.U.
No. 56	R.A.F. Station, Annan.	4 September 1944	No. 14 M.U.
No. 57	Molton House, Milton.	28 August 1944	No. 3 M.U.

The three wing headquarters were formed to a provisional establishment authorised by Air Ministry, and were superimposed on the existing seven (Maintenance) Wings and No. 55 (Barrack and Clothing) Wing organisation.

During the period between the date of formation and 1 October 1944, the staff available was limited to a few senior officers only who carried out a survey to determine the final requirements of the new formations. No executive control was exercised by the new formations during this interim period.

The existing seven wing formation was dissolved on 6 November 1944, leaving Nos. 55, 56 and 57 (Maintenance) Wings permanently established in their

¹ M.C. File S.5750.

² Maintenance Command O.R.B.s, 1944.

respective geographical regions, each being responsible to No. 40 Group for its complement of maintenance units.¹

Miscellaneous Units

The expansion during 1944 was not so marked as in the two preceding years, no major units were formed or disbanded, but to some extent administration was made more difficult by the acquisition of storage accommodation at vacated airfields and stations thrown up as a result of the disbandment of Balloon Command.

A small Service detachment was established at the offices of the British Tabulating Machine Company at Cirencester in May 1944, for the purpose of preparing tabulated statements of shipments to overseas Commands. This was given the title of 'R.A.F. Detachment,' and was placed directly under the administrative control of Headquarters, No. 40 Group.

An Airborne Forces Parachute Servicing Section was formed at Marham in June 1944 to meet the increasing commitments for all types of parachutes, in particular those required for supply dropping purposes. The aircraft hangars at Marham were taken over for the detachment which was in the first place established on the adjacent equipment park (No. 89 Maintenance Unit, Barton Mills). It was subsequently found that this establishment was administratively unsatisfactory, and all the remaining accommodation at Marham, together with the parachute detachment, was taken over by No. 25 Maintenance Unit as a sub-site to that depot.

The Balloon Centre at Kidbrooke was severely damaged by flying bombs in June 1944, and in order to make good the accommodation lost and to provide adequate facilities for the maintenance of the balloon barrages, it was decided by the Air Ministry that No. 240 Maintenance Unit at Chessington should be evacuated by No. 40 Group immediately. The dispersal of stocks from Chessington at short notice presented a problem of some magnitude as heavy loads were at that time being borne by the southern maintenance units. However, the accommodation was cleared and handed back to Balloon Command with effect from 15 July 1944.

No. 40 Group Detachment, Lyneham, was formed on 15 August 1944, its function being to receive from maintenance units and contractors the equipment destined for despatch by air to all theatres. This did not include the 'A.O.G.' requirements of overseas Commands.

The programme for the disbandment of Balloon Command was announced during September 1944. In general this provided for the return of surplus equipment within Balloon Command to certain selected balloon stations which, on completion of stocking, would be transferred to No. 40 Group together with the working parties. The accommodation at numerous vacant airfields was progressively becoming available for storage purposes, and as no new construction could be contemplated vacated stations and balloon centres were the only sources of immediate extra accommodation. Details of these will be found under the heading 'The Shortage of Equipment Storage.'

¹ Details of the three wing organisation in September and November 1944 are shown in Appendix 15.

In 1943 a nucleus forward equipment unit had been formed at No. 3 Maintenance Unit for issues to the 2nd Tactical Air Force. This nucleus was later formed into the base maintenance unit and located at Stapleford Tawney, under the control of No. 85 Group. It was intended that the base maintenance unit should move to the Continent to maintain the air forces located there, and this unit was, therefore, transferred to Bicester and renamed the Forward Equipment Unit (F.E.U.). All equipment, with few exceptions, which was consigned to units of the 2nd Tactical Air Force was forwarded through this F.E.U. In addition the F.E.U. was progressively stocked in readiness for its projected move to the Continent and where possible it met demands from the stocks so accumulated. However, it was finally decided that the F.E.U. should not move to the Continent but should remain in the United Kingdom and supply from there the requirements of the air stores parks operating on the Continent. It was suggested by Headquarters, No. 40 Group that the existence of a unit such as the F.E.U., as then constituted, was both uneconomical and undesirable, and the following alternatives were recommended for consideration :—

- (a) That the F.E.U. should be disbanded and its functions absorbed into No. 40 Group.
- (b) That the storage functions of the F.E.U., as distinct from transit, packing and despatch, should be absorbed by No. 40 Group and that the F.E.U. should remain merely as a transit centre, with packing functions sufficient to prepare equipment for despatch according to their route.

It was agreed at a meeting held at the Air Ministry on 25 December 1944 that the F.E.U. should be reconstituted as a transit centre under the control of No. 57 Maintenance Wing in No. 40 Group. This became effective on 1 January 1945 when the F.E.U. assumed the title of No. 246 Maintenance Unit. In May 1945 No. 40 Group comprised :—

- 7 Aircraft Equipment Depots (A.E.D.s)
- 7 Ground Equipment Depots (G.E.D.s)
- 6 Barrack and Clothing Depots (B. and C.D.s)
- 15 Equipment Parks (E.P.s)
- 4 Mechanical Transport Units (M.T.U.s)
- 2 Marine Craft Storage Units (M.C.S.U.s)
- 2 Miscellaneous Units (including No. 246 Maintenance Unit).

The Types of Equipment Depots in 1945

The main types of depots in use in May 1945 and their functions were briefly as follows :—

(a) *Aircraft Equipment Depots (A.E.D.s).* All these depots (with the exception of No. 3 Maintenance Unit, Milton) were planned to accord with a policy of dispersal and consisted, therefore, of a headquarters site and six or seven separate sites, one to three miles apart. Each contained four or more storage sheds which were generally of three types.

- (i) Fully protected, of stout concrete and steel girder construction in two sizes, approximately 56,000 square feet and 4,000 square feet in area respectively.

- (ii) Semi-protected, having reinforced concrete walls with roofs of cement asbestos sheeting. The area of these was 56,000 square feet each.
- (iii) Unprotected, lightly constructed of cement asbestos sheeting on steel frames with cement asbestos roofs. Their area was normally 40,000 square feet.

DIAGRAM 18

A SUMMARY OF THE GROWTH OF UNITS WITHIN NO. 40 GROUP
1939-1944

Nature of Unit	Feb. 1939	Sept. 1939	Dec. 1939	Dec. 1940	Dec. 1941	Dec. 1942	Dec. 1943	Dec. 1944
Stores Depots ..	3	2	2	—	—	—	—	—
Miscellaneous ..	7	5	7	8	—	2	3	1
Aircraft Equipment Depots	—	5	6	6	7	7	7	7
Barrack and Cloth- ing Depots ..	—	3	3	6	5	6	6	6
M.T. Companies ..	—	—	—	3	8	—	—	—
Equipment Parks ..	—	—	—	—	7	15	15	15
M.T. Units	—	—	—	—	2	2	4	4
Marine Craft Storage Units	—	—	—	—	1	1	2	2
Mobile Equipment Parks	—	—	—	—	—	2	—	—
Ground Equipment Depots	—	—	—	—	—	6	7	7
Totals	10	15	18	23	30	41	44	42

Note: In addition to the above, the F.E.U., Bicester, was absorbed by 40 Group with effect from 1 January 1945 on which date the unit was renamed No. 246 M.U.

These depots stored aircraft spares and airborne equipment from complete engines to sparking plugs; there was one 10-ton electric crane in each depot, situated in the transportation shed on the headquarters site, and a number of 2-ton electric cranes were situated strategically about the depot. There were two or more 2-ton hand cranes in most of the storage sheds. All these depots had a direct main line railway connection. The workshops were used primarily for the manufacture of special packing cases, for the repair and overhaul of the depots' transport vehicles, and for the minor repair of equipment received from contractors in a damaged condition or returned from units in a similar state. All other repair work was carried out by No. 43 Group and the Civilian Repair Organisation. The depot workshops also incorporated in existing stocks of equipment the modifications subsequently received from the contractors who were embodying these improvements in their current deliveries, and were also responsible for making serviceable equipment which had deteriorated in store, and for periodical inspection of engines, magnetos, etc., etc.

(b) *Ground Equipment Depots (G.E.D.s)*. These depots housed the non-airborne technical equipment, such as cordage, dopes, mechanical transport spares, tools, etc. There were seven of these depots, one under hirings and one at an ex-balloon centre. The remainder were specially situated in wooded country and comprised approximately 40 dispersed sheds which were lightly built steel-framed buildings, walled and roofed with corrugated iron, and each had a gross area of 7,500 square feet or a total area of 300,000 square feet per depot.

(c) *Equipment Parks (E.P.s)*. There were 15 equipment parks functioning in May 1945. Each held all stores, with the exception of the barrack and clothing items, required by the units in their supply areas. No. 217 Maintenance Unit, Ballymena, was the exception as, due to its location, it held a more or less universal stock, including clothing. No. 210 Maintenance Unit, Romsey, was manned predominantly by W.A.A.F. personnel, and the unit was commanded by a squadron officer. The policy at that time was to make equipment parks self-accounting, and this was being carried out progressively, although it did not apply to all the 15 parks.

(d) *Barrack and Clothing Depots (B. and C.D.s)*. There were six depots of this type all in hirings, such as exhibition buildings, skating rinks, factories and cinemas, and they held only uniform and clothing both for the R.A.F. and W.A.A.F., anti-gas clothing and barrack stores, and ground fire-fighting equipment.

(e) *Mechanical Transport Reception Depots (M.T.R.D.s)*. These units acted as mechanical transport storage depots and supplemented the holdings at the aircraft equipment depots. A large proportion of the stored reserve was held at the aircraft equipment depots and their dispersed mechanical transport sites.

(f) *Marine Craft Storage Units (M.C.S.U.s)*. One unit on the south-west coast of Scotland maintained the reserves of R.A.F. marine craft. The major repairs to marine craft were effected by its parent unit of No. 43 Group. A similar M.C.S.U. was also opened at Tewkesbury.

The Shortage of Equipment Storage¹

In December 1940 Maintenance Command became very concerned with the growing shortage of equipment storage and the high proportion of the storage in use which was situated in industrial target areas.

Of the eight and a half million square feet of storage space employed at that time, some one and a half million square feet was situated in industrial areas such as London, Newport, Sheffield and Manchester. Three per cent of the storage had already been destroyed at Coventry and further space had been made untenable in London as a result of enemy action. It was therefore feared that if the enemy continued the concentrated attacks on industrial towns there would be a serious risk of further losses in stocks and buildings. It was true that stocks were generally lost with the buildings and therefore ceased to become a storage problem, but deliveries off contracts continued and

¹ M.C. File S.9383.

had to be diverted elsewhere until the lost storage was replaced. No such reserve storage had been provided to cover this.

As regards the future storage position, additional space was required for the proposed expansion and for the large number of American types which were coming into service. It was impossible to calculate exactly the storage volume required owing to the thousands of items involved, each differing in shape and size and whose future rates of consumption were unknown. Some indication could, however, be obtained by comparing the ratio of the existing first line strength with that of the proposed expansion whilst at the same time taking into consideration certain factors enumerated below.

It was understood that the expansion contemplated an increase of 228 squadrons plus a number of operational training and ancillary units, by June 1942. This represented approximately a 100 per cent increase on the existing first line strength, including overseas Commands. However, it did not follow that the increase in equipment holding would be in direct proportion because the existing holding of many items was far below the reserve originally authorised and it was reasonable to anticipate that in the future overseas Commands would receive certain ranges of spares direct from American and Dominion industry. It was also possible that equipment depots would be by-passed, at least in part, by the development of the method of direct supply of difficult spares from contractor to consumer. On the other hand there were many new types of aircraft coming into service for which stocks would have to be built up, whilst the spares held for old types would still require to be retained to cover training and overseas requirements. Enormous quantities of barrack and clothing stores were being purchased to cover the expansion and possible future expeditionary forces, and this would have to be stored until required. The new dispersal policy also meant additional space and as already mentioned there was a need for reserve storage to replace that lost by enemy action.

Bearing in mind that the existing equipment storage was already congested, it was considered that approximately a 50 per cent increase in storage area would be required by June 1942. It was therefore recommended that the figure of three and a half million square feet be accepted on the additional space required, but that the position should be continually reviewed and adjusted in the light of future experience.

To meet this requirement there was approximately 200,000 square feet vacant in existing storage. One and a half million square feet was under construction at Handforth and other equipment depots; and a number of civil premises were being taken over as depositories for overflow stocks. Properties suitable for storage were becoming increasingly difficult to find in safe areas, and although every effort was being made to search for them, including underground mines and disused tunnels, it was not anticipated that more than a million square feet would be obtained by this means.

This meant that a further million square feet would have to be provided by building and it was considered that a seventh universal equipment depot should be constructed in the Wellingborough area in time to be completed and stocked prior to June 1942.

A summary of the storage position at that time is as follows :—

Storage in use	8½ million square feet
Storage under construction	1½ „ „ „
Further storage to be found in hired premises in safe areas	1 „ „ „
Storage to be constructed (new U.E.D. at Wellingborough)	1 „ „ „
Total storage required by August 1942 ..	12 „ „ „

With regard to the 1½ million square feet of storage in use in industrial target areas, it was considered this risk should not be accepted and that alternative storage should be provided to enable units in these areas to be vacated as soon as possible. It was suggested that this provision should be made by building six lightly constructed equipment dispersal depots in safe areas and relying upon wooded country, dispersal and camouflage for their protection. Each depot would be within forty miles by road of a universal equipment depot (U.E.D.) to reduce transportation and enable the workshop facilities of the U.E.D.s to be shared. The parent U.E.D.s which were provisionally selected were Nos. 3, 7, 25, 16 and 35 Maintenance Units. The estimated cost of each unit was £107,000.

However, Air Ministry were opposed to the idea of constructing another universal equipment depot because on investigation it was found that such a depot would take at least two years to build and it was unlikely that Cabinet permission would be forthcoming for the necessary labour and materials.¹ Good progress was being made with the construction of the seventh U.E.D. at Handforth, and it was therefore decided to construct the proposed equipment dispersal depots (E.D.D.s) and make up the deficiency for the time being by increasing the number and capacity of the hirings.² By November 1941 four of these E.D.D.s were under construction, whilst the existing storage space at that time was :—³

U.E.D.s	7,168,000 sq. feet.
Hirings	509,000 „ „
B. and C.D.s.	3,613,000 „ „
Equipment Parks	80,000 „ „
Total	11,370,000 „ „

It was estimated that 5 per cent of this area was vacant and that racks and bins were 85 per cent full.

In addition to this there was 1,000,000 sq. feet under construction in the form of equipment dispersal depots, which together with 426,000 sq. feet under acquisition or earmarked for hirings or equipment parks made a grand total of 12,796,000 sq. feet.

¹ A.M. File S.68709 (re-registered A.571577/43).

² A.M. File S.53362.

³ Details of the equipment storage position from November 1941 to December 1944 are shown in Appendix 14.

The Air Ministry had calculated that on the basis of proportionate expansion of the Air Force an additional 10,000,000 sq. feet would be required by July 1943, and that this would be required at the rate of approximately 5,000,000 sq. feet a year. Deducting 1,138,000 sq. feet of vacant space from the total of existing storage and adding 5,000,000 sq. feet for the year's requirements brought the total required by July 1942 to 15,232,000 sq. feet. With a total of 12,796,000 sq. feet already existing or earmarked this left some 2,436,000 sq. feet still to be found by July 1942.

When it was decided to develop the universal equipment wings in June 1942 it became necessary to convert the equipment depots and to increase their number to seven. An aircraft equipment depot (A.E.D.) was required in the London area and this need was met by hiring 60,000 sq. feet at the White City. This brought the total number of A.E.D.s to eight.

The actual storage space in use by September 1942 was 13,668,000 sq. feet with 435,000 sq. feet still to be constructed at the new ground equipment depots at Sutton Coldfield and Warminster.

By March 1943 the position was as follows :—

A.E.D.s	..	..	..	7,529,656 sq. feet.
G.E.D.s	..	..	..	1,576,640 „ „
B. and C.D.s	..	..	..	5,446,105 „ „
<i>In use Total</i>				14,552,401 „ „
UNDER CONSTRUCTION				
A.E.D.s	..	..	..	2,100,000 sq. feet.
G.E.D.s	..	..	..	615,000 „ „
<i>Grand Total</i>				17,267,401 „ „

Whilst in May 1943 it was :—

A.E.D.s	..	..	..	9,264,800 sq. feet.
G.E.D.s	..	..	..	1,629,820 „ „
B. and C.D.s	..	..	..	5,902,590 „ „
Forward Holding Units	..	..	..	273,410 „ „
M.T. Reception Depots	..	..	..	57,000 „ „
M.T. Storage Sites	..	..	..	30,000 „ „
				17,157,620 „ „
UNDER CONSTRUCTION OR APPROVED				
A.E.D.s	..	..	..	2,121,500 sq. feet.
G.E.D.s	..	..	..	630,000 „ „
<i>Grand Total</i>				19,909,120 „ „

The storage area available for the aircraft equipment depots in March 1944, including that under construction or approved, was 12,523,590 sq. feet. This

area together with the 2,486,570 sq. feet in use at ground equipment depots and the 6,066,740 sq. feet at barrack and clothing depots made a grand total of 21,076,900 sq. feet.

Although it had been thought that provision had been made up to September 1944, the accumulations of stock during the first half of 1944 had exceeded the forecast figure, and in consequence a thorough investigation was made by Maintenance Command into the future storage requirements for the period ending 30 June 1945. From this it was estimated that approximately 7,000,000 sq. feet of space (or the equivalent of four A.E.D.s) would be needed, and of this at least 50 per cent would be required by September 1944. In the time available, construction would have been out of the question and it was recommended that accommodation for this phase should be provided by additional hirings or the release of Service accommodation. This survey was followed by a meeting held at Air Ministry on 21 June 1944 at which it was agreed that some reduction in the estimates could be made on the reasonable assumption that the clearance of redundant stocks would be accelerated. The storage requirements for the period were therefore reduced to 6,000,000 sq. feet, and as new construction could only be undertaken to a very minor extent (60,000 sq. feet) almost all the space would have to be provided in premises already constructed, e.g. redundant aerodromes thrown up by other Commands.

By June 1944 additional hirings and completion of buildings in hand had raised the total storage area to 21,765,000 sq. feet, but the position was becoming acute and was likely to get worse. The possibilities of arranging extensive open-air storage were explored, in order to ensure the best use of the limited covered accommodation available. It was decided that equipment suitable for storage in the open should be scheduled by sub-committees and the scheme was commenced in November 1944.

By the end of December 1944 the storage area for the aircraft equipment depots had increased to 14,029,923 sq. feet, chiefly as a result of the allocation of some fifteen redundant R.A.F. stations with a total storage capacity of 1,486,484 sq. feet.¹ The ground equipment depots showed a slight increase to 2,583,543 sq. feet whilst the barrack and clothing depots were reduced to 5,860,328 sq. feet. However, the grand total of 22,473,794 sq. feet for all types of depots represented an increase over the June figure of 1,396,894 sq. feet.

At a meeting held at Maintenance Command Headquarters on 8 January 1945, various proposals for increasing the storage accommodation within No. 40 Group were considered, but owing to the fact that all labour for major building projects during the year had already been allocated the only forms of additional storage for which there was any hope were as follows :—²

- (a) The provision of additional equipment dispersal depot sheds by Air Ministry.
- (b) The erection of blister hangars under local Command arrangements.
- (c) The use of hard standings already available at airfields in the form of runways and dispersal points, etc.

¹ A.M. File S.101315.

² Maintenance Command O.R.B.s.

It was not anticipated that it would be possible to lay hard standings at the aircraft equipment depots owing to the lack of labour, but this was subsequently overcome, at least in part, by the use of old railway sleepers. The Command were, in fact, faced with the prospect of an increasing number of scattered storages all over the country with all their attendant difficulties. Meanwhile, the shortage of covered accommodation continued and in February 1945 the Secretary of State for Air decided that immediate steps should be taken to dispose of large quantities of technical equipment which the Air Ministry provisioning branches had declared to be surplus to future requirements. It was estimated that when this clearance had been effected over 2,000,000 sq. feet of badly needed covered storage would become available. A high priority was therefore accorded to the task, additional personnel and M.T. vehicles were established at each aircraft equipment depot and the Ministry of Aircraft Production were approached with a view to the establishment of an additional Metal Produce Recovery Depot in the South of England.

By this time it had become apparent that the war in Europe was reaching its closing stages and discussions accordingly centred on such matters as post-war policy within the Group and the arrangements which would have to be made for the reception and disposal of equipment from stations closing down.

The Dispersal of Stocks at Equipment Depots¹

The principle of holding a universal range of all classes of stores at each equipment depot afforded a large measure of dispersal and this was further increased by the layout in the newer types of depot which provided for six widely separated sites, each site consisting of four to five fully protected and non-protected large-size sheds. In addition there were a number of fully-protected smaller sheds on each site for valuable stores. It had been the practice in the past to store one item of equipment in one building only, with the exception of the stock of aero-engines, which had been split between two sites.

By the end of 1940 it was realised that with enemy bases so much nearer, enemy aircraft could approach the depots from the west and south, thereby increasing the threat of attack and rendering the original plan of dispersal inadequate. The ideal, from a security aspect, would have been to hold a comprehensive range of items on each depot site, so that if a number of sheds were destroyed only a small portion of each item would have been lost and issues to units could have been continued. This, however, would have been impracticable, as the administrative difficulties of keeping trace of such widely separated stocks and maintaining an equal division between sites would have outweighed the greater security which would have been afforded.

Further dispersal and protection of stocks was, however, possible and indeed essential, especially with regard to the more important items which would have been most difficult to replace, and in October 1940 steps were taken to provide for this on the following lines :—

- (a) Splitting stocks between sheds and sites as far as possible without seriously compromising the control over the receipt and issue.

¹ M.C. File S.9052.

For example, by dividing the important ranges of aircraft equipment between two sites and spreading aero-engines and airscrews throughout every protected shed in each depot, main aircraft components were also dispersed into a number of protected sheds.

- (b) Dispersing stocks within sheds by splitting the stock of individual items into groups scattered around the sheds.
- (c) By protection within the sheds using sandbags, heavy cases, bins and even some of the stouter items of equipment themselves to form traverses of the more vulnerable items against damage by splinters. Asbestos screens were also provided to divide sheds holding inflammable stores, so that a fire could be isolated.
- (d) Storage in the open was not satisfactory for many types of stores but where this was possible it was done by forming dumps between sheds and camouflaging. This was considered to be a perfectly suitable method of storage for such items as galvanised hardware, drummed oil and other similar stores. M.T. vehicles were also stored where there was natural tree cover within the depot boundaries, and where this did not exist they were stored in sheds throughout the depot.
- (e) By dispersion to local depositories and garages of large stocks of items for which there was little turnover.
- (f) Protection of personnel by the construction of sandbag shelters within the sheds for use in the event of a surprise attack.
- (g) Additional precautions were also taken to protect all fire-fighting appliances and petrol points with sandbags. Repair materials and tarpaulins were also held in readiness so that temporary repairs could be made at once to damaged sheds, thus preventing further damage to stocks due to exposure. Large concentrations of stocks awaiting unloading were also avoided by dispersal throughout the depot lines at nightfall.

The work of dispersing equipment was given a high priority, but progress was handicapped by the acute shortage of storage space in the Group and the difficulty which was experienced in acquiring outside depositories.

Stock Control and Provisioning

In May 1939 the dispersal of stocks held at the stores depots to the new universal equipment depots was commenced. The dispersal was arranged and carried out in a hasty manner with the result that for some time afterwards no exact stock figures existed for the depots.

With the total stock of any particular item divided between a number of depots the need arose for some form of consolidated stock record. These data were required by the central provisioning branches and also as a means of matching demands to the depots holding the necessary stock. It was therefore decided to form Master Provision Offices (M.P.O.s).¹ After some unsuccessful attempts at devising a procedure which would provide the M.P.O. with the

¹ See also Part I, Chapter 3.

information in the manner and with the speed desired, the posting slip was introduced in October 1939. This method of informing the M.P.O.s of receipts and issues of stocks at the individual depots remained in force throughout the war with the exception of those vocabulary sections which became mechanised.

The rapid expansion of the Royal Air Force, coupled with the increase in the range and number of items being provisioned necessitated a corresponding increase in the number of master provision offices. The number of M.P.O.s and the respective number of items provisioned by them in April 1945 were as follows :—

Type of spares provisioned	No. of M.P.O.s	No. of items provisioned		Total
		' Active '	' Current Supply '	
Airframe spares ..	3	56,614	185,291	241,905
Engines and engine accessories	1	34,700	16,700	51,400
Radio, electrical and armament spares ..	1	87,300	9,700	97,000
Misc. airframe spares and A.G.S.	1	21,601	26,394	47,995
Tools and materials ..	1	4,955	4,358	9,313
M.T. spares	1	31,905	135,095	167,000
Barrack and clothing ..	1	14,127	5,401	19,528
American spares and equipment	1	60,356	118,766	179,122
Totals	10	311,558	501,705	813,263

In December 1940 provision scheme 'A' was published. This was the first of the provision schemes designed to provide an automatic method of reviewing every item of equipment twice each year, and items which were sufficiently 'active' once each month. This ensured adequate forward cover on contract. The scheme was initially applied to airframe spares but subsequently was extended to cover other types of equipment. The basic principles of scheme 'A' were, however, retained, although minor modifications were necessary to meet the particular requirements of individual vocabulary sections.

Early in the war it was decided that the duplication of accounting caused by the maintenance of the main stock ledgers was unnecessary and should be discontinued. In July 1940 the storehouse 'tally cards' were withdrawn from the storehouses and centralised in the unit headquarters building, where they were maintained by clerical staff employed in the newly formed stock recording section. The stock recording section was housed in close proximity to the demand control officer and these two sections were later amalgamated under the chief equipment officer to form the stock control office. In the same year, 1940, the schedule of requirements and issues (Form 1368) was introduced. This form was designed to provide a schedule of demand which could be readily

duplicated by the Fordigraph process. It enabled a number of sets of issue vouchers to be raised from the same original 'Master' demand form, and also any number of advice copies, without the need for re-typing the demand. In June 1941 this form was issued in various colours to enable the copies used for specific purposes to be easily recognised.

The Revised Depot Procedure

A great deal of work was done in investigating the problem concerning No. 40 Group and it soon became clear that there was no short cut or simple solution to these problems. The Directorate General of Equipment, Headquarters, Maintenance Command and No. 40 Group all co-operated in an endeavour to find workable solutions.

The experience gained from operating equipment depots in the early years of the war showed clearly that the organisation of a depot should be such as to ensure that :—

- (a) Equipment was received, unpacked and brought on charge quickly, so that it could be available for reissue at the earliest possible moment.
- (b) Available equipment was issued as quickly as possible to meet demands.
- (c) All transactions were recorded accurately and the master provision officers (M.P.O.s) advised without delay of all transactions.
- (d) Within the minimum limitations imposed by the needs of the essential systems the organisation should be made to work with the least possible number of staff.

Investigation of the two aims contained in paragraphs (a) and (b) above was carried out in the summer of 1942. A review of existing methods of bringing on charge and issuing equipment was undertaken, and after detailed discussions had taken place with all concerned revised systems were prepared.

The bringing on charge system had been in operation at the Hartlebury depot, in one form or another, for nearly a year and the revised system was introduced in June 1942. The main essential of the new system was that the 'stores inwards book' and the 'site receipt voucher registers' were combined. The major part of the depot internal transit sheets was eliminated and the compilation of two separate handwritten records avoided by the use of carbon copies. The introduction of an additional copy for the use of a small progress section was also a new feature and was designed to ensure the expeditious passing of the vouchers to stock records (to bring on charge) and to accounts (to release paper for the payment of bills).

A revised system of issuing was also introduced at Hartlebury at the same time. This was based on the principle of issuing the equipment first and recording it afterwards, or the exact opposite of the normal method. A loose-leaf issue voucher register was also introduced with a view to avoiding the preparation of three separate handwritten documents. It was claimed that as the system depended on the application of the demand to the actual equipment in the bins it would ensure that such equipment as was available would be issued and, moreover, that a type of selective stocktaking of those items in constant

demand would be achieved. Statistics substantiated this belief by showing up discrepancies which under the old system would not have been revealed.

In November 1942 these revised procedures were introduced at all the equipment depots.

Mechanised Stock Recording

In November 1943, Hollerith punched card machines were installed at No. 25 Maintenance Unit, Hartlebury. The supply of these machines was, however, limited and it was not until February 1945 that the last machines required to equip all the aircraft equipment depots were received.

The principle underlying the use of the machine was that a card was punched for every movement of stock. The relative details of receipts or issues were punched in code, and these included the section and reference number, quantity, consignee, terms of issue, etc. The cards were then used to prepare the daily stock journal for the maintenance unit concerned and also the posting sheet for onward transmission to the master provisioning office.

The use of these machines reduced clerical labour, increased accuracy, and provided an easy method of obtaining statistical data for future provisioning.

The Introduction of the Three-point Distribution System¹

A review of the dispersal policy in April 1943 revealed that many of the difficulties which existed at that time could be directly traced to use of the seven-point distribution system. This system took no account of the allocation of the consumer units, whilst at the same time contractors were not readily able to comply with the delivery instructions given. As a result the reallocation issues from all aircraft equipment depots were some 30 per cent of their total load, thus causing unnecessary work and delays in issue.

With a view to eliminating these difficulties, economising in storage space and improving the service and standard of the personnel by reason of greater specialisation, it was decided to proceed steadily with the reduction of the dispersal of all airframe, engine and mechanical transport spares to a three holding basis. In order to implement this policy an allocation key was maintained at Headquarters, No. 40 Group in order to determine the distribution on the basis of:—

- (a) Home consumer units.
- (b) Overseas requirements.
- (c) Location of manufacturers.
- (d) Location of home repairers.
- (e) Embodiment loan requirements.

The total number of types to be held by each aircraft equipment depot was reduced by about 50 per cent and this ultimately gave considerable relief in storage space requirements. It was still necessary to allocate one depot in each case as the specialist or M.P.O. depot, in order to provide for the effective handling of modification sets, overseas bond requirements, etc., and depots were selected for this purpose accordingly.

¹ A.M. File S.81906 and No. 40 Group File S.16046/E.92.

The Canal Transit Scheme¹

It was decided at the end of 1941 to carry out experiments in the use of inland waterways as a means of alternative transport. These experiments were conducted from January to April 1942. The object of the scheme was to save road transport, to relieve the railways, and to develop an alternative transport method which would be capable of expansion should the normal methods be hampered by enemy action.

The method employed was to assemble small batches of traffic from contractors in the big industrial areas in transit sheds on the waterside. These batches were then made up into twin barge loads for the same destination. Canal transit depots were located at London, Birmingham and Manchester. Initially the destination was the ultimate consignee and the canal carrier took the traffic straight through and made the delivery from his own wharf by road. Subsequently the delivery was made from transit depot to transit depot, the final delivery to local consignees being by road, this speeded up the turn-round of barges as it enabled them to be loaded with goods destined for more than one consignee.

The traffic for delivery to maintenance units came not only from the contracts placed by the Air Ministry and the Ministry of Aircraft Production, but also from those placed by the Ministry of Supply and Works and Buildings. The scheme was continued after April 1942 and by July of the same year it was handling approximately 1,500 tons of traffic a month by means of 40 pairs of barges.

The main fault of this means of transport was the length of time it took to reach its destination. The canal barges were slow and the numerous locks which had to be negotiated further reduced their speed. With transit times running into many weeks the Ministries became increasingly reluctant to divert from road and rail the limited class of goods suitable for this form of transport, and with this reduction in traffic the scheme died a natural death. Air Ministry authority was given for the disbandment of Nos. 1, 2 and 3 Canal Clearing Depots with effect from 1 November 1944.²

The three canal clearing depots shipped a total of 61,419 tons of equipment during the three years in which they were in operation and it was estimated that their closure placed 14 extra rail trucks on the railway system daily or an average of two trucks per day into each aircraft equipment depot.

The Bomber Command 'A.O.G.' Procedure

The method used to expedite the issue of urgently required spares for Aircraft on the Ground (A.O.G.) had proved to be very successful, but it was decided in March 1942 that the scheme needed certain modifications when used by Bomber Command stations. Trials were therefore conducted with a view to speeding up the delivery of equipment which was already available at the parent universal equipment depots and a special A.O.G. collection and delivery service was introduced. The ultimate aim was to deliver the equipment to the consignee within 30 hours of the time the demand left the Bomber station.

¹ M.C. File S.9616 M.

² Maintenance Command O.R.B.s.

These trials proved successful and on 28 May 1942 a revised A.O.G. procedure for Bomber Command was introduced as follows :—

- (a) Stations submitted their A.O.G. demands as they arose during the day and night by teleprinter either to the equipment park or regional depot. On receipt they were dealt with immediately on a twenty-four hour basis.
- (b) A daily A.O.G. express delivery service was maintained at each equipment depot wing. The vehicle left the depot at a fixed time each day.
- (c) Arrangements were made for the immediate despatch of equipment but due regard was paid to the fact that the express delivery service could sometimes prove the speediest.
- (d) In the case of partial or total inabilities an inter-depot express delivery service was maintained which linked up with the main delivery service from the depot wing. Where items were too large additional transport was provided.

Experience had shown that A.O.G. demands had been accumulating at the station equipment sections and instructions were therefore issued to station equipment officers to give immediate clearance to signal demands as and when completed.

A priority scheme was also introduced for the signals, and station commanders were allowed to authorise immediate priority where this would enable an immediate operational requirement to be loaded on that day's express delivery.

Preservation and Pre-packing

Pre-packing as a subject was first introduced in June 1943, at which time the Starley report was being circulated. Following the publication of this report it was notified that it was the intention to apply preservation and pre-packing to mechanical transport spares. Headquarters, No. 40 Group requested that they should be included in the committees then sitting in London, and suggested that what was necessary for mechanical transport spares was even more necessary for airborne equipment.

The inauguration of pre-packing, so far as the Ministry of Supply contractors were concerned, was decided upon at Chilwell in October 1943. On 28 January 1944 the first meeting of the Joint Air Ministry—Ministry of Aircraft Production Committee was held, and at that meeting it was decided to deal with the equipment in the following order of priority :—

- (a) Aero-engine spares and aero-engine accessories.
- (b) Radio and electrical equipment, including valves.
- (c) Armament.
- (d) Airframe spares.

Following meetings at Austin Works, Longbridge, and R.O.D., Chilwell, on 24 March 1944, at which the Director General of Equipment and Depot Commanders were present, instructions as to the policy to be pursued by No. 40 Group were issued. The work was divided into three phases :—

- (a) Phase I.—This covered the preservation, packaging and identification of overseas issues to the best possible standards with the materials available at that time, and Depot Commanders were instructed to give full consideration to any form of improvisation that could be devised.
- (b) Phase II.—This covered the preservation and packaging of depot stocks by outwork centres or by depot staff.
- (c) Phase III.—This applied to the preservation and packaging by manufacturers before delivery to depots.

The materials were demanded, the personnel establishments prepared, and plant requirements were put in hand. However, there were many difficulties, particularly with regard to the availability of cartons and other materials, but nevertheless a total of 6,794,890 cartons were packed by No. 40 Group units up to the end of 1944. The weekly output in December 1944 had reached a total of 291,951.

The Formation of the Forward Transit Centres.

The volume of work handled at the maintenance units in No. 40 Group in July 1943 showed a marked increase over that handled in January of the same year.¹ Experiments were therefore carried out within Maintenance Command with a view to finding a system which would effect economies in motor transport and man-power whilst at the same time maintaining prompt delivery.

With these ends in view experimental forward transit centres were established close to goods railheads in the forward area. Equipment was forwarded from the maintenance units to them, in bulk by rail, the onward delivery being made by road. The resultant transit times being much better than those which would have been obtained by the use of rail throughout. The trials were conducted at Romsey, Cambridge and York and the results were sufficiently satisfactory for the Command to put up to Air Ministry a detailed scheme for the establishment of some sixteen of these forward transit centres. The scheme required for its execution the addition of some 250 personnel to the establishment of No. 40 Group, a modest addition when compared with the extra volume of tonnage to be handled.

It was submitted to Air Ministry in September and again in November 1943 and approved in principle in the December of the same year. Detailed establishments and the location of the centres were not, however, decided until January 1944. By June 1944 there were 14 transit centres in operation on a national basis, the total tonnage handled for the year being 37,883 tons.

A Statistical Summary—No. 40 Group²

The number of tons of equipment handled by No. 40 Group during the 1939–45 War increased yearly, the peak figure of 2,299,000 tons being achieved

¹ Percentage increase, in turnover, July 1943 over January 1943.

	A.E.D.s	G.E.D.s	B. and C.D.s	E.P.s	All Units
(a) Demands	23.4	120.8	—4.4	181.5	41.3
(b) Issues (tons) .. .	42.1	75.1	42.8	147.7	49.7
(c) Total Tonnage Turnover ..	27.8	21.3	11.3	107.5	26.3

N.B. Demands at B. and C.D.s had decreased but the tonnage had increased.
² M.C. File 48533.

in 1944. The following yearly summary of tonnage handled was prepared by Maintenance Command for Equipment Plans, Air Ministry, in May 1946.¹

<i>Year</i>	<i>Receipts</i>	<i>Issues</i>	<i>Total</i>
	<i>tons</i>	<i>tons</i>	<i>tons</i>
April-Dec. 1940	316,000	211,000	527,000
1941	515,000	434,000	949,000
1942	695,000	572,000	1,267,000
1943	895,000	786,000	1,681,000
1944	1,248,000	1,051,000	2,299,000
Jan.-April 1945	433,000	369,000	802,000
Totals ...	4,102,000	3,423,000	7,525,000 tons dead weight.

¹ Detailed statistics are given in Appendices 16 and 17.

Part III
AIRCRAFT SERVICING IN THE
HOME COMMANDS

CHAPTER 9

PLANNED FLYING AND PLANNED SERVICING

One of the most important innovations which came into being in the Royal Air Force during the course of the Second World War was the system whereby the aircraft servicing arrangements were planned in accordance with the flying programme.¹ Before the introduction of planned flying and planned maintenance the only criterion for judging the maintenance efficiency was the level of serviceability and, before the war, it was the aim of most stations to maintain a serviceability of approximately 70-75 per cent. In this respect, however, it is obvious that such a level could only have been achieved at the expense of flying unless establishments were lavish, as it was flying that produced unserviceability. Every 100 hours flown by an aeroplane necessitated, on the average, a certain amount of work on the airframe, engine and its equipment, depending upon the type of aircraft and the conditions in which it had to fly. Grouped under the heading of daily, minor and major inspections, engine changes, modifications and repairs, the work took a certain amount of time in man-hours and a certain time in aircraft days, depending upon the extent of the work, the number of men employed and the number of man-hours required. Before the outbreak of the 1939-45 War no attempt had been made to organise the maintenance work of a station in order to obtain the maximum flying effort from the number of aircraft available.

The First Attempt at Maintenance Planning

To enable aircraft to spend more time in the air and less on the ground, the Air Ministry in February 1939 introduced a new maintenance organisation which provided for major inspections to be centralised under squadron servicing parties, leaving daily and minor inspections only to be performed by the flight personnel. In addition, the periodicity of inspections was increased and the inspection procedure eased.

When the war commenced, the majority of units were engaged in bringing the new organisation into effect and it soon became apparent to some that while the centralising of a proportion of the work of servicing was an advantage, the scheme did not go far enough, and better results would be obtained if the whole of the responsibility of the maintenance of a unit's aircraft was placed under one head. It was suggested that under war conditions flight commanders were fully occupied with either flying training or operations and could spare no time to control aircraft maintenance. Furthermore, many of the newly promoted flight commanders were inexperienced technically and therefore incapable of supervising the servicing procedure.

The defects in the new maintenance organisation were obvious, particularly in the schools of Flying Training Command, because not only were the schools called upon to produce a larger number of trained pilots with an inadequate

¹ Flying Training Command O.R.B.s.

establishment of aeroplanes and personnel, but, owing to the fact that many of their experienced mechanics had been withdrawn to provide reinforcements for operational squadrons and had been replaced by reservists, the standard of the maintenance staff was too low to permit of good results.

The first step taken by Flying Training Command to improve the position was to point out to the Air Ministry on 15 June 1940 that the output of trained pilots depended upon the number of serviceable aircraft available for use and the number of aircraft available depended upon the degree of maintenance carried out. The dilution of skill created by the influx of reservists and frequent postings of technical tradesmen had, it was stressed, the most direct bearing on aeroplane maintenance. It was necessary, therefore, for the technical personnel of the Command to be 'screened' if the training programmes were to be met. Two days later the Command, as the result of a conference of engineer officers, instructed its schools to arrange their maintenance organisation so as to ensure that :—

- (a) The Flight and Squadron servicing sections were combined under the squadron engineer officer.
- (b) Flight commanders were relieved from taking any part in aeroplane maintenance control that would prevent them from devoting their full energies to the flying training programme.
- (c) Squadron engineer officers were relieved of all responsibilities in connection with squadron administration of the non-technical order.

The introduction of planned maintenance went a stage further in July 1940 when the Air Ministry decided that it was necessary to increase the intake of pilots at certain advanced flying training schools by 25 per cent. A conference under the chairmanship of the Air Officer Commanding-in-Chief was held at Flying Training Command on 31 July to discuss the new programme, and during the weeks that followed the Command set about planning its maintenance organisation in accordance with its flying commitments. Several discussions took place with the Director of Servicing and Repair at the Air Ministry during which it was agreed that a more centralised form of aeroplane maintenance was one of the factors likely to contribute towards accelerated flying training programmes. It was accordingly decided to introduce, first at flying training schools and later on at other flying training units, a form of organisation to be known as 'Wing Maintenance,' the maintenance wing being formed by combining all the squadron servicing parties on a station into one maintenance squadron and grouping the flight servicing personnel together as a servicing squadron.

Immediately following this decision the Air Ministry agreed to raise the establishments of those schools which catered for wing maintenance, and during the latter part of 1940 the new scheme was brought gradually into being.

In March 1941 the first 'Notes on Aeroplane Maintenance Planning' were issued to the units of Flying Training Command.¹

¹ Flying Training Command File 55436/Eng.

The Introduction of Maintenance Wings at the Operational Training Units¹

Throughout 1941 Flying Training Command developed its planned maintenance organisation. Various instructions elaborating the scheme were issued from time to time. Copies of these were forwarded to the Air Ministry and the Director of Servicing and Maintenance was kept informed of progress. In December 1941 the Inspector General of the Royal Air Force (Air Chief Marshal Sir Edgar Ludlow-Hewitt) visited the operational training units of Bomber Command. In his report he complained of the high rate of aircraft unserviceability at the O.T.U.s and said this was mainly due to the inexperience in the maintenance organisation. Air Chief Marshal Ludlow-Hewitt recommended that an expert should be sent to the Bomber Command training units to study their maintenance problems and draw up general principles for the guidance of the chief maintenance officers of all operational training units.

At the request of the Director of Servicing and Repair, Air Commodore Cuckney carried out during January 1942 an investigation into the methods of aircraft maintenance being used in Bomber Command operational training units. In his report dated 3 February, Cuckney said that the Command's difficulties were mainly due to the fact that instead of realising the fact that it was the training programme 'which called the tune' and the job of maintenance 'to play it,' the O.T.U.s were still working under the conditions of peace-time activities and were flying their aircraft at a rate dictated by their serviceability. He suggested that their maintenance arrangements should be reorganised on the lines recently introduced in Flying Training Command.

In March 1942 the Air Member for Supply and Organisation decided to introduce the maintenance wing organisation at all operational training units throughout the Royal Air Force. Air Ministry publication No. 1464A Vol. 1, Part 2, entitled 'Maintenance Wings, Organisation and Functions—Maintenance Planning' was prepared in the Directorate of Servicing and Maintenance and issued to the Service both at home and overseas.²

Coastal Command's Experiment in Planned Operational Flying

After the introduction of maintenance wings in the operational training units, the Directorate of Servicing and Maintenance considered the possibility of extending the scheme to the operational squadrons. Whilst the problems involved were being investigated, the Prime Minister expressed his concern regarding the lack of success of the anti-submarine campaign which was said to be due to the low rate of operational sorties carried out by the aircraft of Coastal Command. It was at first considered that the best method of improving the position was to transfer a number of aircraft from Bomber Command, but later it was suggested that in view of the shortage of aircraft steps should be taken to obtain better results from the aircraft already held. In July 1942 the Operational Research Section of Coastal Command under Dr. G. Gordon, carried out an investigation as to how the operational effort of the Command could be increased. Dr. Gordon said that the three controlling factors were:—

¹ A.M. Files S.79199, A.368655/42 and S.6457.

² A.M. File A.368655/42.

- (a) *Pilots.* Could the pilots fly more frequently without a reduction in efficiency or premature operational fatigue?
- (b) *Policy.* Was there a deliberate restriction to the flying in order to conserve a striking force?
- (c) *Maintenance.* If flying were more frequent could the servicing and maintenance keep pace?

Regarding (a) the investigation showed that pilots could undertake more flying without loss of efficiency and that the deliberate policy restriction to guarantee a striking force mentioned at (b) was not widespread. Therefore the answer to increased operational efficiency lay in improving maintenance. An analysis of the maintenance showed that the maximum amount of flying per month was determined by:—

- (a) The time taken on routine inspections.
- (b) The time taken on repairs outside routine inspections.
- (c) The time taken awaiting spares (neglecting for the moment weather conditions).

The conditions (a), (b) and (c) and maximum flying without regard to the maintenance of a striking force, fixed a serviceability which was found to be below the 70 per cent standard which had been aimed at. The figure calculated was about 30 per cent. The maintenance of a serviceability of 70 per cent therefore restricted the amount of flying.

Dr. Gordon went on to suggest that the maintenance organisation and establishment of all operational squadrons should be planned in accordance with the operational needs. For instance, a large striking force to be used at infrequent intervals required a relatively large squadron strength of aircraft with a relatively small number of maintenance personnel per squadron, while a regularly operating patrol force, with the same number of flying hours but spread over a long period, needed a small squadron strength of aircraft with a relatively large number of maintenance bodies per squadron. He recommended that experiments be carried out with one or more squadrons in Coastal Command to ascertain what the requirements were in organisation and establishment to meet the various operational needs.

The Chief of the Air Staff sent a copy of Dr. Gordon's report to the Prime Minister and on 5 July 1942 requested the Air Member for Supply and Research to give his personal attention to the suggestions made. He added:—

'This matter is of considerable urgency since, as you know, I am under constant pressure to divert aircraft from Bomber to Coastal Command. It would be far more efficient and economical to get a greater effort out of the existing Coastal Command aircraft.'

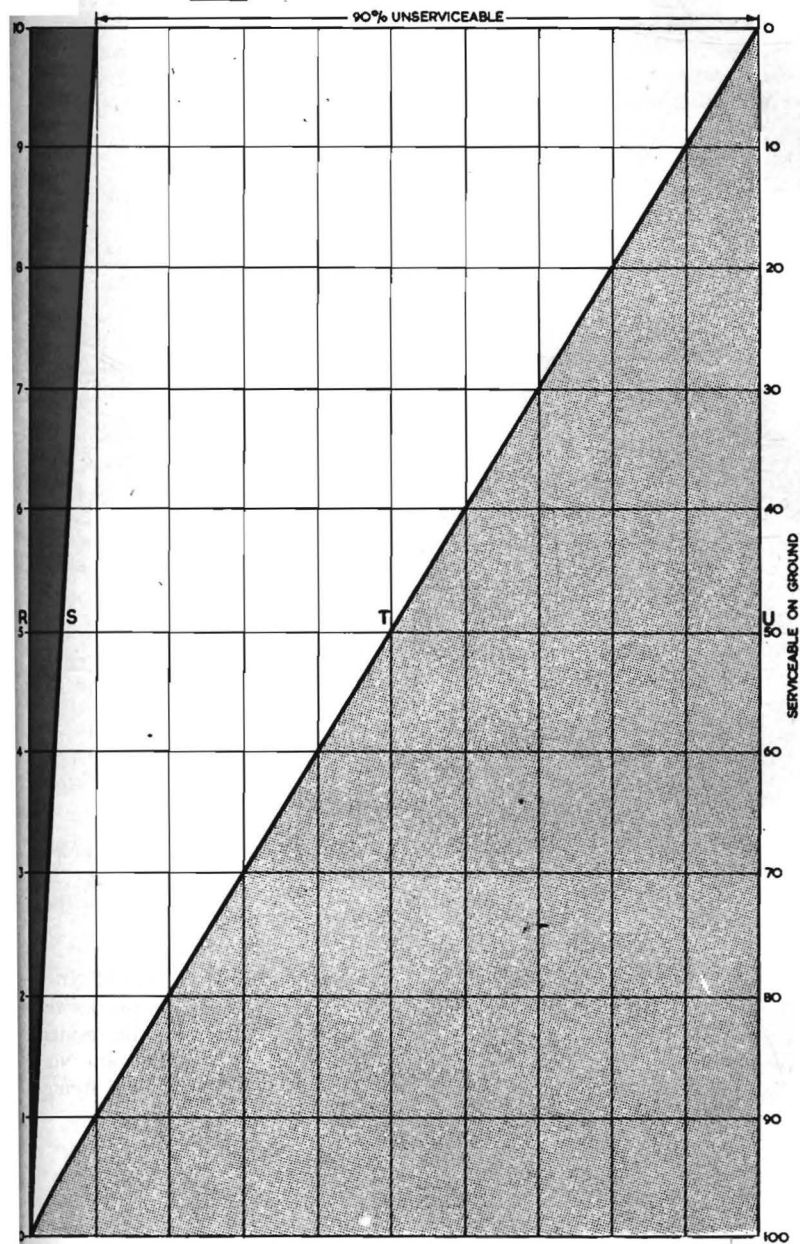
Immediately afterwards Coastal Command commenced experiments at Nos. 120 and 210 Squadrons, but, owing to the fact that these units were equipped with American aircraft for which spares were not at the time available, the results obtained were inconclusive. In August 1942, therefore, another squadron—No. 502 equipped with British (Whitley) aircraft—was selected for planned flying and planned maintenance trials.

DIAGRAM 19

RATIO OF AIRCRAFT SERVICEABILITY

LEGEND

- PERCENTAGE FLYING
- PERCENTAGE SERVICEABLE ON GROUND
- PERCENTAGE OF UNSERVICEABILITY



When the experiment commenced in No. 502 Squadron an examination of serviceability returns showed that there were times when serviceable aircraft were not being flown and when the number of aircraft under servicing was below average. A fetish was also being made of high serviceability at the expense of flying hours which should not have been the criterion of a squadron whose work was the exertion of a steady pressure rather than isolated heavy attacks.

It did not prove possible to plan the maintenance in No. 502 Squadron on the lines tried out at the operational training units as had been intended, owing to the rigid employment by the unit of the 'Flight' system. To have modified this system, as maintenance planning required, would have introduced artificial factors tending to obscure the true results of planned flying. Under the 'Flight' system the ground personnel were in three sections and not readily interchangeable; two flights dealt with daily servicing, and even minor inspections at dispersal points, the remaining personnel carried out major inspections and repairs in the hangars. Ideally, in bad weather, when work at dispersals was curtailed, the unemployed personnel should have been put to work in the hangars; in actual fact this was possible to a small extent only and the attempt at planning maintenance was the anticipation of inspection in bad weather and the staggering of major inspections as far as possible. The results of the experiment therefore represented, almost solely, the effect of planned flying.

The flying plan was based on hypotheses drawn from experience: approximately 9 hours' maintenance would be required for every hour's flying and consequently under ideal conditions 10 per cent of the force could be maintained continuously in the air, the remainder all being worked on and there being no serviceable aircraft on the ground. At the other extreme, if no flying were undertaken at all, the whole force would be serviceable on the ground. The actual condition in practice would lie between these extremes and the line RSTU on the accompanying diagram is taken to represent the equilibrium position.¹ This position could be found only by experiment, although it was anticipated that it would be some 50 per cent above the prevailing average. Flying was increased gradually by one sortie per day until equilibrium was reached. This was indicated by there being at least one aircraft awaiting maintenance during working hours. Any tendency for waiting aircraft to build up to about 3 or 4 was offset by a similar progressive reduction in flying. The ratio of flying hours to maintenance hours was, of course, subject to variation according to the efficiency of the maintenance organisation and other factors, but this variation was compensated by the same adjustment of flying intensity, the overriding factor being the maintenance of a pool of unserviceable aircraft sufficiently large to keep the ground staff fully employed during all but exceptional spells of bad weather, but not larger than necessary to meet this condition. It was at once apparent that the greater the intensity of flying and therefore the greater the output of the squadron in flying hours per month, the lower would be the percentage serviceability, a fact which immediately exposed the fallacy of judging the efficiency of a squadron by the criterion of aircraft serviceability. The unwritten law that serviceability should be maintained above 70 per cent was therefore disregarded and the serviceability allowed to find its own level well below that figure.

¹ See Diagram 19.

Over the period of the experiment in No. 502 Squadron the average monthly output of flying hours was 80 per cent above the average for all the Whitley squadrons in the Command up to August 1942. The flying hours per month per aircraft on the strength of the squadron were more than doubled for the period August to December and the flying hours per aircrew increased by some 60 per cent. In the light of this it was considered that a matured Whitley squadron on regular patrol with a strength of 20 aircraft, 23 aircrews and 220 technical ground staff (corporals and aircraftmen) should average 1,250 flying hours per month. After spells of bad flying weather additional flying could be made up to the limit of the aircrew capacity, but in good weather the planned rate must not otherwise be exceeded.

The Extension of Planned Flying and Planned Maintenance to all Coastal Command Squadrons

On 2 December 1942 the Air Council invited all the Air Officers Commanding-in-Chief to forward their views on the possibility of making aircrews responsible to some extent for the maintenance of their aircraft in order to relieve the shortage of skilled personnel. All the Commands agreed that the proposal was not practicable on the grounds that of the personnel concerned a large proportion were officers whose work would have to be supervised by non-commissioned officers, whilst others were warrant officers and N.C.O.s whose qualifications were restricted to their own particular duties in the air. Moreover, the majority of aircrew were completely untrained to undertake the highly specialised work which the maintenance of modern aircraft entailed. Several Commands were of the opinion that the carrying out of air operations under war conditions was sufficient unto itself without calling upon aircrews to undertake additional responsibilities. One Air Officer Commanding-in-Chief said that in his view aircrews should be relieved as far as possible of all ground responsibilities not connected with their flying duties. They must know how to carry out daily inspections of the equipment on which they had been trained but should not be expected to do so except in an emergency. This qualification should not, he considered, be used to reduce maintenance establishments. The senior technical staff officer of Bomber Command pointed out that aircrews on the return from operations must be rested and this was normally the time when inspections of the aircraft must take place.¹

Various suggestions for improving the man-power situation were put forward but the most practicable came from the A.O.C.-in-C., Coastal Command, who, in a letter dated 22 April 1943, drew attention to the research in connection with planned flying and planned maintenance which had been carried out in his Command. Air Marshal Slessor said that with planned flying and maintenance he would undertake to operate Coastal Command at an increased effort with a substantial saving on present establishments, believing that, instead of carrying on with an arbitrary percentage of an unbalanced and wrongly calculated establishment, increased output could be obtained from a reduced but properly calculated and balanced establishment—provided the necessary flexibility were afforded by the transfer of the control of posting and establishment to Command Headquarters.

¹ A.M. File S.84278.

The Coastal Command suggestions were considered at a meeting held at the Air Ministry under the chairmanship of the Director of Organisation on 27 May 1943. Representatives of the other Commands attended. It was agreed that the scheme whereby Command Headquarters would be enabled to adjust their establishments in accordance with their operational commitments was a practicable one and it was decided to institute at Coastal Command H.Q. a new section under the Senior Personnel Staff Officer to calculate and advise the Record Office and the Directorate of Manning on their personnel requirements. It was also decided to give the Command a block allocation on establishment of technical personnel in each trade, allowing an average margin of 5 per cent., to cover the requirements of a pool of personnel on which the Command could draw to meet changes in the roles of its squadrons. The provision of these facilities in the other Commands would, it was agreed, be discussed at a later date when more experience of their efficacy had been gained.¹

Regarding the introduction of planned flying and planned maintenance in the operational squadrons of the other Commands, both Bomber and Fighter said that they had adopted the scheme in their operational training units but preferred to reserve judgment as to its suitability for operational squadrons. The Deputy A.O.C. of Bomber Command remarked that as Bomber Command requirements depended more on a scale of effort than on the role of the unit, it was difficult to apply the same method of calculating establishments of their operational squadrons and a planned economic system to what were in effect battle conditions. The Fighter Command representative said that it was difficult to apply planned flying and planned maintenance to their squadrons because they had to provide a twenty-four hour service for defence. Also that it was impossible to agree that the role of day squadrons would not be changed, and impossible to forecast their offensive and defensive commitments. Both Commands, however, promised that their Operational Research Sections would continue to study the matter and maintain close contact with the O.R.S. of Coastal Command.

During June, July and August, 1943, Headquarters, Coastal Command endeavoured to put into effect the arrangements which had been agreed at the conference of 27 May. In this they were frustrated by shortage of the personnel which the scheme required. Since 1942 all the Commands had been forced to bear a percentage deficiency in their establishments because of the shortage of technical tradesmen, and on 7 July 1943 all concerned were notified they were to be called upon to face an additional cut.² In the case of Coastal Command, even though they were prepared to reduce their establishments by the introduction of planned flying and planned maintenance, they were still expected to bear the same percentage cut in their establishments.

It was not until November, after several months' discussion of the personnel question, that the reorganisation of Coastal Command commenced. Many units were readjusted, establishments were modified and planned flying and planned maintenance became the accepted method of procedure throughout the Command. The net result of this was to make available for employment

¹ A.M.S.O. Folder 210098 Part II, 'Planned Flying—Planned Maintenance.'

² A.M. File S.91923.

elsewhere a useful number of headquarters and station personnel and to create a valuable pool of personnel within the Command to increase the operational effort of squadrons equipped with the most efficient types of aircraft and those most in need of more man-power.

Between 1943 and 1945 the Operational Research Section of Coastal Command carried out a great deal of work towards the furtherance of the principles of planned flying and planned maintenance. Every aspect of the subject was covered and the most comprehensive instructions were issued from time to time. In May 1943 the Command produced the first three parts of a publication which described the scheme as applied to its units under the following headings :—

Part I. General Instructions on Planned Flying and Planned Maintenance and its Application to the Command.

Part II. Maintenance Instructions.

Part III. Servicing Wing Organisation.

In May 1945, Part IV was produced which described the system as employed in Operational Training Units.

It was not until the war ended that Coastal Command published Part V of its treatise on maintenance planning. This appeared on 22 August 1945 and was entitled 'The Approach to a System.' It included a brief history of the introduction of planned flying and planned maintenance in the Command, the chain of co-ordination in the planning of effort ; the statistics, records, system of task and manning control in all their aspects as applied to Coastal Command units ; the calculation of flying tasks and the establishments of servicing and specialist personnel and the effect of alteration in flying training on the total flying effort of an operational squadron.¹

The Benefits Accrued in Coastal Command from Planned Servicing and Planned Flying²

It is difficult to assess the true measure of the benefits resulting from planned flying and planned servicing in Coastal Command because the war came to an end before the Command reached the standards they themselves had aimed at. It was not so much the percentage of aircraft serviceability that was achieved but that an increased flying effort was obtained with a reduction in maintenance man-power. In a report on the subject prepared by the Directorate of Servicing and Maintenance at the request of the Air Member for Supply and Organisation in April 1944, it was stated that planned flying and planned servicing not only gave an overall increase of 43 per cent in flying hours per maintenance man and enabled establishments to be reduced by some 5,000 men, but that 'there were more flying hours available than were used.'³

¹ Space does not permit of the inclusion of the Coastal Command publications in this monograph and they have been filed under Air Historical Branch Reference IIK/54/2/1(A)-(E).

² A.M.S.O. Folder 210098 Part II.

³ See Appendix 21.

The Adoption of Planned Flying and Planned Servicing for the Operational Units of the Other Commands

Planned Flying and Planned Servicing, as it was eventually renamed,¹ had gone beyond the experimental stage when the 1939-45 War came to an end but had not been adopted for the operational squadrons of Bomber and overseas Commands. In the first place, to introduce into a formation, in the heat of battle, a major change in internal organisation was considered inadvisable and, in some cases, impracticable. Again, some formations considered that they were meeting their commitments satisfactorily, as indeed they were, but at an unnecessarily high cost in aircraft and man-power.

In 1943, Headquarters, Middle East examined the possibility of introducing planned flying and planned servicing in that Command but it was considered that the system brought into being by their own maintenance staff under Air Vice-Marshal Dawson was preferable as far as bomber and fighter formations were concerned. Under the Middle East scheme, work in squadrons was limited to 48 hours and in wing repair and salvage units to seven days. If the forward organisation could not deal with the work within the stipulated period it was passed back to a unit with greater facilities. By those means a very rapid turn-round was obtained and practically every man kept fully employed. Figures for the fighter squadrons in the Western Desert showed that for a reduction of 40 per cent of the maintenance personnel on the establishment a much higher percentage than 70 per cent serviceability had been obtained in spite of adverse conditions. It was contended that the Middle East scheme achieved the full employment of personnel without the attendant disadvantage of low serviceability, but required for its efficient operation senior maintenance staff officers at Air Headquarters and Groups with authority to use the maintenance personnel in squadrons, repair and salvage units and maintenance units according to the strength of squadrons under their control so that men were disposed of in such a manner as to keep them fully employed.²

The Aircraft Servicing Arrangements of the German Air Force during the 1939-45 War³

Before leaving the subject of the development of planned flying and planned servicing, it is interesting to compare the aircraft servicing arrangements adopted by the German Air Force during the 1939-45 War. Like the Royal Air Force, the German Air Force soon found that the supervision of the maintenance of aircraft by the flying personnel who were untrained technically for the task was not efficient organisation. Although they did not introduce planned flying and planned servicing, the German Air Force did foster a system of centralised servicing controlled by technical personnel.

At the beginning of the war the servicing of aircraft and minor repairs were undertaken by technical personnel attached to the flying formations. In the case of very mobile units (fighter, ground-attack and dive-bomber

¹ 'Planned Flying and Planned Servicing. The Air Staff Approach.' Provisional publication issued by the Air Ministry OPS/P.F.M. in July 1946. Since reissued as A.P.3152.

² O.R.S./M.E. File S.59332/43.

³ Study of the Supply Organisation of the German Air Force, 1935-1945. Prepared by the Air Division of the Control Commission for Germany, June 1946. A.H.B./VD/94.

squadrons) the technical personnel were organised into companies permanently attached to Wing Headquarters. Other types of flying units were served by technical personnel organised into Airfield Servicing Companies which were attached as required to appropriate formations. It was intended originally that Airfield Servicing Companies should be provided only for units operating from airfields which had no other workshops. In contrast to the Headquarters Companies the Airfield Servicing Companies were to be independent of flying formations and it was intended that they should work only within a given area, viz., the Airfield Regional Commands, and not be moved over great distances. This system did not, however, function as planned owing to the diversity of types of aircraft in existence with which the Airfield Servicing Companies had neither the training nor equipment to deal. The Airfield Servicing Companies were consequently reorganised to cope with specific types and permanently attached to flying formations to which they were subordinated in every respect. However, it was found in practice that this subordination also had its disadvantages. In the case of a transfer of a flying formation to another airfield the servicing company arrived at the destination much later than the flying elements. Alternatively, the Airfield Servicing Companies had to be moved long in advance, leaving the formation without its maintenance services. To overcome this difficulty the Airfield Servicing Companies were placed in a 'pool' under the control of the Quartermaster General and were only temporarily attached to the flying formations to which they were allocated. This system and also the Headquarters Company scheme worked reasonably well until the lack of transport aircraft, fuel and motor transport made itself felt when both Airfield Servicing Companies and Headquarters Companies found it increasingly difficult to catch up with the flying formations which they served. At the end of 1944 it was decided, therefore, that both types of companies would be abolished. They were replaced by maintenance companies which were independent of particular flying formations. Although the Airfield Servicing Companies had proved the impracticability of such an organisation at the beginning of the war it was now considered to be more feasible in view of the reduction in types of aircraft which had now taken place. The new organisation took the form of Aircraft Maintenance Companies which were subordinated to the Station Commands and their task was the maintenance of aircraft landing on the particular airfield to which they were allocated. By the end of the war, however, this reorganisation had not been effected completely.

CHAPTER 10

AIRCRAFT SERVICING IN FIGHTER COMMAND

The Servicing Arrangements at the Outbreak of War¹

In tracing the development of aircraft servicing in Fighter Command, the essential need for a change in policy dates back to the expansion of the Royal Air Force in the period from 1936 to 1939. Prior to this period the squadrons in Fighter Command were operating on a servicing system whereby each Flight was a self-contained unit in a flying squadron; that is, each Flight had a quota of Groups I and II tradesmen who were responsible for all inspection and repair work on aircraft up to the 'write-off' category. Such a system functioned satisfactorily under normal conditions, but soon displayed faults when subjected to the increased flying intensity which came with expansion. In addition, aircraft were becoming more complex and the ratio of highly skilled work to duties of a routine nature increased considerably. An outstanding defect was that the aircraft of one Flight in a squadron could be awaiting attention while unemployed man-power was available in other Flights. To eliminate this fault it was decided to adopt the squadron as the unit for servicing purposes and divide tasks into two phases:—

- (a) Handling of aircraft, routine inspections and repairs of a minor nature.
- (b) Major repair work and inspections not dealt with by the handling parties.

To meet this phasing squadrons were reorganised to consist of two flying Flights manned with Group II tradesmen and adequate supervision, and a third Flight for purely servicing purposes manned with Group I tradesmen. This Flight undertook all major inspections and repair work. In effect the system recognised that the servicing of aircraft within a squadron was an important task and merited the formation of a Flight to undertake the work.

Development during the War²

The system mentioned remained in force during the first year of the war but operations within that period and particularly while the Battle of Britain was in progress showed that the mobility of squadrons was hampered by the static servicing organisation. As the tempo of the battle was intensified, squadrons had to be moved at increasingly frequent intervals. The moves commenced with complete squadrons. This was followed by a reduction to a move of aircraft, pilots and some 70 personnel, then by a further reduction in which only the pilots, aircraft and a maximum of 32 maintenance personnel, all travelling by air, were concerned, and in exceptional cases only the pilots and aeroplanes moved. This resulted in squadrons becoming detached to a greater or lesser extent from their personnel, and in some cases a squadron and its personnel became distributed over at least three different stations.

A squadron on moving had to leave its unserviceable aircraft, and personnel to repair them. There was considerable difficulty in arranging whether these

¹ F.C. File S.39369/45.

² A.M. File S.67906.

aircraft, when serviceable, should follow their squadrons and whether new pilots and new aircraft should be posted to the original base or to the station from which the squadron was operating. The personnel left behind were 'nobody's children' and their position, and sometimes their work, was unsatisfactory. These facts were brought to notice by the Air Officer Commanding No. 12 Group (Air Vice-Marshal T. Leigh-Mallory) who, in a letter to Headquarters, Fighter Command dated 11 December 1940, said that as the result of the many difficulties experienced during reinforcing and relieving movements of squadrons within the Command during the past seven months he had given careful consideration to the possibility of so reducing the composition of fighter squadrons as to increase their mobility, while at the same time removing the difficulties arising from the transport of large ground parties and redundant bulky equipment from station to station. Two schemes, he wrote, had been considered :—

- ' A ' The maximum mobility of a squadron would be obtained by reducing the unit to an operational minimum of personnel, aircraft and equipment, i.e. pilots, plus an essential skeleton administrative staff, accompanied by aircraft and any special equipment which was not common to most types. This would result in the Station Headquarters becoming a large unit which would supply all the needs of the squadrons on the station and be responsible not only for housing, feeding and defending all personnel on the station but would also cater for every aspect of aircraft maintenance.
- ' B ' A compromise between scheme ' A ' and the existing scheme, in that a larger number of personnel than in scheme ' A ' would be retained in the squadron with a view to fostering the squadron spirit. The main features of scheme ' B ' were :—
 - (i) The combination of squadron servicing parties to form a station servicing party to undertake the major items of squadron maintenance, the squadrons retaining only sufficient personnel to perform minor inspections and handling of aircraft.
 - (ii) The holding of ground equipment on station charge.

After discussion it was decided that Scheme ' A,' although attractive in principle, was not acceptable. The main objection was that it would destroy the ' body ' of the squadron owing to the absence of the squadron fighting spirit which depended not only on the skill and morale of the pilots but also on the efficiency and keenness of the ground staff. It was recommended that Scheme ' B ' be adopted with modifications, and the essentials of the final proposals were as follows :—

- (a) That a station maintenance unit be formed.
- (b) That the bulk of the Group I tradesmen held by squadrons should be transferred to the station maintenance unit.
- (c) That all ground equipment should be held on the charge of the station maintenance unit, and that special equipment peculiar to certain types be issued to squadrons by the station maintenance unit as required.
- (d) That all technical maintenance, other than daily inspections and minor adjustments, should be undertaken by the station maintenance unit.

- (e) That a percentage of the station defence personnel should be trained in the duties of refuelling and rearming aircraft.

The advantages of this reorganisation were said to be :—

- (a) The mobility for purposes of permanent or semi-permanent moves would be assisted by the consequent reduction of the bulk of the squadron.
- (b) Problems of rapid reinforcement would be eased by the training of the ground defence personnel in refuelling and rearming duties, and by the fact that the station maintenance unit existed for the benefit of any unit which might arrive on the station.
- (c) It would relieve the squadron commander of the major problems of aircraft maintenance and allow him to devote more time to operational matters.
- (d) The formation of a station maintenance unit would pool the skilled personnel on a station, and to some extent avert the troubles resulting from a lower standard of training and experience, which was now being felt, by enabling the more reliable men to be employed to their full capacity.
- (e) An economy in ground equipment and tools would be effected by more continuous use of these items.

Additional suggestions to improve the scheme were :—

- (a) That the size of the flight mechanics' toolkits could be reduced to a very small number of tools which could be carried by the airman in a pouch or similar container,
- (b) That a suitable proportion of personnel and equipment held by the station maintenance unit should be earmarked to form a mobile unit when required, i.e. to accompany a squadron moving to a base possessing no maintenance facilities.

The scheme was discussed at a conference held on 17 January 1941 at Headquarters, Fighter Command which was attended by all the Fighter Group Commanders and the Director of Organisation from the Air Ministry. It was agreed that scheme 'B' should be adopted throughout the Command subject to the following modifications :—

- (a) The squadron establishments should be cut to the bone and the bulk of the maintenance personnel transferred to the station maintenance party.
- (b) The internal structure of the station maintenance party should be organised in such a way that it could throw off echelons. One of these echelons would be attached to each squadron in residence at the parent station or at a satellite. These echelons when attached to a squadron would, of course, come under the squadron commander and station engineer officer. Each echelon would have the minimum normally necessary for the type of work done by the squadron, being reinforced temporarily, if required, by the loan of additional personnel from the top hamper of the station maintenance party.
- (c) The squadron engineer officer would remain in the squadron and not be reposted to the station maintenance party.

- (d) Night flying and foreign squadrons should be organised on the same lines although, in fact, night-flying squadrons would rarely move. As regards foreign squadrons, steps were to be taken to ensure, as far as possible, that they were changed over with others of the same nationality, e.g. a Polish squadron would relieve a Polish squadron.

Some two years elapsed before the new organisation was a going concern. Numerous adjustments to the establishments of both personnel and equipment were necessary to enable it to operate effectively. It was not until the first invasion exercise 'Spartan' was performed in the early part of 1943 that the servicing of squadrons was on a fully centralised basis.¹

During the planning of Exercise 'Spartan' it was decided that stations as a whole in Fighter Command must be mobile and they were renamed 'Airfields,' and the aircraft servicing organisation was devised for three areas :—

- (a) The advanced landing ground area.
- (b) The airfield area.
- (c) The base area.

Advanced Landing Ground Area.

It was appreciated that under active service conditions there would be occasions when to ensure quick 'turn-round' it would be necessary to use advanced landing grounds forward of the airfield areas. To perform the servicing task on these landing strips servicing commandos were established under the control of Group Headquarters. These personnel were taught to operate with a minimum of equipment and to improvise as much as possible, besides being instructed in self-defence. Their essential duty was to perform refuelling, rearming, between-flight and daily inspections and repairs of a minor nature.

Airfield Area

Each airfield was designed to contain three flying squadrons and the airfield technical organisation was one of complete centralisation, the technical personnel being divorced from the squadrons, leaving one sergeant tradesman on the squadron establishment for technical continuity purposes. The tradesmen were formed into a repair and inspection squadron for inspectional and repair work, and a daily servicing squadron for handling and minor work, the whole being commanded by a squadron leader (Chief Technical Officer) who acted in both a technical and administrative capacity.

To preserve their mobility a ruling was made that airfields would not carry out major inspections or any work that caused an aeroplane to become non-effective for more than 48 hours. This naturally placed a limit on their capacity and necessitated the formation of support units. To meet this requirement, one repair and salvage unit was established for every two airfields. Their function was to salvage aircraft and to perform repairs and modifications beyond the airfield capacity. Each repair and salvage unit was organised into mobile and static repair parties, the former for aircraft outside the airfield boundaries, the latter for work that arose within the boundaries. The work

¹ F.C. File S.39369/45.

undertaken by these parties was limited to tasks that could be completed within seven days. On each of the repair and salvage units an aircraft reception flight was established. The function of this flight was to receive and hold new aircraft and issue them to squadrons equipped to operational standards.

Base Area

For all servicing work beyond the capacity of the airfield or a repair and salvage unit, a forward repair unit was envisaged. This was planned but not established during the exercise. The function of the base area was to be three-fold :—

- (a) Aircraft repairs.
- (b) Aircraft salvage.
- (c) Mechanical transport repair and salvage.

For the purpose of the exercise these duties were fulfilled by the existing repair and salvage organisations.

Reorganisation of the Servicing System

Exercise 'Spartan' showed that the system devised was sound basically for a tactical air force, and when the first composite group of 2nd Tactical Air Force was formed this servicing organisation was employed.

2nd T.A.F., as it became known, came into being on 1 June 1943.¹ It was formed for the projected landing of Allied forces in Normandy in 1944: the role of Fighter Command being reduced to one of defence only and named, on 15 November 1943, Air Defence of Great Britain. A fundamental principle in the formation of T.A.F. was that there should be an interchange of squadrons between T.A.F. and Fighter Command (or A.D.G.B.) and thus it was essential to devise a common servicing system to enable this principle to operate. Although it was not considered necessary to adopt the airfield system complete for the defence squadrons, the technical personnel were divorced from the squadrons and formed into an echelon. At that stage the problem of squadron *esprit de corps* arose and in order to meet this as far as possible, compatible with efficiency, the echelons were established to support specific squadrons, their number being correlated to that of the squadron. It was the policy of the Command for the echelon to accompany the squadron whenever possible.

For centralisation the echelon of each squadron was amalgamated under the station engineer officer who was renamed the chief technical officer, the squadron engineers being called echelon engineer officers and placed under the jurisdiction of the Chief Technical Officer. In this amalgamation the Group I tradesmen were formed into a repair and inspection squadron and the Group II personnel into a daily servicing squadron. By this reorganisation, which took place in July 1943, exchange with T.A.F. was made possible, the internal mobility of squadrons within the Command was increased and the servicing as a whole gained in efficiency.

¹ The first Tactical Air Force (N.A.T.A.F.) was formed for the North African Campaign in 1942.

Formation of Servicing Wing Headquarters

Although the echelon system worked efficiently, minor administrative difficulties emphasised that the control of echelons on a station was too loose. In addition, it was found that the number of squadrons on stations varied and engineer officers of equivalent rank were controlling widely differing technical organisations. It was obvious that the administration of echelons must be tightened and regard paid to rank when devising the station control establishment. To meet this it was decided to introduce headquarters sections of the Servicing Wing Organisation which was in use in the Command's operational training units. These headquarters were mobile and were established on Fighter Command Headquarters, their deployment being under the jurisdiction of the Command Engineer Officer. Each servicing wing headquarters consisted of a chief technical officer, whose rank was determined by the number of echelons the wing was designed to carry, an adjutant, suitable specialist officers or warrant officers and clerical and aircraft personnel. By the establishment of only a nucleus of personnel in the servicing wing headquarters, expansion and contraction of the wing could take place with the movement of squadrons in and out and so the organisation was made flexible.

Auxiliary Servicing Unit for Support of Squadrons

The development of improved aircraft and the constant re-equipment of squadrons prevented them from staggering their major inspections and caused peak loads on the servicing organisation when such inspections became due. Because of operational requirements it was not possible to restrict flying in order to obtain a smooth flow of inspections and it was apparent that some outside source for the performing of major inspections was necessary. A servicing unit within the Command organisation, which had been designed originally to support the operational training units because of their intensive flying programme, was utilised and proved of extreme value. The unit absorbed inspections beyond the capacity of the station servicing organisation and also undertook major modifications, re-engining of aircraft, etc.

Special Servicing Units

As operations became intensified it was found that diversionary and damaged aircraft returning from sorties over the Continent caused considerable servicing work at airfields within the Command. To meet this task special refuelling and rearming parties were established in April 1944. Late in March 1945 these parties were reorganised into servicing units on a mobile basis and were deployed, as necessary, by the Command Engineer Officer at Headquarters, Fighter Command.

Support of 2nd T.A.F. by Fighter Command

When preparations were being made for the landing of the Allied forces in Normandy in 1944, it was foreseen that whilst moving their airfields to the Continent the squadrons of 2nd T.A.F. would be deprived of servicing facilities at a time when they would be operating from the United Kingdom at an intensive rate of effort. Consequently, in May 1944, a supplementary airfield servicing organisation for these squadrons was provided by A.D.G.B. for the period of the move. The temporary organisation comprised 'Backers-up' parties which were established in addition to the Command static formations. The function of the parties was to perform all the servicing work of 2nd T.A.F. squadrons

whilst their own airfield servicing organisation was being transferred across the Channel.

The Changes Made in the 2nd T.A.F. Servicing Organisation in the Light of Experience

After the formation of the 2nd Tactical Air Force it was found that changes from the basic policy devised in Exercise 'Spartan' were necessary. For one thing, the aircraft reception flights attached to the repair and salvage units proved to be inefficient mainly because their role was incompatible with the function of the R. and S.U.s as a whole. Consequently the reception flights were amalgamated within each Group, with the exception of the Light Bomber Group, into a central group support unit whose function was essentially that devised in the original scheme, namely, the receipt, handling, preparation and issue of new aircraft.

The airfield servicing system also proved to be unsatisfactory. Experience had shown that it was necessary on occasions to carry more than three squadrons on an airfield, and it was found that the airfield servicing system devised in 'Spartan' was too rigid to permit the temporary attachment of squadrons. In addition, the supervision of welfare of the personnel was restricted to the technical officers in the servicing wing. These officers, with their many duties, were unable to give airmen's welfare the attention that should have been vouchsafed. To overcome these defects it was decided to reorganise the airfield system on the lines of that employed in A.D.G.B. Command. This reorganisation maintained the airfield servicing Headquarters with its attendant workshops and repair and inspection section, but formed the remaining personnel into echelons each of which was designed to support one squadron. This facilitated the moves of squadrons between airfields.

In the base area the operation of the forward repair unit showed it to be cumbersome and unwieldy and it was divided eventually into three sections working independently, one section being for airframe and engine repairs, a second for base recovery (aircraft salvage) and the third undertook the salvage and repair of mechanical transport. The sections were controlled by the Base Group organisation.

Aircraft Serviceability in Fighter Command Throughout the War¹

At the outbreak of the 1939-45 War the serviceability of aircraft in Fighter Command averaged about 70 per cent. This was increased to 80 per cent by November 1939 and was largely due to the revision of the maintenance schedules, a drastic cut of unnecessary inspections and the extension of time between them. Some misgiving was felt as to the result of this action when it was first introduced, but experience proved it to be fully justified.

Lack of ground equipment proved a serious disadvantage in the early stages, and some six months elapsed before the situation was satisfactory. The supply of spare parts for airframes and engines also presented considerable difficulty. In addition, maintenance problems arose continuously as the result of the multiplicity of types of airframes, engines, ground equipment and accessories that were provided.

During July 1940 intensification of air activity resulted in a slight decrease in aircraft serviceability but in no case did this fall below 76 per cent in so far as

¹ Fighter Command O.R.B., Maintenance Section, September 1939 to June 1940.

Spitfires and Hurricanes were concerned. In August the maintenance of aircraft in hangars became impossible at the aerodromes in the south-east of England because of intensified enemy bombing and it was necessary to disperse the aircraft around those aerodromes and in the fields adjoining. The servicing of aircraft in dispersed positions did not present many difficulties owing to the fact that it was still summer, but it was anticipated that troubles would occur if the same conditions were to be faced during the forthcoming winter. Consequently the Air Ministry were asked to provide aircraft shelter tents and engine heater covers before inclement weather prevailed. To prevent loss by enemy bombing, as many unserviceable aircraft as possible were transferred to aerodromes in the back areas for their repairs or maintenance to be completed.

The serviceability of single-seater fighters was maintained at 80 per cent during September 1940, i.e. the peak month of the Battle of Britain, but the establishments of personnel proved to be insufficient to meet the demands for increased flying time. In October, November and December the rate of serviceability of single-seater fighters remained as previously but the twin-engined night fighters experienced a great deal of unserviceability due to defects in their instruments. Various measures were taken in an attempt to rectify the faults. During October the first supplies of shelter tents and winter equipment commenced to arrive.

Throughout 1941 serviceability varied considerably because of the many factors involved. New types or new Marks of existing types of aircraft were continuously being supplied to the Command and the serviceability of these depended upon experience in their use, the efficiency or otherwise of their equipment, the extent to which modifications were necessary, the availability of spares, the type of operations employed and the efficiency of the maintenance organisation and the technical and equipment personnel of the station concerned. For instance, the average serviceability of the early Mark of 'Spitfighter' aircraft nearing the end of their lives could be as low as 45 per cent., while the average serviceability of a later Mark in the heyday of their usefulness would be as high as 89 per cent. Furthermore, the latest type, with its teething troubles still unsolved, seldom reached a serviceability of over 78 per cent. The following figures show to what extent the serviceability varied during 1941 :—¹

1941 Month	OPERATIONAL AIRCRAFT			TRAINING AIRCRAFT	
	Serviceability of various types	Average Serviceability during the month		Serviceability of various types	Average Service- ability during the month
		Day [*] Night			
		Fighters	Fighters		
May ^a	From 59% to 88%	73%		From 55% to 83%	64%
June	From 47% to 89%	73%		From 52% to 88%	64%
July	From 55% to 82%	75%		From 49% to 71%	60%
August	From 45% to 83%	75%	70%	From 46% to 78%	61%
Sept.	From 62% to 89%	74%	74%	From 52% to 70%	66%
Oct.	From 48% to 83%	70%	76%	From 43% to 72%	62%
Nov.	From 33% to 88%	68%	75%	From 38% to 71%	62%
Dec.	From 47% to 83%	72%	73%	From 50% to 80%	69%

¹ Fighter Command O.R.B., June 1941.

² Details of aircraft serviceability during the months of January to April 1941 were apparently not recorded.

The variations in the average serviceability rate according to type continued throughout the war. In 1942 the lowest average monthly serviceability of operational aircraft was 67 per cent and the highest 78 per cent. In 1943 the lowest and highest average percentages were 69 and 81 respectively. The best serviceability figures were obtained in 1944, particularly immediately before and during the Allied landings in Normandy, the lowest monthly average rate being 75 per cent and the highest 84 per cent. The average monthly serviceability percentages for these three years¹ divided into day and night fighter and operational training aircraft were :—

<i>Year</i>		<i>Day Fighters</i>	<i>Night Fighters</i>	<i>Training</i>
1942	..	75%	69%	68%
1943	..	74%	74%	68%
				(7 months only)
1944	..	79%	78%	—

¹ Serviceability percentages for fighter aircraft were not recorded by the Command in 1945. In the case of training types the percentages were not recorded after July 1943.

CHAPTER 11

AIRCRAFT SERVICING IN BOMBER COMMAND

The Servicing Arrangements at the Outbreak of War

In the period between the two wars up to the year 1937, the flight commanders of the squadrons of Bomber Command were entirely responsible for the servicing of their aircraft, the flight sergeants being their right-hand men. From 1937 onwards, with the general introduction of twin-engined aircraft, the flight commanders gradually took less interest in maintenance and the flight sergeants assumed more responsibility, usually working directly under the station engineer officer. In consequence, the latter tended to control the servicing arrangements. This trend increased still further when more complicated aircraft and equipment appeared, and by 1940 the station engineer officers had taken over the entire responsibility for servicing.

The Servicing Difficulties of the Command when the War Commenced

From the point of view of the maintenance of aircraft, Bomber Command commenced the war in a state of some unpreparedness. There was a serious lack of handling and ground equipment and the limited amount available was often unsuited to modern aeroplanes. Technical accommodation too was insufficient and spares were hard to come by. Many aircraft were placed out of action as the result of shortages of operational equipment, and aircraft temporarily unserviceable could not again be brought into use as their operational equipment had to be transferred to new aircraft which arrived in the squadrons in an incomplete state.¹

The dispersal of aircraft, which the German offensive against this country in 1940 rendered necessary, increased considerably the servicing difficulties. At first the aircraft were dispersed around the perimeter of each aerodrome then, as concrete sites were constructed in the fields adjoining, a wider distribution came into use. Unfortunately, however, the farther the aircraft were dispersed from the main aerodrome the more difficult their servicing became. At first no hangar facilities or labour-saving devices were available and the maintenance personnel were asked to work under conditions that, in winter, reduced the useful output to a figure that was probably less than one-third of the output from the same men working in a well-illuminated and heated workshop. There was also the considerable amount of time lost as the result of personnel having to travel long distances during their breaks for meals. Under those conditions it is not surprising that in February 1943 the average monthly serviceability of aircraft in Bomber Command was as low as 61 per cent. The policy of the dispersal of aircraft by picketing them in the open as distinct from dispersal by housing in remotely situated hangars meant a heavy price in terms of serviceability and maintenance efficiency.²

There were two large and distinct aspects of Bomber Command which presented different servicing problems, i.e.

¹ Bomber Command O.R.B., 1939-40 and information from A.V.M. Roach, S.T.S.O., Bomber Command.

² A.M. File S.84278.

- (a) The operational training and heavy conversion units which had a definite programme to fulfil.
- (b) The operational squadrons which had no set task and whose activities were to a great extent dependent upon the weather.

The Operational Training Units

In 1941 the operational training units experienced great difficulty in completing their training syllabi in time owing to a shortage of serviceable aircraft. Most of the units were not able to muster more than 50 per cent of their aircraft strength at any one time. Furthermore, this percentage was usually calculated from the number of aircraft handed over to flights as serviceable before training commenced, and the percentage often dropped much lower during the day owing to the development at the last moment, or in the course of flying, of some defect in their equipment. This high rate of unserviceability, which applied only to the operational types of aircraft, was due mainly to the fact that the aircraft were those thrown up by the operational squadrons.

There were, of course, other factors such as shortage of spares, dispersal and organisation questions which affected the aircraft serviceability and which were contained in a report of the Inspector General, dated 25 December 1941. It was this report which led to planned flying and planned servicing being introduced into the O.T.U.s and H.C.U.s of Bomber Command on the lines of that employed in Coastal Command. This measure eventually overcame the difficulties resulting from the maintenance organisation and inexperienced personnel.

As regards the shortage of spares, the Inspector General pointed out that whereas the major inspections of certain types of aircraft were scheduled to be completed in eight days, the difficulties in obtaining spares prolonged the work to two or three weeks. He also drew attention to the impossibility of undertaking night maintenance under blackout and dispersed conditions. This work was necessary if aircraft were to be ready for flying the next day. He recommended that serious consideration should be given to the following to enable aircraft servicing conditions to be improved :—

- (a) The provision of two hangars at each O.T.U. satellite—well dispersed.
- (b) The provision of a small hangar for each flight dispersal area at main O.T.U. aerodromes.
- (c) Refuelling standings for aircraft engaged on night flying.
- (d) Freer use of light in the open for night maintenance purposes except during air raid warnings.
- (e) A reduction of dispersal and greater use of existing hangars for night work during non-moonlight and non-flying nights.
- (f) The provision of more aircraft ' comforts ' such as :—
 - (i) Condenser lamps for drying the interior of aeroplanes.
 - (ii) Special covers for individual items of technical equipment.
 - (iii) Maintenance shelters and their lamps for keeping engines warm.
 - (iv) Engine, fuselage and wing covers.
 - (v) Hot-air blowers.

Concerning these comforts, the Inspector General said that his examination of the serviceability records of aircraft revealed a feature, which at first appeared surprising, that during periods of bad weather when little flying was being done, the serviceability curve did not rise to the extent which one would expect. This was due partly to the fact that when the weather was very bad the aircraft could not be worked on in the open and also because after aircraft had been left standing in the open during very bad weather they tended to become unserviceable from the damp.

The Operational Squadrons

The operational squadrons suffered from difficulties similar to those of the training units and the percentage of serviceable aircraft available depended to a great extent upon the ingenuity of the station engineer officers in improvising equipment and obtaining spares. With the advent of four-engined aircraft, deliveries of which commenced during the third quarter of 1940, the servicing difficulties were increased due to lack of adequate lifting gear and other aircraft servicing equipment which the new heavy types required. The existing equipment being designed for light and medium weighted aircraft was of little use, even if there had been sufficient quantities available.

Steps Taken to Improve Servicing Conditions

The re-equipping of squadrons with four-engined aircraft necessitated considerable increases in technical establishments. Additional engineer officers were provided and electrical engineer officers were also established at units. As new squadrons were formed additional aerodromes came into being, but most of the war-time airfields in 1942 had little or no technical accommodation and it was necessary to erect two small open-ended hangars (Type T.1) on each airfield and later a somewhat larger hangar (Type B.1) for the use of M.A.P. to undertake repairs. The open-ended hangars proved to be not wholly satisfactory but were better than working in the open air. The ban on the use of the permanent hangars on main aerodromes which were evacuated during the German attacks of 1940 was also relaxed, provided that the number of aircraft housed was kept to a minimum.

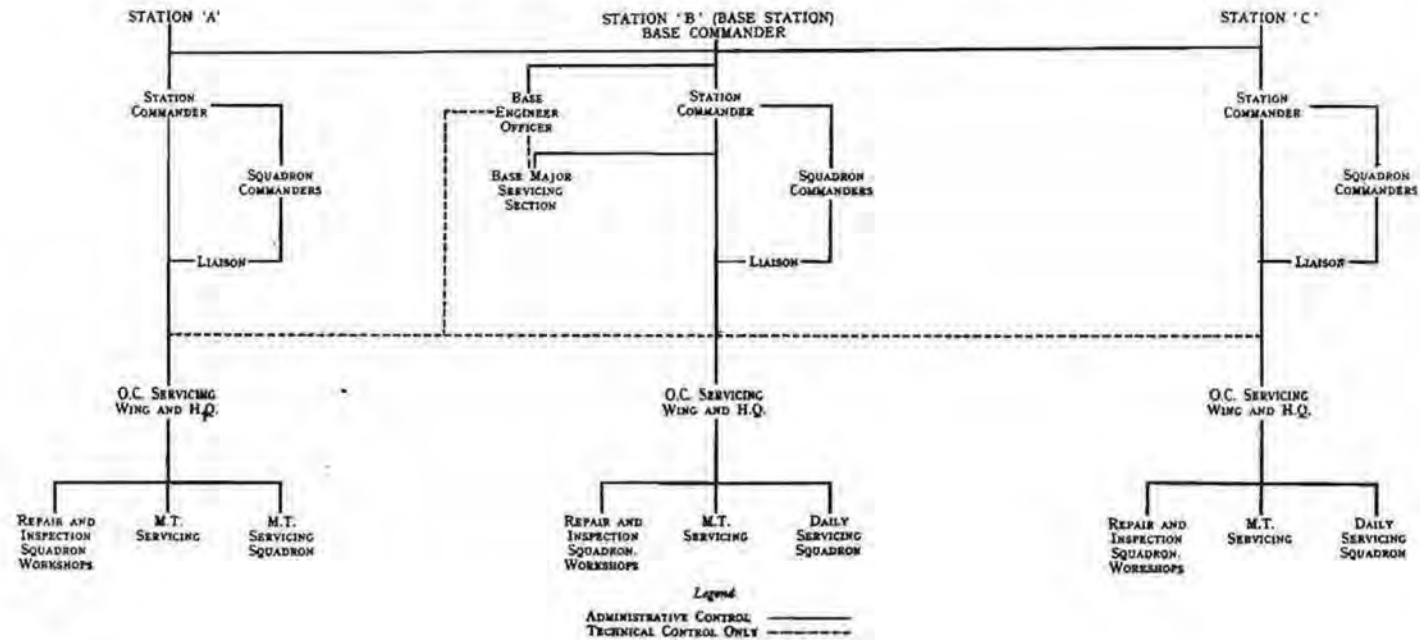
The absence of adequate ground equipment coupled with the lack of technical accommodation, however, remained throughout the later part of the war and caused the technical staff of Bomber Command to direct their attention to the best methods of making the most economic and efficient use of what was available. The first idea was to form Group servicing units to undertake the major servicing of all the squadrons in the Group, but as such a unit would require its own airfield, and at a time when sufficient airfields were not available, arrangements had to be made on a somewhat smaller scale. The inception of the Base Organisation to provide better operational control of squadrons eventually provided the answer to the servicing problem.

The Servicing Arrangements under the Bomber Command Base Organisation¹

During 1942 the actual and projected growth of the Bomber Groups began to render their operational and administrative control difficult. Each Group was

¹ A.M. File S.82201.

BOMBER COMMAND BASE SERVICING ORGANISATION (OPERATIONAL)



intended eventually to control about 20 operational squadrons on 10 aerodromes, with five further aerodromes occupied by heavy conversion and other miscellaneous units. It had been decided in 1941 that these aerodromes should be divided into 'clutches' of three, one being the parent and, in the interests of economy, undertaking as much administration as possible for the other two.

On 26 June 1942, Bomber Command put forward the suggestion that these 'clutches' of three aerodromes should be organised as a subordinate formation to be called a 'Base,' each Base to be commanded by an Air Commodore, with a Group Captain commanding each of the three stations. This suggestion was considered by the Air Ministry and deferred in August 1942 until the growth of the Command should justify it. The question was revived by a request from the C.-in-C., Bomber Command, on 21 December 1942, for the introduction of Base Commanders. After further discussion the system was approved on 14 February 1943.

It was agreed that three 'Bases' should be organised immediately, those chosen being Mildenhall, with its satellites Lakenheath, Newmarket and East Wretham, in No. 3 Group; Pocklington, with Melbourne and Elvington, in No. 4 Group; and Topcliffe, with Dishforth and Dalton, in No. 6 Group. Further Bases would be approved as each 'clutch' reached a figure of 72 I.E. aircraft and three heavy conversion units. Under the latter arrangement two further Bases at Marston Moor and Swinderby respectively were approved immediately.

By the institution of the 'Base' system it was hoped to economise in both administrative and technical personnel. This became more than ever necessary as the critical man-power situation became more apparent during 1943. The opportunity was taken, therefore, to reorganise the aircraft servicing arrangements in the operational squadrons in the following manner:—

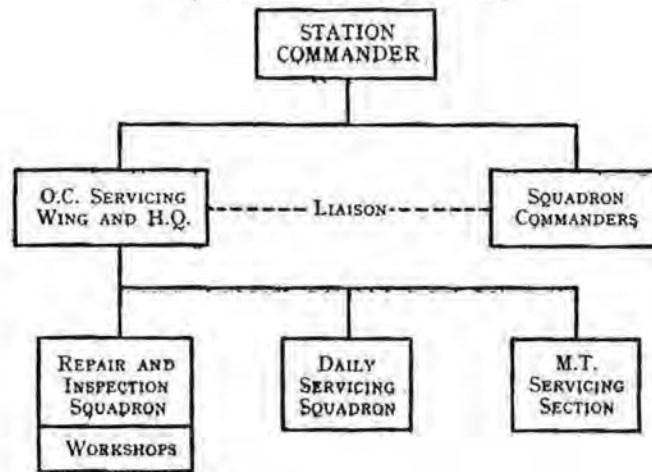
- (a) The Servicing Wing organisation was introduced as part of station establishments and servicing was centralised under the Chief Technical Officer of the Wing.
- (b) The servicing personnel in squadrons were limited to those required for daily servicing, e.g. refuelling, rearming and daily inspections. They were controlled technically by the Wing C.T.O. and remained under their squadron commanders for administration and discipline.
- (c) Servicing echelons were formed under the C.T.O. for undertaking minor inspections and minor repairs. Each servicing echelon was attached to a squadron and was given the squadron number preceded by 9000, e.g.
No. 9 Squadron—No. 9009 Servicing Echelon.
No. 207 Squadron—No. 9207 Servicing Echelon.
- (d) Major inspections and repairs capable of being completed within a period of five days were undertaken for all the airfields comprised in the Base by a Major Servicing Section located on the principal airfield.

The Base Major Servicing Section was commanded by a wing commander engineer who was responsible for the technical organisation throughout the Base, and he, in turn, was answerable to the Group engineer. All new aircraft

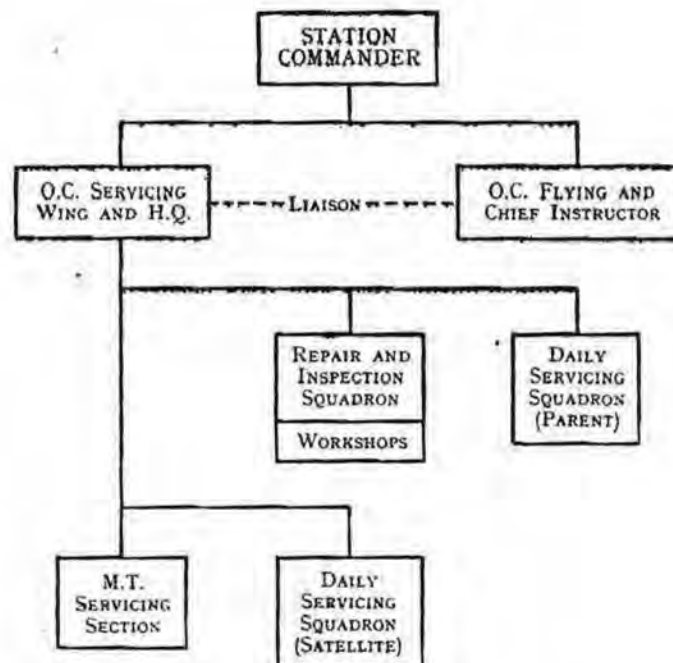
BOMBER COMMAND STATION ORGANISATION

OPERATIONAL

(Station not in Base Organisation)



O.T.U.



were received by the Base stations and prepared to operational standards, which included the incorporation of Command modifications. These modifications were essential for the efficiency of the aircraft and averaged about 40 for each machine.¹ As regards the repairs carried out by the Base organisation, although the work was scheduled to be limited to five days, actually many of the repairs took up to ten days. In addition to airframe repairs each Base built up to 100 power plants per month and repaired and serviced numerous quantities of components.

The Base stations were provided with more technical accommodation than the stations they served. This was more than offset by the savings made in the latter. It was also possible to effect considerable economies in equipment and spares by concentrating these on to one airfield. In many items of equipment the Base organisation reduced the requirements by two-thirds.

Not all the Bomber Command stations were brought into the Base organisation, and for those not included in the scheme, major servicing and repair arrangements were provided by a Station Major Servicing Section.² It was considered in May 1944 that, from the airfield aspect, 26 or 27 Bases would be authorised ultimately. In view, however, of the trend of the war it was decided in September 1944 that there would be no expansion of Bomber Command beyond 31 December 1944 and the total number of Bases would not exceed 23. The original scheme that a Base would consist of three stations and six squadrons (or three heavy conversion units) was also found to be difficult to organise and there were variations. For example, some Bases comprised four stations, others only two. In the latter stages of the war several readjustments were made. A number of Bases were disbanded and others were formed. When the war in Europe came to an end the number of Bases in existence was 19 with an equal number of independent stations. Five of the latter airfields were constructed to Base standards but did not operate as such.³

Aircraft Serviceability in Bomber Command during the 1939-45 War⁴

The high rate of serviceability during the winter of 1940-41 was due to the limited scale of operations carried out, while the lowest percentages which occurred during the early months of 1943 were the result of increased activity coupled with servicing difficulties. The steady rise in serviceability during 1943, which was maintained during 1944 and 1945, occurred as the result of the introduction of the Base maintenance organisation.

¹ A.M. File S.82201.

² See Diagrams 20 and 21. B.C. File 5115/Eng.1.

³ A.M. File S.82201.

⁴ Figures for the first year of the war were not recorded. See Appendix 23 for the period October 1940 to April 1945.

Part IV
THE MIDDLE EAST CAMPAIGN

CHAPTER 12

THE MIDDLE EAST CAMPAIGN SEPTEMBER 1939 TO NOVEMBER 1941

The Servicing and Repair Organisation in the Middle East in September 1939

On the outbreak of war in September 1939, the Royal Air Force in the Middle East consisted of :—

- Egypt* .. Headquarters, Royal Air Force, in Cairo.
R.A.F. Station, Heliopolis, accommodating Nos. 113 and 216 (Bomber) Squadrons, No. 208 (Army Co-operation) Squadron.
R.A.F. Station, Ismailia, accommodating Nos. 45 and 211 (Bomber) Squadrons and No. 33 (Fighter) Squadron.
R.A.F. Station, Helwan, accommodating No. 80 (Fighter) Squadron.
R.A.F. Station, Abu Sueir, accommodating No. 4 Flying Training School.
R.A.F. Repair Depot, Aboukir, with Port Detachment at Alexandria.
No. 101 Maintenance Unit, El Ma'sara.
- Sudan* .. R.A.F. Station, Khartoum, accommodating No. 47 (Bomber) Squadron.
- Palestine* .. Headquarters, Royal Air Force, Transjordan and Palestine, Jerusalem.
R.A.F. Station, Ramleh, accommodating No. 6 (Bomber) Squadron and No. 2 Armoured Car Company (less one section).
Sarafand. Equipment and Supply Detachment.
- Transjordan* R.A.F. Station, Amman, accommodating No. 14 (Bomber) Squadron.
Ma'an. One section of No. 2 Armoured Car Company.
- Kenya* .. R.A.F. Station, Nairobi, accommodating No. 223 (Bomber) Squadron.

In Egypt there were a number of landing grounds in the Western Desert up to Mersa Matruh, and in the south at Luxor and Wadi Halfa. Additional emergency landing grounds were in the Suez Canal and Red Sea areas. When war broke out a number of squadrons were deployed in the Western Desert and a small air stores park (No. 31) with a workshops flight was formed to support them.

All squadrons were responsible for the maintenance of their own aircraft and were established in most cases with their own engineer officer or warrant officer who was, however, only concerned with the servicing of aircraft undergoing

inspections or repair. The serviceability of aircraft in the flights was the responsibility of the flight commanders who were ably assisted by their flight sergeants.

As a general rule, squadrons and stations did as much work as they were able in the way of engine changes, inspections, repairs and minor modifications, but in cases where certain tasks were beyond the facilities of a particular squadron or station, aircraft were flown in to the depot at Aboukir for the purpose.

The aircraft depot at Aboukir had been in existence since the 1914-18 War and had provided the main backing for all squadrons in the Middle East Command since that period. Under the Anglo-Egyptian treaty of 1936, which provided for the move of all R.A.F. units in Egypt to the Canal Zone, a new depot was eventually to be built near Abu Sueir at the expense of the Egyptian Government. To this new depot it was intended in due course to transfer most of the equipment and facilities of the Aboukir depot.

The facilities of the Aboukir depot included engine and airframe repair shops, wooden airscrew manufacture, general engineering, mechanical transport repair shops, etc., and a main stores depot. The depot undertook the erection of all cased aircraft arriving in the Command, the complete overhaul of all airframes, engines, mechanical transport vehicles, armoured cars and other equipment, the manufacture of parts for certain modifications, and the supply of all spares and stores for all the units throughout the Middle East Command.

During the crisis of 1938 the vulnerable position of the depot to air attack and sabotage caused considerable concern and the Air Officer Commanding-in-Chief recommended that the proposed removal to the Canal area should be accelerated as an urgent necessity. As a precautionary measure certain sections of the depot were dispersed to Abu Sueir and No. 101 Maintenance Unit was formed at El Ma'sara, in caves situated in the Mockhattam heights, approximately five miles from Helwan, wherein was housed the majority of the explosives and petrol, hitherto accommodated at Aboukir.¹

Technical administration in the Command was the responsibility of the Engineer Branch of Headquarters, R.A.F., Middle East, under the direction of the Air Officer-in-charge of Administration.

Expansion of the Engineer Services after the Outbreak of War

On 11 September 1939 an advanced repair and salvage section was formed at Fuka, its function being to carry out all repairs beyond the capacity of squadrons (but limited to jobs not entailing more than 7 days' work) operating in the Western Desert, the handling of crashed aircraft and the installation of replacement engines 'in the field.' On the same day, No. 6 Supply and Transport Column was formed at Fuka to provide additional transport vehicles at places where the normal establishment of vehicles was either inadequate or unsuitable for a particular operation.

On 12 September 1939 a subsidiary repair depot was formed at Abu Sueir, utilising the hangars and workshops of No. 4 Flying Training School which moved to Iraq. Additional machine tools and other equipment required for

¹ M.E. File WGM/4.

this depot were obtained from other stations in the Command and skilled personnel transferred from the depot at Aboukir.

The functions of the subsidiary repair depot were to supply operational squadrons with serviceable aircraft and to undertake, in conjunction with the depot at Aboukir, the overhaul, repair and erection of aircraft beyond the capacity of the advanced repair section at Fuka. As a general principle aircraft from Fuka requiring the more extensive repairs were to go to Aboukir. The subsidiary repair depot gave priority of work to squadrons operating in the forward areas.

On 19 September 1939 an equipment section was added to the subsidiary repair depot and the complete organisation was named No. 102 Maintenance Unit. The equipment section was formed by utilising the equipment and personnel of No. 12 Air Stores Park transferred from Iraq. The function of the equipment section was to supply replacement spares, aircraft equipment and general stores to the R.A.F. Stations at Ismailia, Heliopolis and Helwan, Nos. 14, 30, 55, 70, 112, 113 and 216 Squadrons and the units at Abu Sueir. The stocks of spares hitherto supplied by Aboukir to these stations and units were transferred from Aboukir to Abu Sueir together with a number of Aboukir's equipment personnel.

On 16 May 1940 No. 6 Supply and Transport Column was enlarged from the resources of vehicles, drivers and other personnel in the Command and re-organised into four sections. The sections were based on various landing grounds in the Western Desert and were utilised for the transportation of bombs, ammunition, petrol and oil from railhead to the landing grounds and for the carrying of other equipment between No. 31 Air Stores Park at Fuka and squadrons operating in the Western Desert when normal facilities were inadequate or a breakdown in communications occurred. Three sections were under the control of Headquarters, Middle East, and one under Headquarters, No. 253 Wing.

Reorganisation of the Repair and Servicing Arrangements on the Entry of Italy into the War

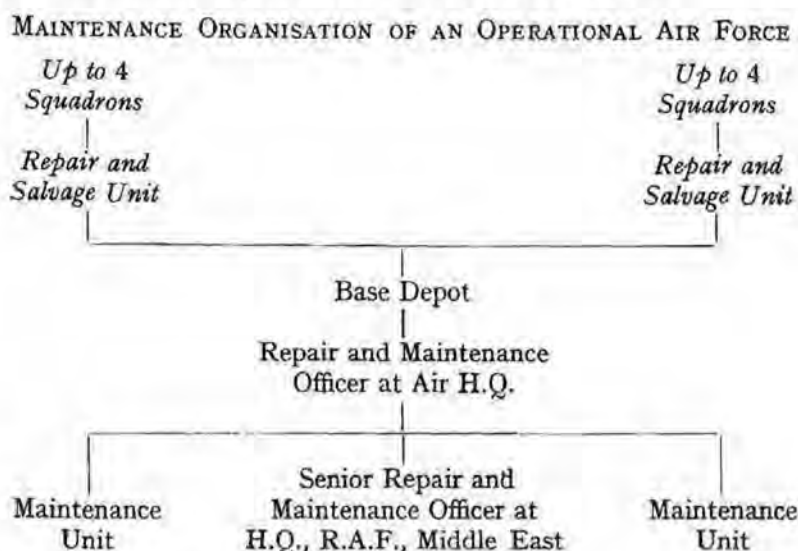
Italy declared war against Great Britain and her Allies on 10 June 1940. On 11 June the Air Officer Commanding-in-Chief, Middle East, was informed by Air Ministry that in future he was to command all Royal Air Force units operating in the following areas:—¹

- Egypt.
- Sudan.
- Palestine and Transjordan.
- East Africa.
- Aden and Somaliland.
- Iraq and adjacent territories.
- Cyprus.
- Turkey.
- Balkans (Yugoslavia, Roumania, Bulgaria, Greece).
- Mediterranean Sea.
- Red Sea.
- Persian Gulf.

¹ Air Ministry Signal X540, dated 10 June 1940.

The A.O.C.-in-C. was also informed that the Air Officers Commanding Aden, Iraq and the Mediterranean would continue to exercise local administrative control in direct communication with the Air Ministry, but he would, however, be responsible for general administrative control of those Commands so far as operational requirements dictated. He could also draw on, or interchange, the resources of those Commands as circumstances required.

A few weeks later the Air Ministry issued instructions that in the light of experience gained in France in 1939-40 and with the object of obtaining maximum operational efficiency of squadrons operating in the Middle East, the following maintenance organisation was to be introduced :—¹



The repair and salvage units were to be situated on aerodromes so that aircraft could be flown to them for overhaul and modification. They were also to be semi-mobile and situated within a reasonable distance of a railhead to facilitate the disposal of salvage and repairable equipment.

The essential function of the base depot was to back up the repair and salvage units and to undertake work of a limited nature which normally would have necessitated the return of aircraft and components to the rear maintenance units.²

Failure of the Middle East Command to Organise its Maintenance Service in Accordance with the Air Ministry Plan

The Air Ministry scheme, based on the experience of the British Air Forces in France, undoubtedly presented the ideal method of servicing and repairing aircraft under conditions likely to be experienced with squadrons operating in the desert, but unfortunately the Command found it impossible to bring the recommendations immediately into effect.

¹ H.Q., M.E., O.R.B. Appendix A.

² Details of the composition and duties of the repair and salvage units and the base depot are given in Appendix 24.

Although the Middle East had, before Italy entered the war, enjoyed a quiet period which might, if circumstances had permitted, have been used for building up resources, the Command was faced with a serious shortage of equipment and personnel because the requirements of the Metropolitan Air Force and the British Air Forces in France had prevented adequate supplies being sent to Egypt. With the evacuation from Dunkirk the position worsened by the fact that the Royal Air Force left most of its equipment in France.¹

The number of squadrons operating in the Western Desert when Italy entered the war was five. Reinforcements had increased the number of squadrons based on peace-time aerodromes in Egypt to eight. Further reinforcements to the tune of twelve squadrons had been promised from the United Kingdom, so that the minimum number of mobile repair and salvage units to be organised was six.

Experience in France had also shown that an advanced air striking force required, in addition to mobile repair and salvage units, mobile air stores parks equal in number to the R. and S.U.s. Headquarters, Middle East, found itself not only unable to form an adequate number of repair and salvage units and air stores parks, but the fact that the second maintenance unit had only come into being by robbing the first precluded the establishment of an advanced base depot.

The absence of an advanced Air Headquarters also prevented the provision of the link in technical control between Headquarters, Middle East, and the advanced repair, salvage and stores units which the Air Ministry scheme recommended. As a compromise, Headquarters, Middle East, amended the suggested organisation in the following manner.

Owing to some squadrons being located at peace-time stations while others were at desert landing grounds, a separate repair and maintenance policy was laid down for each type of accommodation.

Squadrons on permanent stations were made responsible for :—²

- (a) All maintenance and inspections of aircraft and engines up to and including the 180-hour inspection.
- (b) Repairs and replacements which were within the capacity of the units and which would not take longer to effect than the time taken for a 180-hour inspection.
- (c) Modifications Class 1 and such Class 2 war modifications the completion of which was within the capacity of the unit.

The maintenance of aero-engine sparking plugs and parachutes, and the maintenance and repair of M.T. vehicles estimated to take not more than seven days was the responsibility of station workshops.

Squadrons at desert landing grounds in the open were made responsible for :—

- (a) All maintenance and inspections of aircraft and engines up to and including the 150-hour inspection.

¹ COS(39)102.

² H.Q., M.E., O.R.B. Admin. Plans Appendix 1940.

- (b) Repairs and replacements which were within the capacity of the unit and which would not take longer to effect than the time taken by a 3 star inspection.
- (c) Modifications Class 1 and Class 2 war modifications which were within the capacity of the unit.
- (d) Maintenance of parachutes and aero-engine sparking plugs.
- (e) Maintenance and repairs of M.T. vehicles up to and including work estimated to occupy not more than four days.

The only repair and salvage unit formed (No. 51) was attached for administration to No. 31 Air Stores Park at Fuka and was placed directly under the control of H.Q., Middle East, while the work which would normally pass to the base depot went direct to Nos. 102 and 103 Maintenance Units at Abu Sueir and Aboukir respectively.

No. 51 Repair and Salvage Unit included two complete salvage sections responsible for the collection of crashed aircraft in the advanced area from the Libyan frontier eastwards to longitude 28°E. Their responsibility did not normally include any area eastwards of Fuka excepting by agreement with No. 103 Maintenance Unit, Aboukir.

For dealing with crashes in the rear areas two salvage sections were formed at No. 103 Maintenance Unit, Aboukir, to be responsible for collecting aircraft in the forward area as far as Fuka, i.e. between meridians 28° to 31° East, except within a 50-mile radius of Heliopolis; one salvage section was formed at Heliopolis for collecting aircraft within a 50-mile radius of that station; two salvage sections were formed at No. 102 Maintenance Unit, Abu Sueir, for collecting aircraft in the Canal area, i.e. between meridians 31° to 34° East, and finally two salvage sections were to be formed to handle aircraft in the Sudan area.

In order to ensure that salvage sections were always available in the Western Desert area, arrangements were made for one of the salvage sections at Aboukir to proceed to Fuka immediately one of the Fuka sections left loaded with aircraft for delivery to one of the maintenance units.

No. 103 Maintenance Unit, Aboukir, was also made responsible for handling Fleet Air Arm floatplanes beyond unit capacity and for holding immediate reserve floatplanes, while No. 102 Maintenance Unit, Abu Sueir, was made responsible for handling Fleet Air Arm landplanes beyond unit capacity and for holding immediate reserve landplanes of the Fleet Air Arm.

In laying down this organisation, Headquarters, Middle East, stressed the fact that it was important to deliver crashed aircraft to maintenance units with the least possible delay and a crash, once loaded, should proceed direct to a maintenance unit as unloading and reloading would cause delay and unnecessary additional damage to repairable material.

First Enlargement of the Maintenance Services in the Western Desert

It soon became obvious that it was not possible for the squadrons in the Western Desert to be maintained by only one air stores park and one repair and salvage unit and in September 1940 it was decided to establish additional units of this nature.

No. 32 Air Stores Park and No. 53 Repair and Salvage Unit were formed on 1 October 1940 from personnel already at No. 103 Maintenance Unit, Aboukir, and from civilians locally engaged. It was anticipated that it would be possible to replace the personnel taken from Aboukir with airmen from the United Kingdom when promised reinforcements arrived.

It was intended that the new air stores park would cater for all units in the Alexandria area and in the Western Desert up to a line drawn west of Dhaba. The additional repair and salvage unit was to be responsible for the repair of aircraft and M.T. of all units east of and including Fuka. Unfortunately, however, these two new formations were not able to commence the duties for which they were designed because the decision made in November to provide a small air force to assist the Greeks resulted in these two units being sent to maintain that force.

Introduction of the West African Reinforcement Route

In 1939 and early 1940 the supply of replacement aircraft to the Middle East Command was dependent upon shipping through the Mediterranean. Aircraft were taken off ships at Alexandria or Suez and were erected at Aboukir or Abu Sueir.

With the entry of Italy into the war in June 1940, two factors became evident :—

- (a) Wastage of aircraft in the Middle East would immediately increase owing to operations on the Egyptian-Libyan border.
- (b) The Mediterranean supply for reinforcement aircraft to the Middle East would be jeopardised.

It was thus necessary to provide an alternative supply line for reinforcement aircraft to the Middle East Command. This alternative had to be capable of supplying aircraft at a rate which would keep pace with the accelerated wastage.

Three main alternative methods of supply presented themselves. They were :—

- (i) The shipping of crated aircraft round South Africa to the Red Sea for assembly at a base in Egypt.
- (ii) The delivery of aircraft by air through the Mediterranean via Gibraltar and Malta.
- (iii) The shipping of crated aircraft to the West Coast of Africa where they would be erected and then flown across Africa to Egypt.

The first course had the advantage of safety, but was wasteful in shipping space. Moreover, it would have locked up a vast quantity of first-line aircraft and shipping during the long voyage to Egypt.

The second course had the advantage of speed and economy in shipping, but it was clear that such a method of delivery was impossible for fighters unless forward landing grounds in Cyrenaica were held or the aircraft were equipped with additional tankage. Moreover, if successful initially, this course was liable to interruption and open to increasing enemy resistance.

The third course was a compromise between the other two. It would occupy less than one-third of the shipping which would be required for the first. At the same time it was infinitely more secure than would have been the case if the aircraft had been flown out by the Mediterranean.

For the above reasons it was decided by the Air Ministry to investigate the possibilities of implementing the third scheme which had been considered and the route surveyed before the war. Consideration of the West African colonies limited the choice of an assembly point to Lagos in Nigeria or to Takoradi on the Gold Coast. Here requisite aerodromes and harbour facilities were available on the already existing Trans-African air route then being operated by the British Overseas Airways Corporation.

From information obtained it was decided that Takoradi was the most suitable centre for the assembly point. The aerodrome was of recent construction and had a main runway of 1,000 yards with an apparently sound surface. Moreover, accommodation was more easily obtainable than in Lagos.

An advance party consisting of seven officers and fifteen other ranks under the command of Group Captain H. K. Thorold proceeded from the United Kingdom to Takoradi in July 1940 to examine the practicability of the scheme from the point of view of the port, aerodrome and ferry route and the accommodation available at Takoradi.

An organisation for the route was then formulated and provisional standing orders prepared. In brief, the organisation consisted of:—

At Takoradi .. Station Headquarters
 Three independent units whose commanders were directly responsible to the Station Commander, i.e.
 Port Detachment
 Aircraft Assembly Unit
 Communication Unit.

Along the Route

1st Stage—Takoradi to Lagos	..	..	..	Distance 370 miles
2nd Stage—Lagos to Kano	..	..	..	525 "
3rd Stage—Kano to Maiduguri	..	..	..	320 "
Maiduguri to Geneina	..	..	..	690 "
4th Stage—Geneina to Fasher	..	..	..	195 "
Fasher to El Obeid	..	..	..	330 "
El Obeid to Khartoum	..	..	..	230 "

A month later an additional staging post was added at Wadi Halfa to provide a stop between Khartoum and Egypt. The distance from Khartoum to Wadi Halfa was 520 miles and from Wadi Halfa to Cairo 506 miles.

Kano, Geneina and Khartoum were night-stopping posts. Lagos, Maiduguri, Fasher and Wadi Halfa were refuelling posts, Obeid was the turning point along the recognised air route to Khartoum.¹

The general administrative and operational control of the whole route was placed under Headquarters, R.A.F., Middle East. The route was divided into two sections, placing all the aerodromes on the Gold Coast and Nigeria under the administration of the Officer Commanding, R.A.F. Station, Khartoum. The Air Officer Commanding, No. 203 Group was responsible to Headquarters, R.A.F., Middle East, for the operation of the route from Takoradi to Wadi Halfa inclusive. Each staging post was in charge of an officer or senior N.C.O. with a small number of skilled personnel to deal with the servicing and refuelling of aircraft landing there.

¹ See Diagram 22.

It was intended that the reinforcement route would supply the Middle East with from 120 to 130 aircraft per month of which approximately one-third would be fighters, one-third bombers and one-third communication and other aircraft.

The first main party to operate the route, consisting of 28 officers and 329 other ranks, arrived at Takoradi on 21 August 1940. The first aircraft, six crated Blenheims and six crated Hurricanes, arrived by sea on 5 September. The following day the aircraft carrier *Argus* arrived with thirty Hurricanes. On 20 September, the first delivery flight, consisting of one Blenheim and six Hurricanes, left Takoradi and arrived at Khartoum on 24 September. One Hurricane was left on the route with technical trouble. By the end of December 1940, 27 Blenheim, 68 Hurricane and 12 Fulmar aircraft, a total of 107, had been delivered to Egypt.

Taking into consideration all the difficulties which were encountered in the early stages—difficulties resulting from the lack of equipment, lack of accommodation, lack of hangar space, lack of communications, insufficient transport, insufficient personnel and the weather conditions, the route did remarkably well to deliver the first batch of aircraft to Egypt within four weeks of the arrival of the first main body of personnel at Takoradi and two weeks after the arrival of the first crated aircraft.

From October 1940 onwards the rate at which aircraft were received, erected and despatched to the Middle East increased steadily, while at the same time the necessary ancillary organisations were expanded to keep in step.

As Takoradi's production grew so its commitments were increased by the Air Ministry. From 125 aircraft per month in October 1940, the scheduled programme was increased to 150 per month in November 1940, to 180 per month in January 1941, and established at 200 per month in May 1941. Owing to the irregularity of the arrivals at Takoradi, however, the scheduled figures were not reached until June 1941, when 203 aircraft were erected and tested. Subsequent production dropped due solely to the lack of crated aircraft delivered to the Base. The summary of the aircraft erected between September 1940 and October 1941 is as follows :—

September 1940	33
October	5
November	55
December	37
January 1941	99
February	55
March	133
April	123
May	161
June	203
July	150
August	123
September	131
October	146
Total ..	<u>1,454</u>

Of this total at least 94 per cent reached their destination and were available in due course for operation. These excellent results were not achieved without a great deal of hard work and reorganisation, as experience was gained and the facilities improved. From the technical point of view the major difficulties resulted from the lack of equipment and spares.

Swiftly changing policy in the number and types of aircraft to be erected also caused much anxiety from the equipment angle as each change needed more and in some cases different items which were not available. When the first American aircraft arrived no provisioning had been made, as has been previously explained, for the necessary operational equipment, so that these aircraft were simply flying machines and nothing more. The difficulties over the lack of A.G.S. items and tools were, however, not so great with the American types as, in contrast to the British practice, each aircraft was packed with a bag of the essential parts and an efficient tool kit arrived in each crate.

As regards the early technical difficulties other than the supply of equipment : these were many and were mainly the result of the lack of attention to detail on the part of those responsible for packing and despatching the aircraft in the United Kingdom. When the first batch of aircraft arrived all the tools were at the bottom of the ship's hold with the aircraft on the top. Consequently it was necessary completely to unload the ship, resulting in considerable congestion on the quayside, before work could be commenced on unpacking and transporting to the base the first aircraft to be off-loaded. The removal of crated aircraft from ships and transportation from the port to the aerodrome also presented problems which had to be solved. The capacity of the wharfside cranes on the only wharf where ships carrying crated aircraft could berth was only two tons. (A crated Blenheim weighed over 5½ tons.) A 10-ton mobile crane was available, but owing to the weakness of the jetty it could not be employed for off-loading. Early consignments of crated aircraft arrived in ships whose derricks were adequate to off-load the aircraft but, as the flow of supplies increased, several ships were employed without suitable lifting tackle, and the situation arose when neither the wharfside cranes nor the ship's derricks could off-load the crates. In some cases this complication was overcome by inserting a second ship with adequate derricks between the smaller ships and the wharf and lifting the cargo from the smaller vessel to the wharf. Several instances occurred, however, when no convenient second ship was available and cargoes of crated aircraft had to lie outside the harbour until such time as a second suitable ship turned up. Alternatively, the little ships were sent on to Lagos where a 10-ton crane was available to off-load them and where the aircraft could be loaded on to a suitable ship returning to Takoradi. To overcome these difficulties urgent demands were sent to the Air Ministry for a suitable heavy crane, but owing to delays in shipping and other reasons, the crane was still only partially erected in September 1941.

The M.T. vehicles supplied initially for transporting the aircraft from the port to the aerodrome were designed for a 3-ton load. Disregarding factors of safety, the springs of these vehicles were strengthened and they were employed to carry the 5½-ton crates. By keeping a careful watch on the unloading, and limiting the speed to 5 miles per hour, these vehicles were successfully used to move the excessive loads without breakdown or accident for approximately six months.

On the arrival of the crated aircraft at the erection hangar, further handling difficulties were experienced as the cranes provided were too few in number and had not the lifting capacity to deal with many of the crates. The base was therefore obliged to design and manufacture special devices to cope with the situation. These comprised goal-post type steel gantries, 23 feet high and 23 feet wide, fitted with two 5-ton tackles which were erected at points convenient for off-loading cased aircraft in the vicinity of the erecting sites; low wood-top trolleys constructed from axles and wheels obtained from a railway waste dump and run on 2 foot gauge tracks for transporting the cases from the gantries to the erecting hangar, and step jacks of about 5 tons capacity to enable the crates to be raised from the trolleys and lowered to the ground. All this equipment was manufactured in the Gold Coast Railway workshops at Sekondi.

The technical troubles at the staging posts were many and difficult to deal with. Numerous aircraft developed defects in the course of their progress along the route, others were damaged during landing, while some came down some distance from the landing grounds and had to be located and retrieved. The rectification and repair of these aircraft, coupled with the lack of spares and equipment, placed a very severe strain upon the limited number of personnel at the posts, and in February 1941 the number of aircraft unserviceable and awaiting spares along the route assumed alarming proportions.

All these troubles represent but a fraction of the total difficulties which the route had to contend with. There were numerous handicaps, both domestic and otherwise, outside the scope of this narrative,¹ which affected to a considerable extent the rate of the flow of aircraft to the Middle East. There was the occasion when the aerodrome runway at Takoradi caved in while a Hurricane was taxiing, resulting in damage to the aircraft and the stoppage of flying until the runway could be rebuilt. There were the several occasions when, owing to the shortage of ferry pilots, the rate of production outstripped the flying organisation, resulting in the accumulation of completed aeroplanes which could not be got rid of; and the times when, because the pilots were not skilled in the types of aircraft they had been sent to collect, it was necessary for the Takoradi base to complete their training before they could be sent on their way. There was the high rate of sickness resulting from the disagreeable climate and the excessively long working periods. Finally, there were the varying and at times very bad weather conditions along the route which often resulted in aircraft being held up for days at the respective landing grounds, and called for additional efforts from the already overworked technical personnel in order that the serviceability of the accumulations could be maintained so that eventually they would be able to continue their journey.

And yet, despite all these troubles, the organisation grew apace, the rate of production steadily increased and, in due course, the R.A.F. in the Middle East was adequately reinforced.

Aircraft Maintenance Organisation for the Greek Campaign

Italy invaded Greece on 28 October 1940. A decision to provide air assistance to the Greeks resulted, in November 1940, in the despatch of a force known as 'Barbarity' which comprised :—

¹ A.H.B. Narrative *The West African Reinforcement Route*.

British Air Force Headquarters.
Four Squadrons.
An Air Stores Park.
A Mobile Radio Unit.
A Port Detachment.

As regards the servicing and repair of aircraft, it was originally intended that squadrons would maintain their own aircraft and that all aircraft requiring repairs beyond the capacity of squadrons would be returned to Egypt. A salvage section was attached to the air stores park to deal with 'crashes.' It was soon found, however, that the original proposals were not workable, consequently a repair and salvage unit was added to the force and the arrangements were then as follows :—¹

Squadrons at stations with hangars were to maintain their aircraft entirely up to and including 180-hour inspections. Only important modifications for which parts would be despatched were to be embodied. Squadrons operating in the open were to service their aircraft up to but not including the 180-hour inspection which would be performed for them by No. 53 Repair and Salvage Unit. Modifications for these squadrons were also to be undertaken by the latter.

The salvage of aircraft was to be undertaken entirely by No. 53 Repair and Salvage Unit which would, if possible, either repair the aircraft *in situ* or at the R. and S.U. The repair of parts which the repair and salvage unit could not undertake was to be done at the Hellenic Aircraft Factory. Failing this, such parts were to be returned to Egypt.

Aircraft beyond the repair of squadrons, the repair and salvage unit or the Hellenic Aircraft Factory were, if they could be flown, to be returned to maintenance units in Egypt. If they could not be returned by air the aircraft were to be reduced to components by a railhead handling party and sent to Egypt by sea.

Servicing and Repair Difficulties of the Campaign in Greece and Crete

The main servicing and repair difficulties resulted from the lack of spares, absence of ground equipment, and bad communications. Transport was inadequate. No modern 'aircraft servicing vehicles' were provided and the old-fashioned 3-ton lorries with which the force was equipped were not only unsuitable but too few in number to meet the requirements. The repair and salvage unit was non-mobile from the moment it was established in Greece.

Salvaging of crashed aircraft was mostly undertaken by small parties detached from the repair and salvage unit and operating from the various aerodromes used by the Royal Air Force. The roads communicating between the R. and S.U. and the majority of the aerodromes were, however, so narrow, winding, mountainous and obstructed that it was almost impossible to convey aircraft larger than a Hurricane fighter, and even these were only transported with difficulty.

¹ In the absence of any reserve maintenance units in the Command, Headquarters, Middle East, were forced to send to Greece No. 32 Air Stores Park and No. 53 Repair and Salvage Unit, followed later on by No. 33 Air Stores Park.

The Hellenic Aircraft Factory near Athens (formerly owned by the British Blackburn Aircraft Company) was not equipped with its own aerodrome, but by positioning the R. and S.U. at Hassani, the nearest landing ground, it was possible to arrange for a certain amount of repair and modification work to be undertaken by the factory. The procedure was for aircraft requiring work to be performed on them to be flown in to the R. and S.U. where the dismantling necessary was undertaken. Airframe components requiring repair or modification, and engines in need of overhaul were then transported by road to the factory. On completion of the work, the components, etc., were returned to Hassani for reassembly in the aircraft by the R. and S.U. A number of the Greek aerodromes used by the R.A.F. were equipped with machine tools which were of assistance in carrying out the repair and modification of squadron aircraft.

In March 1941 the strength of the R.A.F. in Greece was raised to nine squadrons. In April 1941 it was expected to reach eleven squadrons. To meet the maintenance needs of these increases, arrangements were made for an additional air stores park and an additional repair and salvage unit to be provided, but while these two units were *en route* to Greece, the evacuation of our forces to Crete and Egypt in April 1941 was decided upon and the two additional maintenance units returned to Egypt. The majority of the squadron maintenance equipment was left behind in Greece, but a number of squadrons succeeded in taking their servicing tools to Crete where they were used for the servicing of aircraft during our brief stay on that island. All the equipment of the repair and salvage unit was lost, together with most of the supplies held by the air stores park.

Our total losses in aircraft in Greece and Crete were approximately 200, a number which could ill be spared from the limited resources of the Middle East.

Preparations for Wavell's First Campaign

Concurrently with the despatch of the 'Barbarity Force' to Greece, preparations were made for pushing the Italians back to Cyrenaica. To augment the air forces in the Western Desert a number of flights and squadrons were moved from Aden, Sudan, Alexandria and the Canal area, and the equivalent of ten squadrons formed the contribution for the direct support of the Army in their offensive which opened on 9 December 1940.

This number of squadrons should have been provided with at least three repair and salvage units and three air stores parks. The second recently formed R. and S.U. and the second A.S.P. having been sent to Greece, the Command apparently found it impossible to increase the maintenance to the extent required and the best arrangements that could be made were to add two additional salvage sections and two additional repair sections to the one existing (No. 51) R. and S.U. In addition, No. 1 Middle East Air Explosives and Fuel Park was formed for the purpose of supplying explosives and fuel to all units in the Western Desert. The park consisted of five dumps located as follows:—¹

No. 1 Main Dump	..	Fuka.
No. 2 Reserve Dump	..	Burg el Arab.
No. 3 Sub-Dump	..	Qotaifiya.
No. 4 Reserve Dump	..	Ikingi.
No. 5 Reserve Dump	..	Amriya.

¹ M.E., O.R.B. Admin. & Org. Section, August 1940.

Very little transport was available for the park and the arrangements were that the heavy vehicles required for transporting fuel and explosives between the dumps and railhead were provided in some cases by No. 31 Air Stores Park, in others by No. 6 Supply and Transport Column and at times by squadron M.T. Squadrons were responsible for producing vehicles for collecting their own requirements from the dumps.

In the back areas the arrangements for transferring the remainder of the facilities of No. 103 Maintenance Unit, Aboukir, to the Canal Zone went on apace. No. 107 Maintenance Unit was formed at Kasfareet on the site originally intended for the new depot by the Anglo-Egyptian treaty of 1936.

Servicing and Repair Difficulties of the R.A.F. during Wavell's First Campaign.

In spite of a shortage of armour, M.T. and almost everything else, General Wavell pushed the Italians back to El Agheila by February 1941. This advance of nearly 700 miles, however, severely taxed our meagre resources. In so far as the R.A.F. were concerned, fuel, bombs and the aircraft themselves were all short. With only one repair and salvage unit the facilities for dealing with disabled aircraft were inadequate during the advance. Sand and dust clouds in the desert caused many aircraft to become unserviceable for periods of 48 hours, while fighters left unprotected on the ground during such storms required some four days' work to be performed on them after the storm had abated before they were again fit for operation. On 20 January 1941, as the result of so many aircraft being put out of action by sandstorms which continued for four days, No. 202 Group were compelled to carry out fighter patrols with only one aeroplane.¹

Fortunately, the Italians were even more hampered by supply, servicing and repair difficulties. During their retreat they abandoned hundreds of aircraft, many of which could have been made flyable if they could have been repaired.

Our swift sweep forward presented acute supply and maintenance problems. Shortage of fuel was the most urgent problem. No. 31 Air Stores Park at El Adem had been rendered non-mobile through lack of transport as its vehicles had been 'borrowed' to meet other demands. The position was further complicated for both the Army and the R.A.F. by the fact that reinforcements originally intended for the Western Desert were being diverted or earmarked for Greece.

What was more serious, however, was the arrival in Cyrenaica of German land and air forces under Rommel. On 24 March the enemy occupied Agheila and the British were soon forced to fall back to the Sollum line, leaving a garrison isolated in Tobruk.

Reorganisation of Maintenance in the Western Desert²

On 9 April 1941 No. 204 Group Headquarters was formed together with three 'Striking Force Bases' and six 'Subsidiary Aerodromes' to operate all R.A.F. squadrons and units west of Burg el Arab. The striking force bases

¹ M.E., O.R.B. Air Staff Section Appendix 28, dated 20 January 1941.

² M.E. File S.44211/Org.

were for the reception, administration and ground operation of squadrons or parts of squadrons being sent forward from rear areas without ground organisations, and for squadrons or parts of squadrons returning from forward areas without their ground organisation. The administrative organisation set up enabled squadrons or parts of squadrons to operate immediately from these bases. The subsidiary aerodromes were for the reception of squadrons and their ground organisations returning from forward areas or moving forward from the Delta area.

No technical maintenance spares were held at either the striking force bases or the subsidiary aerodromes, but the former were equipped with refuelling devices, rearming kits, flares, rigging trestles, bomb trolleys, etc., and the latter with refuelling devices and night landing flares. Supplies of fuel, oil, bombs, ammunition, pyrotechnics and oxygen were laid down at each base and subsidiary aerodrome. The units responsible for the main supplies of equipment, spares, etc., and for providing assistance in aircraft servicing, repair and salvage were the two 'old originals' No. 31 Air Stores Park and No. 51 Repair and Salvage Unit. In addition, two main petrol and explosives dumps were established.

During April 1941 a number of squadrons were assembled at the bases and subsidiary aerodromes and by the end of the month the force consisted of :—

Headquarters, No. 204 Group.
Headquarters, No. 258 Wing.
3 Fighter Squadrons.
7 Bomber Squadrons.
1 Army Co-operation Squadron.

In addition to the air stores park and the repair and salvage unit, a limited number of maintenance personnel were provided at each station. An air ammunition park and a mobile radar section also joined the force while transportation requirements were provided by No. 6 Supply and Transport Column.

On 1 May the Desert Air Force was again reorganised. An Advanced Air Headquarters was formed to control all operations in the Western Desert. This Headquarters was mobile and stationed in proximity to the Army Western Desert Force Headquarters. A Rear Headquarters also came into being to exercise administrative control of all R.A.F. units in the Western Desert. Two additional Wing Headquarters were also formed—No. 257 Headquarters Wing (strategic reconnaissance and bombing) and No. 253 Air Component Wing (close support and tactical reconnaissance for the Army).

The striking force bases and the subsidiary aerodromes were then abolished and were superseded gradually by :—

(a) *Base Landing Grounds (B.L.G.s).*

Each squadron, with the exception of heavy bomber squadrons,¹ was allotted a B.L.G. which was manned by the servicing and non-operational elements of the squadrons. The functions of the staff at the B.L.G.s were to :—

¹ Heavy bomber squadrons at this period were those equipped with twin-engined Wellington aircraft. When four-engined aircraft were afterwards introduced the Wellingtons were known as medium bombers.

- (i) Carry out inspections of aircraft and equivalent repairs up to but excluding the 180-hour (or 220-hour where applicable).
- (ii) Retain the squadron's immediate reserve and unserviceable aircraft.
- (iii) Hold all M.T. other than that required at operational landing grounds.

(b) *Operational Landing Grounds (O.L.G.s).*

Each squadron, with the exception of heavy bomber squadrons, was allotted an O.L.G. which was manned by the operational element of each squadron. The functions of the staff at the O.L.G.s were to :—

- (i) Control and operate aircraft actually required for use.
- (ii) Rearm, refuel and carry out daily inspections and servicing of aircraft entailing up to six hours' work.
- (iii) Return to base landing ground all aircraft which could not be repaired in six hours. If this was not possible, servicing parties were to be obtained from either the B.L.G. or the repair and salvage unit according to the amount of work involved, subject to local repair being advantageous.
- (iv) Hold M.T. required to make the personnel and equipment of the O.L.G. fully mobile.

(c) *Fuelling Landing Grounds (F.L.G.s).*

All squadrons of the Air Component Wing, the fighter squadrons of No. 204 Group and the heavy bomber squadrons of the Headquarters Wing were allotted an F.L.G. Personnel for the F.L.G.s were obtained from various units in the rear areas whose function was to :—

- (i) Refuel and rearm medium bomber, army co-operation and fighter squadrons.
- (ii) Refuel heavy bomber squadrons.
- (iii) Hold M.T. required to make the personnel and equipment of the F.L.G.s fully mobile.

The general maintenance policy for the reorganised Desert Air Force was that initially only one air stores park (No. 31) and one repair and salvage unit (No. 51) would be available, but additional personnel would subsequently be sent to these units to form a second A.S.P. and a second R. and S.U. so that, as in the past, the reorganised force was again handicapped from the maintenance point of view by being insufficiently provided with aircraft supply, servicing, salvage and repair units.

Both the A.S.P. and the R. and S.U. came under the direct control of Air Headquarters and were located in the B.L.G. area. An advanced section of the A.S.P. and the salvage sections of the R. and S.U. were, however, sent forward to the O.L.G. area. The rear and advanced sections of these units were organised on a fully mobile basis.

Until the formation of the second air stores park, No. 31 A.S.P. catered for the needs of all the units in the Western Desert and was established with one month's stock of equipment for the squadron served. The advanced section in the O.L.G. area carried 7 days' stocks.

The repair responsibilities of No. 51 Repair and Salvage Unit, and the additional R. and S.U. when formed, were restricted to such work as could be effected in 7 days and the 180-hour (or 220-hour where applicable) inspections for fighter and medium bomber squadrons. They had also to be prepared to send parties to the operational area to repair aircraft if that would be more economical. The salvage sections of the R. and S.U.s were responsible for the collection of damaged aircraft and their return to either the base landing grounds, the repair and salvage unit or a maintenance unit, according to the extent of the repairs required.

The air ammunition park fathered all the main R.A.F. petrol and explosives dumps in the Western Desert and came directly under the control of Air Headquarters. Assistance in the transportation and formation of certain dumps west of Mersa Matruh was given by the Army to which specialist personnel from the A.A.P. were attached.

Only No. 6 Supply and Transport Column was available initially to meet transportation requirements, but it was intended to form an additional S. and T. column as soon as personnel and vehicles became available.

Introduction of a Chief Maintenance Officer at R.A.F. Headquarters, Middle East

Early in 1941 the Air Ministry, as the result of experience gained in France in 1939-40, decided to establish a Chief Maintenance Officer at R.A.F., Middle East, Headquarters to deal with all questions of supply and maintenance which had hitherto been referred to the Air Officer-in-charge of Administration. On his arrival in Cairo in April 1941, the C.M.O. found that the aircraft repair organisation presented a difficult problem. There were four maintenance units in existence at this period :—

No. 101	..	Explosives	..	..	..	El Ma'sara
No. 102	..	Repair and Equipment	..	..	..	Abu Sueir.
No. 103	..	Repair	..	..	..	Aboukir.
No. 107	..	Equipment	..	..	..	Kasfareet.

Both No. 102 and No. 103 Maintenance Units were doing their best to deal with the accumulation of repairs but were handicapped by a lack of spares and operation equipment.

During the middle of May 1941 the aircraft position commenced to show signs of improvement. Personnel for the repair sections of No. 107 Maintenance Unit, Kasfareet, and for additional repair and salvage units and air stores parks were on their way from the United Kingdom. Equipment for the R. and S.U.s and A.S.P.s was also expected. Port Sudan had been approved as an additional aircraft erection centre, and aircraft, mechanical transport, equipment, etc., to replace the losses in the Western Desert, Greece and Crete were being shipped. Additional fighter squadrons had been promised and more squadrons were to come up from South Africa and East Africa. Whilst the squadrons evacuated from Greece and Crete were awaiting new aircraft, equipment and mechanical transport to replace that left behind, the skilled personnel of those units were used to increase the maintenance effort.

In the light of the improved situation, the chief maintenance officer was able to draw up a comprehensive scheme for the future maintenance organisation, which included the formation of a Maintenance Group on the lines of the Maintenance Command in the United Kingdom which he placed before the Deputy A.O.C.-in-C. At that stage the Command was informed by the Air Ministry that it was proposed to send out a mission to organise maintenance in the Middle East. On 9 May 1941 the War Cabinet, on the recommendation of Lord Beaverbrook, had decided to send Air Vice-Marshal Dawson of the Ministry of Aircraft Production to the Middle East to investigate the aircraft maintenance organisation.¹

Proposals to Improve the Maintenance Organisation

Shortly after he arrived in Cairo, Air Vice-Marshal Dawson in conjunction with Air Commodore Cooke prepared a scheme whereby Dawson was to be established with a small staff at Headquarters, Middle East, as Chief Maintenance and Supply Officer directly under the Air Officer Commanding-in-Chief and not under the Air Officer-in-charge of Administration, as had been the accepted R.A.F. practice in the past. The new C.M.S.O. was to be responsible for supply and maintenance policy and would provide all information required by the A.O.C.-in-C. The C.M.S.O.'s staff would include two inspecting officers, Air Commodore Boswell and Wing Commander Barnard, who were to deal with operational formations and the creation of additional maintenance units as required. A new maintenance group was to be formed under the command of Air Commodore Cooke to control all maintenance units, repair and salvage units and air stores parks.

The scheme, briefly, was that the Chief Maintenance and Supply Officer would lay down the policy for production, etc., and this would be implemented by the maintenance group which would assume the functions exercised by Maintenance Command and the Ministry of Aircraft Production in the United Kingdom. The whole of the existing equipment staff (except Movements) and engineer staff plus aircraft inspection department personnel and certain armament and signals officers were to be transferred to the new maintenance group, and owing to the great increase in supplies and aircraft these staffs were to be considerably augmented.

The A.O.C.-in-C. forwarded these proposals to the Air Ministry on 25 June 1941, together with details of the new increased establishments required, but formal authority was deferred for some months. In the meantime the Command went ahead to reorganise its maintenance services on the lines it had suggested. The new maintenance group (No. 206) under the command of Air Commodore Cooke was formed with effect from 17 June. Air Vice-Marshal Dawson, with his two inspecting officers, acting independently of the Air Officer-in-charge of Administration, proceeded to enlarge the maintenance facilities throughout the Command. Visits were made to the Western Desert, the Levant and various units in the Delta to study conditions under which aircraft operated and would have to be repaired.

Improvement of the Maintenance Organisation from June to November 1941

The formation of the Chief Maintenance and Supply Officer's Branch at

¹ A.H.B./II J1/88.

Headquarters, Middle East, to co-ordinate the supply and maintenance of equipment throughout the Command was, undoubtedly, one of the most important innovations introduced throughout the Middle East and Mediterranean campaigns.

There was still a shortage of almost every item, from the aircraft itself to the pilot's equipment. Every effort was made to remedy this state of affairs, and particular attention was paid to the salvage and repair side of the organisation. The difficulties of transporting salvaged aircraft across the desert, often for many hundreds of miles, to the nearest repair unit made it necessary to plan for highly mobile and self-supporting repair and salvage units and to augment considerably their numbers. The existing R. and S.U.s were therefore reorganised and additional units of this nature were formed. A base salvage depot was created to transport crashed aircraft collected by the R. and S.U.s from the battle area to the base workshops. Steps were then taken to reduce the congestion at Nos. 102, 103 and 107 Maintenance Units at Abu Sueir, Aboukir and Kasfareet respectively.

Additional repair units were created by adopting the same methods used by the Ministry of Aircraft Production in England and a full-scale plan was embarked upon to make the best possible use of all the civilian industrial resources to an extent hitherto unknown.

At the same time, the Axis forces were also augmenting their African air power and a series of determined attacks were made upon our bases with the obvious intention of crippling our efforts to develop air strength and increase our reserves of material. In spite of repeated air attacks, involving loss of Egyptian civilian lives and damage to civilian property, the enemy had only one significant military success. During July and the early part of August 1941, No. 102 Maintenance Unit at Abu Sueir was systematically destroyed. After the first serious raid, however, the evacuation of the remainder of the valuable and irreplaceable plant and stocks was completed within three days, and the major loss was one of facilities rather than actual equipment.¹

The loss of Abu Sueir served to emphasise the importance of a repair organisation dispersed in depth. It showed also that it was time to break away from the conventional depot which had been ideal for the Middle East under peace conditions, i.e. tightly packed groups of buildings usually isolated in desert country, in favour of something that would meet the demands of an impending spread of the war around the Middle East, and would also enable the maintenance organisation to operate in the event of the loss of the maintenance units in the Middle East itself, either by bombing or by actual invasion.

¹ It is interesting to record that No. 107 Maintenance Unit at Kasfareet, although only 25 miles distant from Abu Sueir, was not attacked. The Officer Commanding Kasfareet (Gp. Capt. Clappen) considers that this was due to—(a) the fact that R.A.F. Station Abu Sueir had been in existence for many years and its position was known to the enemy, whereas Kasfareet only came into being after the war commenced and had not apparently been mentioned in the enemy's intelligence reports. (b) Abu Sueir was defended with guns and searchlights but Kasfareet possessed no defences. The Station Commander of Kasfareet when offered guns and searchlights refused them on the grounds that they would reveal the existence of a new target. He relied on camouflage and blackout as a protection and was apparently justified in his choice.

H.Q., M.E., Report 'Maintenance and Supply Organisation—Crusader and after.'

To replace the loss of No. 102 Maintenance Unit, small garages, storehouses and other buildings, some of them in the native quarter of Cairo, were taken over and the men and equipment evacuated from Abu Sueir moved into them. Innumerable administrative and domestic problems arose as the result of this arrangement, particularly as the C.M.S.O., in face of the difficulties of feeding and housing the personnel, insisted on production commencing immediately. In addition, objections to utilising the unsavoury areas of Cairo for production purposes were raised by the personnel branches of Middle East Headquarters on the grounds that these areas were out of bounds and always had been out of bounds to troops. However, despite all objections, the forbidden areas were occupied and the repair of equipment soon commenced in them.¹

A most ambitious programme of clearing the ancient caves of Tura was commenced. These vast caverns in the heart of the Mokhattam Hills had been made by the ancient Egyptians during the process of quarrying stone to build the Pyramids. Thus, projects originated so many centuries ago became of the greatest value to the engineers of the Royal Air Force in the war of 1939-45. The floors of the caves were cemented, the walls whitewashed, electricity, power and water installed and a comprehensive aircraft depot created with storage space for spares and workshops facilities for the overhaul of aero-engines, the repair of equipment and numerous other ancillary requirements.

The sections in the caves were linked with the parties scattered around Cairo under a single technical control with two distinct administrative echelons, the whole being named No. 111 Maintenance Unit. Echelon 'A' comprised the sections in the Tura Caves, approximately 10 miles from Cairo. Echelon 'B' consisted of the shops spread over the Boulac district of Cairo, an area of over 1½ square miles. Included in Echelon 'B' were Messrs. Thomas Cook's Engineering Works, used for R.A.F. purposes as a mechanical transport repair unit. R.A.F. Stations Helwan and Heliopolis each provided four engine test beds for the use of the M.U. which also utilised the engine repair and propeller repair facilities at the latter station.

Concurrently with the creation of No. 111 Maintenance Unit, the old R.A.F. aerodrome at Heliopolis with its many hangars was taken over by the maintenance organisation, and a large repair unit formed which was staffed and managed by the British Overseas Airways Corporation. The maximum use was made of local artisans, who proved extremely efficient in repetition work. R.A.F. technical personnel were included to supervise and inspect the work. (At the peak of its production this unit achieved the very high figure of 245 aircraft repaired or inspected in one month.)

The R.A.F. aerodrome at Helwan was also developed and two repair units placed there, one for Hurricanes and one for Tomahawks. They were manned jointly by R.A.F. and native personnel. The peace-time depot at Aboukir (No. 103 Maintenance Unit) was retained in full production instead of being shut down as had originally been planned. Although a considerable number of air attacks were directed against it the total damage sustained was negligible, and at no time was the depot out of action. The existing station buildings at

¹ M.E., O.R.B., C.M.S.O. Section 1941.

Khartoum were developed into a compact repair depot (No. 104 Maintenance Unit) to act as a reserve capacity behind the repair units in the Delta area.

With the development of the Takoradi reinforcement route it became clear that the number of aircraft arriving in the Command requiring work to be performed on them before they could be used operationally would increase considerably. A number of aircraft storage units were consequently created in the Delta area and up the Nile Valley at Luxor and Khartoum to provide facilities for the tasks involved. Similarly, a maintenance unit (No. 109) was formed at Summit in the cool of the Red Sea hills to render operationally serviceable the aircraft shipped from America and erected at Port Sudan.

All this improvement in the maintenance organisation did not, of course, take place without a great deal of planning. Lack of good civilian engineering facilities of easy access to the repair units made it necessary to formulate schemes whereby work not normally demanded of R.A.F. workshops could be undertaken. During the latter half of 1941, to deal with the increased flow of damaged aircraft, the existing repair units were reorganised and placed on a production basis with the sole object of achieving the greatest possible output from all sources.

The world shortage of spares made it necessary for recovery schemes to be instituted, and damaged and worn items, which in more normal times would have been relegated to the scrap-heap, were repaired and put back into aircraft and engines. Overhauls were undertaken, largely by the reconditioning of worn parts, and in some cases only by improvisation and local manufacture was the work completed. Cylinder barrels were chromium plated, reground and finished by honing and lapping. Cracked crankcases were welded and re-machined, etc. New sections were spliced into wooden propeller blades, while salt baths and equipment were manufactured for the heat treatment and straightening of metal blades, thus obviating the necessity for returning propellers to the parent factories for repair.

To keep check on the vast amount of equipment which was distributed over the whole of the Command, preliminary steps were taken to form a master provision office to control all spares and general equipment, except complete aircraft engines, mechanical transport, marine craft, explosives, aircraft fuels and rations.¹

The shortage of maintenance personnel was to a certain extent alleviated by the large-scale employment of civilians in all accessible repair depots. This applied particularly to the British Airways Repair Unit. The mechanical transport repair organisation was almost entirely staffed by making use of the civilian mechanics from established Egyptian firms under the supervision of R.A.F. personnel. Another outstandingly successful innovation was an agreement with the Faculty of Engineering in the Egyptian University which enabled the R.A.F. to obtain the benefit of excellent plant and floorspace, and the services of Egyptian students. By the end of 1941 the total number of civilian artisans employed by the R.A.F. in the Middle East had risen to 5,440, whilst the total number of civilians of all classes employed, i.e. clerks, artisans and labourers, was nearly 23,000.

¹ This was the result of an Air Ministry decision originally made in 1940 and based on experience in the United Kingdom.

CHAPTER 13

THE MIDDLE EAST CAMPAIGN NOVEMBER 1941 TO JANUARY 1943

Aircraft Maintenance and Supply Organisation for Crusader

The Crusader offensive, designed primarily to destroy the Axis armoured forces in Cyrenaica, opened on 18 November 1941. During the preparation period for the operation, H.Q., No. 204 Group became Air Headquarters, Western Desert, while in Cairo, Air Headquarters, Egypt, was formed to relieve Headquarters, Middle East, of its duties as a local Command. Administration was also put in hand for the formation of self-contained mobile wings so that squadrons could be moved quickly, unhampered by excessive maintenance personnel. Although schemes for increasing the mobility of squadrons and wings were worked out (including the re-design of repair and salvage units and air stores parks) the imminence of the Desert offensive precluded their full implementation in time for Crusader. Even so, the improvements made in the aircraft maintenance and supply services kept the R.A.F. in the air during both the advance and the retreat.

In the maintenance organisation for Crusader the forward elements for maintenance, repair, salvage and supply were directly connected to the base maintenance and supply organisation. Thirty-nine squadrons were employed and the organisation for aircraft servicing, repair and salvaging for the force was extremely practical. Squadron servicing personnel were split into wing base parties and very small forward operational sections. In the Western Desert there were three repair and salvage units each working in parallel with an air stores park. Two of the three R. and S.U.s and A.S.P.s kept an advanced section working as far forward as possible. Before the offensive the limit of work in the R. and S.U.s was reduced to 14 days and the necessity for readily available replacements led to the formation at these units of reserve aircraft pools. Altogether the repair and salvage units operated thirteen mobile repair sections and twelve mobile salvage sections. In addition, there was a repair and salvage unit and an air stores park with three mobile salvage and six mobile repair sections operating with the heavy bomber wing in the rear area.¹

The depots which played the major part in backing the forward maintenance organisation were :—

No. 103 Maintenance Unit	..	..	An aircraft repair depot at Aboukir.
No. 106 Maintenance Unit	..	..	An equipment depot dispersed in the Khanka area.
No. 107 Maintenance Unit	:	..	An aircraft repair depot and equipment holding unit in the Canal Zone.
No. 108 Maintenance Unit	..	..	An aircraft storage unit on the Fayoum Road.
No. 110 Maintenance Unit	..	..	The main storage depot for all explosives in the Tura Caves.

¹ H.Q., M.E., Report 'Maintenance and Supply Organisation—Crusader and after.'

No. 111 Maintenance Unit	.. ..	The new comprehensive depot in Cairo and the Tura Caves.
No. 113 Maintenance Unit	.. ..	An aircraft storage unit at Hurgada.
No. 121 Maintenance Unit	.. ..	An air ammunition park at Bardia.
No. 124 Maintenance Unit	.. ..	An air ammunition park at Fuka.
No. 132 Maintenance Unit	.. ..	An aircraft storage unit at Kilo 8.
The British Airways Repair Unit at Heliopolis.		
An Auxiliary Repair Depot at Helwan.		

New aircraft for Crusader either arrived cased at Takoradi or Port Sudan or, for certain types, were flown direct from the United Kingdom to the Middle East. The focal point for distribution was at Wadi Natrun where an aircraft delivery unit worked in conjunction with the aircraft reinforcement pool. Seven days' estimated wastage for Crusader was stored at Wadi Natrun. The units supplying the squadrons in the desert kept two days' wastage for the squadrons they served.

The provision for ground transportation was on a much larger scale than had hitherto been made for operations in the Command. There were about 4,000 R.A.F. vehicles in the Western Desert, and approximately 2,000 in the base area. All units in the forward area were mobile; two supply and transport columns under the control of Air Headquarters, Western Desert, supplied additional transportation as required, and two main pools of load-carrying vehicles were located at Burg el Arab and Wadi Natrun respectively to supply replacements for casualties. To obviate delay in the delivery of replacements in the forward area, an additional pool was formed at Daba, with an M.T. repair section attached. A pool of M.T. drivers to ferry vehicles between the main M.T. pools and the forward M.T. pool and, if necessary, onward to the location of units, was also provided.

The organisation for mechanical transport repair consisted of an M.T. repair section attached to each repair and salvage unit. In the Western Desert the M.T. repair sections were combined to form an M.T. light repair unit operating in the forward area. This was supported by the base M.T. repair shops in the Delta area.

Before the operation commenced, a number of supply dumps containing petrol, oil, ammunition, spares, etc., were laid down at various points and arrangements were made for additional dumps to be established in the forward area as the proposed advance proceeded.¹

The offensive began at dawn on 18 November. It went well at first and by the 20th our armoured forces had advanced to Sidi Rezegh and had managed to join up, although weakly, with Tobruk. Weather curtailed the work of our air forces during the first two days, but the enemy appeared to be even more affected, there being virtually no opposition to our activities. Strong attacks were made against enemy landing grounds and vehicles to the west of Bardia and in the El Adem area. On the whole it could be said that the battle, both on the ground and in the air, was going well. There was, however, a sharp change for the worse on 22 November. The enemy armour had not been

¹ See Appendix 26.

decisively engaged, as had been intended, and was still substantially in being. On the 23rd our Sidi Rezegh positions were overrun and the connection with Tobruk was lost. Very hard fighting followed and for the next ten days the offensive hung in the balance. By 3 December the position had begun to improve but it was not until six days later that Tobruk was finally relieved. By this time our air forces had assumed a real ascendancy over the enemy. The fight was always carried to the enemy whereas his offensives against our troops or targets farther to the rear were on a lesser scale and were comparatively ineffective. It was not surprising, therefore, that when our ground forces began to make progress at the end of the first week in December, a rapid advance was soon under way which culminated in the capture of Benghazi on 23 December.

Immediately after the capture of Benghazi work was commenced on clearing the harbour. A fortnight later the first ship was able to enter. At this stage it was decided to reduce the enemy garrisons at Bardia, Sollum and Halfaya which had been by-passed in the early days of the offensive. Bardia fell on 2 January, Sollum on the 12th and Halfaya on the 17th. In each case the ground assault was preceded by heavy air bombardment. In the forward area, however, the range of the enemy targets was by now too great for our fighter aircraft and, above all, there was a serious shortage of fuel, affecting the Army and Royal Air Force alike; we were, in fact, generally short of all supplies and our lines of communication were ill-developed.

By 7 January the position of the two armies was largely stabilised at El Agheila, and for both the principal task was to build up supplies. The enemy had undoubtedly suffered heavier losses than ourselves during our two months' advance, but he had the advantage that his lines of communication in Africa were hundreds of miles shorter than those of our own forward troops and squadrons. The Eighth Army was in no position to press forward again until units which had been on the move since the middle of November were rested and refitted. The air forces, too, were suffering from all the disadvantages of operating without firmly established forward supply bases; nevertheless, such was the ascendancy attained over the enemy air forces that adequate support could have been given had a further advance on the ground been practicable.

The race to build up supplies was won by the enemy. In fact, the speed with which he completed his arrangements came somewhat as a surprise. On 21 January the Axis forces began a movement that met with such success that it became a major attack. The weak forces which the Army had available in the forward area were beaten back or by-passed. On the opening day of the attack our forward landing grounds were waterlogged and the Axis aircraft were able to operate unhindered by R.A.F. opposition. By midday on the 22nd the enemy were approaching Antelat, where the bulk of our fighter force was located. Very little warning was received and the last aircraft left the moisture-saturated aerodrome under shell fire. The 'hop-back' was to Msus, some 160 miles from El Agheila.

The enemy forces advanced rapidly but the success of his moves was not due to the work of his air force. It was due to the vigorous and well-directed operations of his armoured and motorised columns, which in the early stages had as their object the recapturing and cutting off of our ground forces, rather than

victory in pitched actions. For the better part of a week the scope and intentions of the enemy's advance remained obscure, although it was very clear that we were in danger of losing all the territory so recently won. Our ground forces were too weak to risk a major battle and, in addition, there was no suitable place between El Agheila and Gazala where an army could make a stand. The task of the Army for the moment was, therefore, to delay rather than to attempt to stop the enemy advance.

On the morning of 28 January the enemy columns pierced our defensive lines in the coastal sector and pushed fast patrols on to Benghazi. Despite our attacks from the air the town was captured and thus fell to the enemy within one week of the opening of his offensive. Without pause the Axis forces sent further patrols into the Jebel Akhdar area. Their rapid advance, however, which was made only at the expense of leaving behind main armour and by dispensing with all but token air support, laid them open to severe attacks from the air. During the first two weeks in February the Allied air forces were able to destroy and damage hundreds of vehicles and also to carry out a rearguard action that allowed our ground forces to reach Gazala where prolonged defence was possible. Although the Desert Air Force was moving back with the Army from Msus to Mechili and from Mechili to El Adem, air operations were maintained at an intensity which, in the difficult circumstances of rapid retirement, was remarkable. By the middle of February the Imperial Forces had fallen safely back to a shortened line running south-west from Gazala.

The campaign—especially when our lines stretched up to El Agheila—threw a great strain on the maintenance organisation, particularly on the repair and salvage sections which had to make a maximum effort to keep up aircraft strength. Nearly 2,000 aircraft were casualties from 18 November 1941 to 13 March 1942. Approximately 700 were lost and the rest scattered over perhaps 100,000 square miles of desert, all having crashed or forced-landed, and most of them seriously damaged. It was not easy to discover the exact location of an aeroplane which had been forced down in the desert. In almost every instance it meant many days of hard searching over many square miles. 'Pin-points' given by the pilots who 'walked in' were often inaccurate.¹

Once an aircraft was located it was carefully inspected and a decision was made on the method and the extent of repair necessary. Sometimes the machine was made serviceable on the spot; sometimes temporary repairs were performed to enable the aircraft to be flown to the base; more often than not the aircraft was transported bodily over many hundreds of miles of desert, taking many days of hard travel, back to a base depot. On occasions this last course was modified to the extent that the aircraft was taken only so far as the main working party of the repair and salvage unit concerned, perhaps two or three days' journey distant. The repair capacity of an R. and S.U. was, however, limited.

The repair or transportation of a damaged aircraft was always a formidable undertaking. The day's heat, the sandstorms which penetrated everything, the bitterly cold winds after sundown, the sudden and torrential downpours and all the time the shortage of drinking water, translated every aspect of

¹ H.Q., M.E., Report 'Maintenance and Supply Organisation—Crusader and after.'

living into discomfort. Small groups of men were continually isolated, either working on an aeroplane, or attempting to transport one over the harsh desert surface, all around them an illimitable ocean of sand. The obvious hazards of the war—a stray enemy aircraft or an enemy patrol attacking them—were matters to which the least thought was given.

As the advance proceeded the repair and salvage units did not convey aircraft all the way back to the base depots. A separate organisation was formed to link part of the forward salvage work with the base. This was known as the base salvage section which operated with over fifty articulated vehicles. The base salvage section was controlled direct from Headquarters, R.A.F., Middle East, and its work was co-ordinated and linked with that of the forward salvage sections. Direct wireless communication was maintained between the forward salvage parties and Headquarters, Middle East. In this way the maximum number of salvage returns were obtained for the efforts made in the forward areas. This was important in view of the shortage of mechanical transport vehicles in both the forward and base salvage sections and the necessity to control the particular types of aircraft being brought back to meet the demands of the types required for operations.

The mobile salvage parties in the battle area transported aircraft to pre-arranged focal points. These were, at different times, located in Gambut, El Adem, Maddelena, Jiarabub and at L.G. 75. The aircraft were dumped at those points. At times there were as many as eighty salvaged aircraft at one place awaiting collection by the base salvage section.

The base salvage section operated in convoys; each convoy having eight to twelve articulated vehicles. Two to three convoys were constantly outbound and two to three were always on the way back to the base. On occasions these convoys transported aircraft over distances of from 700 to 900 miles across some of the most difficult terrain in the world. The base maintenance units did well during the period of the operation and a steady flow of aircraft, both new and repaired, was fed to the squadrons. In the seventeen weeks from the commencement of Crusader to the middle of March 1942, 1,035 aircraft casualties were received by the maintenance units for major repairs. Of these aircraft 810 were delivered back to the battle area operationally serviceable.

An increasing number of Hurricane fighters Mark II 'A', 'B' and 'C' were received during the early weeks of the campaign and many squadrons were equipped with the improved type. The Tomahawks did well, but the appearance of the German 109F fighter soon after the offensive started caused many R.A.F. losses. The Blenheims and Hurricanes Mark I were definitely outclassed, and it was the last occasion on which they were used in any strength in Libya.

The shortage of aircraft spare parts and operational equipment was still one of the major handicaps of the maintenance units during Crusader and every opportunity was taken to utilise parts and equipment from crashed aeroplanes to make others operationally serviceable. The moment an aeroplane became a casualty the remains were seized upon by mechanics in an endeavour to obtain some items of equipment which were preventing other aircraft from being brought into use.

The provision for mechanical transport, although large, proved to be insufficient to meet requirements. M.T. commitments during Crusader were heavy. Furthermore, since the operation did not end cleanly, unforeseen additional commitments arose. These in turn affected the organisation for repair which itself was handicapped from the beginning by a shortage of personnel and repair facilities. The campaign which imposed such additional strains upon the land operation and revealed in consequence weak points, emphasised the necessity to review completely the problem of too few vehicles, heavy wastage and the need for quick repair.

Of the total R.A.F. vehicles involved at the beginning of the advance 80 per cent were new. This was a fortunate factor as the forward movement was rapid, and since the operation did not run according to plan the vehicles were called upon to undergo unduly protracted spells of duty over harsh desert surfaces. As it was the arduous conditions took heavy toll of the vehicles used and those responsible for M.T. servicing and repair had to exert super-human efforts to meet even the normal maintenance requirements.

During the withdrawal a clearing-up party of the M.T. light repair unit was left at Gambut. It proved to be such a convenience to have this detachment in the forward area that it was subsequently retained as a permanent advanced section.

Effect of the Japanese War on the Aircraft Position in the Middle East

In the same manner in which the necessity for sending aircraft to Greece handicapped the efforts of the R.A.F. during Wavell's first campaign, so the outbreak of the Japanese war interfered with the aircraft support arrangements during the Crusader operation.

Japan attacked Pearl Harbour on 7 December 1941, i.e. less than three weeks after the commencement of Crusader. Britain declared war on Japan on 8 December and it became immediately obvious that the Middle East would have to supply the much-needed aircraft for the defence of Singapore, Burma and India. When the Crusader offensive started all the squadrons and the repair and salvage units were at full strength, but there was little behind them other than the new aircraft on their way from the reinforcement routes and those under repair.

The decision that part of the reinforcements intended for the Middle East were to be diverted to the Far East, and also that a proportion of the Middle East stocks of aircraft was to be sent there, put an end to the immediate hopes for building up an adequate reserve.

In the early days of the Far East war, some of the aircraft were sent cased, some were sent direct to India, and one batch was despatched on H.M.S. *Indomitable* from Port Sudan. As the Japanese advanced it became necessary to fly as many aircraft as possible. Hurricanes which had already flown the 4,000 miles from Takoradi were serviced and sent on another 6,000 miles via Habbaniya, the Persian Gulf, Karachi, Allahabad, Calcutta, Rangoon and Palembang.

The American Army Air Force flew their heavy bombers and transport aircraft all the way from the United States via Miami, Brazil, Bathurst, Takoradi, Khartoum, Cairo, and then on by the same route. Their Kittyhawk fighters were erected at Takoradi and flown on in the same way as the Hurricanes. The number of engine hours used was phenomenal but there was no other method of supplying the Far East. All these arrangements meant additional work for the R.A.F. maintenance personnel which was not eased until the United States were able to build up their own servicing organisation.

The Middle East continued to provide aircraft, spare engines, etc., for the Far East during 1942, even when Egypt was in danger of being captured by Rommel's forces. In addition to Nos. 11 and 45 Squadrons, Nos. 84, 113 and 211 (Blenheim) Squadrons were despatched from Egypt to the Far East in January 1942, making a total of 120 Blenheims diverted. Some 30 Hurricane fighters were also sent in December 1941 and 39 in January 1942 in addition to the 50 supplied in February 1942.

On 6 May 1942 the South Arabian Reinforcement Route was formed under the administrative control of R.A.F., Middle East, Headquarters for the supply of aircraft to the Far East. The main staging posts were at Aden and Salala with refuelling facilities at Masira and Ras el Hadd. Aircraft were largely drawn from Middle East strength initially though a considerable and increasing number passed by the West African Reinforcement Route from Takoradi and, later, from assembly units in Northwest Africa, principally at Casablanca, Oran and Algiers.¹

Preparations for a New Offensive in Cyrenaica—March to May 1942

Following the withdrawal to the Gazala line, a period of some three months was spent in preparation for the next battle. Unfortunately some of the preparations had of necessity to be in reverse—not only was an immediate increase of aircraft out of the question, but the existing resources were being sapped by India, which was at this time being seriously threatened by the Japanese. The effort of sending both aircraft and spares strained everything to the limit. These diversions, begun during the Crusader operations, were continued at the very time when the Air C.-in-C. was anxious to overhaul squadrons that had been weakened by their recent efforts.

By draining all resources, during February and March, the Command was able to despatch to the east 300 fighters and 139 light bombers which was followed by a request by the Chiefs of Staff, fearing an invasion of Ceylon, for a further 30 fighters, 20 light bombers and a complete torpedo bomber squadron. Furthermore, there was a possibility that the Command would have to mount a force to operate in Trans-Caucasus. This resulted in a serviceable fighter strength in the Desert barely equal to the enemy's strength of the superior Me.109F. Clearly the solution lay in Spitfires, and therefore urgent requests for this type of aircraft were made to Air Ministry. As a result one squadron was operational in May and a further three in the following six months.

While the reinforcement and supply position had thus deteriorated on account of the war in the Far East, the enemy, since the beginning of the year, had concentrated on securing an adequate build-up in Libya. Our ability to prevent

¹ O.R.B.s of No. 216 Group and Air H.Q., Iraq and Persia.

this was limited because Malta had been to a large extent neutralised as an offensive air base by the German Air Force stationed in Sicily. In the light of these facts there was little hope of the Allies repeating past successes in interrupting supplies to Tripolitania until western Cyrenaica was again captured or until the enemy air offensive against Malta slackened. Thus, though every effort was made to interfere with the enemy's supply routes, and to restrict the use of Benghazi, it was apparent that the battle for supplies was running adversely.

The date of the opening of the campaign by either side was at this stage uncertain, but the Chiefs of Staff in London were anxious that we should take the initiative as soon as possible. As the principal German effort was directed at Russia, it was important that as much diversion as possible should be caused. An early offensive would pin down the enemy forces in Libya, and a successful battle would give us Cyrenaica and so enable us to retain Malta. There was always the possibility, however, that we should be forestalled by an enemy offensive, which might prove an advantage to us in our existing strong positions, and the return of Rommel to Libya produced indications of an offensive by him in early May. It was considered that the time factor for the enemy was principally governed by the rate of supplies into Benghazi. During April, therefore, this port was the target for our bomber force.

About mid-May it became clear that the enemy offensive was imminent as every effort was made to prevent our reconnaissance from observing troop movements, and air attacks increased on our landing grounds. By this time it was estimated that the enemy had based in Cyrenaica, Crete and the Dodecanese about 928 aircraft with a serviceability of 50 per cent. In addition, powerful forces were based in Greece, Sicily and Southern Italy. In comparison, our forces in Egypt and the Western Desert on 28 May numbered 849 aircraft in squadrons with an average serviceability of 60 per cent. The reserves in fighters, however, were less than 60 per cent of what they were in Crusader, and this for a battle in which the wastage rate would no doubt be considerably higher.

Following the advance to El Agheila and the subsequent retirement to the Gazala line in February 1942, every effort was made to learn the lessons of mobile warfare and to apply them to the fullest degree in subsequent offensives. The air stores parks were made completely mobile. No. 40 A.S.P., the forward air stores park, was so organised that it could strike camp and be on the road within two hours. It could pitch camp and be ready for issues within half an hour, and could also issue spares and consumable stores on the roadside.¹

The repair and salvage units, particularly No. 51, which served the light bombers, were made highly mobile, each having 3-ton vehicles modified as mobile instrument repair shops, armouries and sparking plug cleaning shops, in addition to the standard mobile workshop lorries. The mobility of these units was limited by the amount of work they had on hand, but flexibility was maintained by restricting the number and type of repair jobs which they were permitted to undertake and by laying down a procedure for passing back or flying back to base any aircraft which could not be completed within the

¹ M.E., O.R.B., C.M.S.O. Section, Jan. to Dec. 1942.

specified time. The base salvage depot was further developed and provided with specially constructed vehicles for collecting damaged aircraft from points as far distant as 800 miles, and performing round trips of from 1,600 to 1,800 miles.

The rear maintenance units were also further developed. A cotton ginning plant in Mansura was taken over and transformed into an engine repair section using two-thirds native personnel. Greek nationals, who had been conscripted by their own *émigré* Government were banded into the Greek Technical Unit which operated self-contained sections in several of the R.A.F. maintenance units. The local purchase and manufacture of equipment was increased, until at the peak the Royal Air Force was spending three quarters of a million pounds sterling per month. To aid in the supply of light alloys and aluminium, duralumin, copper and brass scrap was collected and melted down into ingots which were shipped to the United Kingdom to increase the flow of finished spares to the Middle East.

Two more aircraft erecting centres were established at Basrah (No. 118 Maintenance Unit) and Shaibah (No. 119 Maintenance Unit) respectively.

The explosives supply organisation was expanded to include two more major explosives depots at Khatatba and Abu Sultan with reserves deployed in Palestine and in Upper Egypt at Luxor. A system of regional issue was introduced whereby operating squadrons were able to accelerate the drawing of their explosives requirements.

In view of the need for increased mobility of all units, the mechanical transport establishments were enlarged considerably but the actual number of vehicles in the Command never reached the new figures laid down for immediate use and reserve because of the limitation of shipping space. An arrangement was made, therefore, with the Army whereby approximately thirty-five per cent of all vehicles in common use which entered the theatre should be allotted to the Royal Air Force. The vehicles were erected from their 'breakdown' cases by Army personnel and handed over and stored in the Mechanical Transport Base Depot at Helwan, from which they were issued to squadrons. The mechanical transport repair arrangements were expanded to include additional workshops in Egypt and new ones at Ramleh and Jaffa in Palestine.

The equipment holding and issue organisation was enlarged concurrently with the repair rearrangements. New equipment depots were opened at Khanka, near Cairo (No. 106 Maintenance Unit), and on the Suez Road (No. 112 Maintenance Unit). Thus the stocks of equipment and spares were spread over four depots in the Delta area, each serving a separate region. The policy of dispersion in depth as a safeguard against threats to the Middle East base units was furthered by the organisation of nucleus bases in Iraq, Persia, the Sudan and Kenya.

The four-day campaign in Persia in August 1941 concluded in the capture of Teheran and, with it, the factory which the old Shah had built to make his own aircraft and aero-engines. This factory had been laid out by British aircraft engineers and was magnificently equipped with machine tools and a very considerable quantity of raw material. Again the policy of making the best

use of facilities on the spot was pushed to the utmost, and the factory was reopened as No. 138 Maintenance Unit with a small supervisory staff of R.A.F. personnel and about four hundred native workmen. The primary object of developing the Persian depot was in order to have some form of maintenance support in the event of R.A.F. squadrons being called upon to operate in the southern Caucasus, but since the necessity for this never materialised, the unit was employed in the manufacture of aircraft modification parts and torpedo tails both for the R.A.F. and the Navy.

Behind the Persian factory a complete nucleus maintenance organisation was built up in the southern Iraq and southern Persia areas. Basrah and Shaibah were expanded as complete maintenance units (No. 118 M.U. and No. 119 M.U.) and were employed for the time being on the erection of new aircraft for the R.A.F. and for the Russians. Another depot was planned at Ahwaz in South Persia but this was not developed beyond the nucleus stage.

The equipment for these dispersed maintenance units, approximately 4,000 tons, was obtained partly from the Middle East and partly from the United Kingdom and the United States of America. In addition, 20,000 tons of explosives and 20,000 tons of aviation fuel and oils were stored at these units.

The control of the units in the South Iraq and South Persia areas was undertaken by a nucleus Maintenance Group Headquarters at Basrah (No. 218 Group).¹

In Eritrea, captured from the Italians, the Italian Air Force workshops and plant at Asmara were taken over and were used by the British Overseas Airways Corporation for the civil type landplanes employed for the overland routes. At Gura, also in Eritrea, where the Caproni Company had a very large factory, a project on a grand scale was started to repair all types of American equipment, aircraft, aero-engines and aircraft tanks. This depot was manned by American civilian personnel under contract with their parent companies in the United States. The necessity for the full development of Gura did not, however, arise.

Maintenance units were also created in Kenya which had been developed as a training ground. An aircraft repair depot was formed at Eastleigh near Nairobi, an equipment depot at Thika, an explosives depot at Gilgil and a flying boat repair base at Kisumu on Lake Victoria. All these units made maximum use of local African artisans who proved themselves very efficient.

After Japan's entry into the war, flying boats operated from the east coast of Africa against Japanese and German submarines in the east Indian zone. The maintenance units formed in Kenya not only provided maintenance services for the operational flying training units in Kenya and the flying boats based on the east coast of Africa, but provided a strategic reserve of technical facilities for the main forces operating in Egypt. Aden was also reorganised and expanded with a view to meeting possible contingencies, but was never called upon to support more than two squadrons and an operational training unit.

¹ H.Q., M.E., O.R.B., C.M.S.O. Section, Jan. to Dec. 1942, amplified by information from W/Cdr. Goodbody.

Expansion of the Aircraft Reinforcement Routes

The aircraft reinforcement routes were considerably extended during 1942. In addition to an expansion of the Takoradi route the Cape to Cairo route was opened up and connections were made with the East African Coast, Aden, Iraq and Persia.¹ The Takoradi route continued to supply aircraft to the Middle East during 1942. By the end of December of that year a total of 3,822 aircraft had been delivered since the inception of the route in July 1940.²

Aircraft were not able to fly in large numbers over the African continent without incurring some casualties, and at the end of 1941 and the beginning of 1942 there was a very considerable number of damaged aircraft scattered along the route from Takoradi to Khartoum. It was arranged that No. 203 Group Headquarters, Middle East, should be responsible for salvaging aircraft in the Sudan sector of the Takoradi route, and to accomplish this salvage sections were established at each staging post.

The salvage sections despatched parties into the bush with spare engines, etc., to endeavour to make forced-landed aircraft flyable, or to deliver them to the aircraft repair depot at Khartoum for repair. They were aided by a 'Bombay' aircraft which had been fitted up as a flying workshop and which was capable of undertaking a number of useful, if limited, engineering jobs. In this task orthodox and conventional ideas were, when necessary, disregarded.

Enemy Offensive at Gazala and the Retreat to El Alamein—May to July 1942

On the eve of the Axis offensive the Royal Air Force formations concerned remained the same as in November 1941, apart from the new (No. 211) Fighter Group. The fighter aircraft were based on the desert airfields at Maaten Bagush and Sidi Haneish, but operated principally from the advanced landing ground at Gambut. Light bombers were farther back at Daba, with advanced landing grounds at Baheira. Medium bombers used landing grounds in the Canal Zone and at Daba. The defended positions of our land forces ran south from Gazala to the fort at Bir Hakeim, protected by minefields and strong-points in considerable depth.

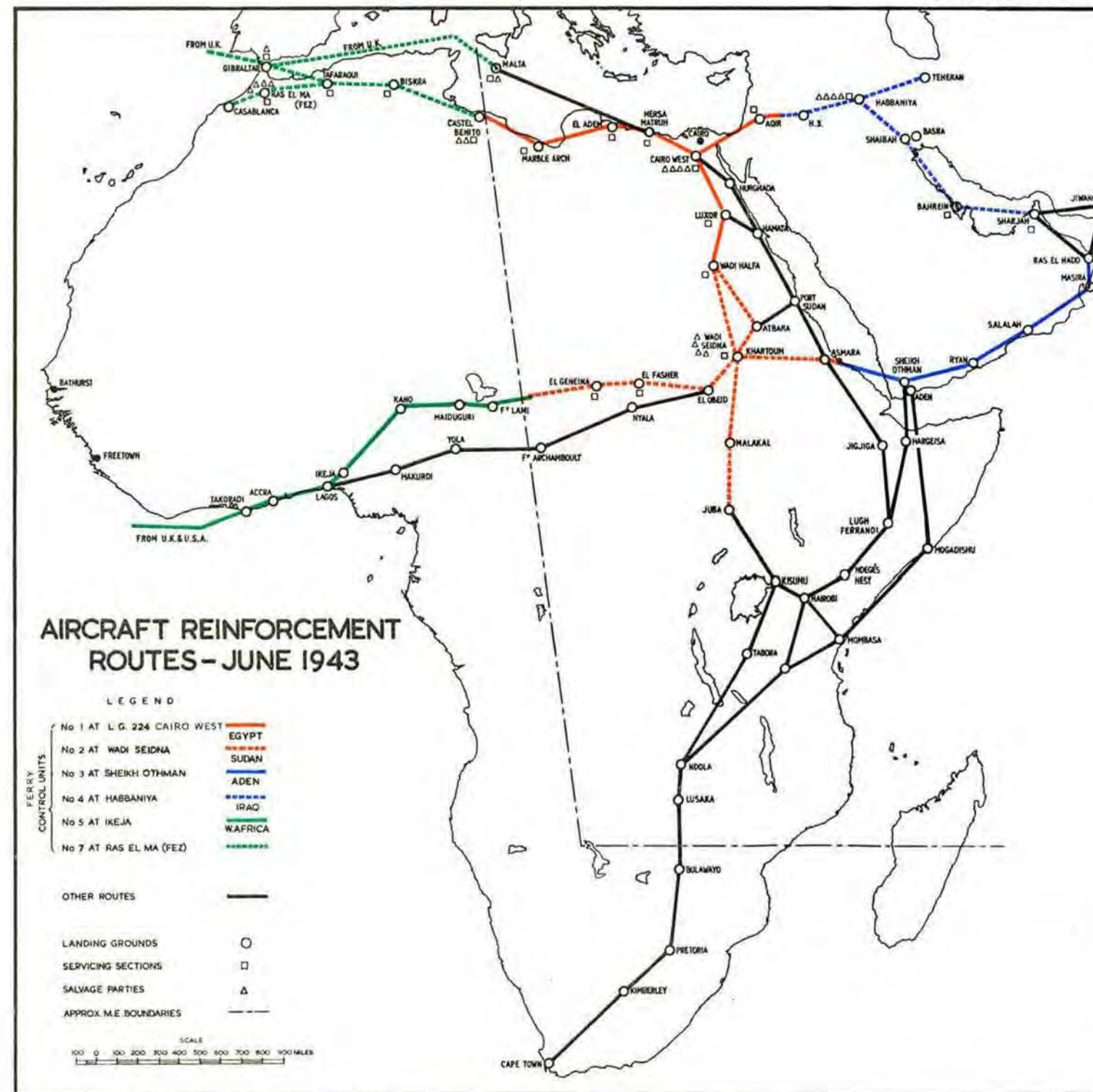
Rommel launched his attack on the evening of 26 May, and after severe and fluctuating fighting succeeded in capturing Bir Hakeim, the key point in our defence system, on 10 June. The enemy exploited their success to the full. On 14 June, with the whole weight of the enemy attack pressing towards Acroma, it was necessary to withdraw the Eighth Army hastily from Gazala along the coastal road to Sollum.

Tobruk fell on 21 June, and with the enemy advance as yet unchecked the decision was taken to continue the retirement to Matruh and to fight a delaying action on the frontier at Sollum. On the evening of 26 June, however, strong enemy columns passed through a gap south of the Matruh defences and the Eighth Army was forced to withdraw eastwards to the El Alamein line.

¹ See Diagram 22.

² For details of Aircraft Reinforcements—See Appendix 27.

DIAGRAM 22



Royal Air Force operations during the retreat continued on an undiminished scale with the squadrons drawing on the stocks of fuel and ammunition which had been established at selected bases according to the withdrawal plan. As the enemy concentrated at Matruh, targets improved and much damage was done, but our own M.T. concentrations continued to present even better marks. Again and again there were appalling congestions involving thousands of vehicles, but our fighter force undertook their protection and our land forces were withdrawn virtually unscathed by enemy attack.

Such an effort would have been impossible had not the maintenance crews and refuelling parties been prepared and organised to work twenty-four hours a day. Their efforts were reflected in the aircraft serviceability figures, which, starting in the first week at 67 per cent, rose during the next week to 75 per cent, and by the fifth week to 84 per cent. In the sixth and final week, with operations having carried on at full strength during a retreat, the figure was still 75·3 per cent. In spite of the drain of continuous action, the maintenance units behind the lines increased the average daily strength of the single-seater fighter squadrons from 15·3 aircraft in the first week to 16·9 in the week ending 6 July.

As regards the reorganised and now highly mobile desert aircraft maintenance service, although it had been designed primarily to go forward, events showed that it was equally proficient working in the opposite direction. The retreat to El Alamein, although a major disaster to the Army involving the loss of thousands of M.T. vehicles, tanks and guns, caused practically no loss to the R.A.F. All but some half-dozen repairable aircraft were retrieved and only 3,000 tons of aviation spirit and 1,000 tons of explosives were left behind. Moreover, most of this was recovered during our subsequent advance later in the year. This achievement was made possible by the excellent organisation within the operating squadrons and by the magnificent work of the repair and salvage units and the base salvage unit.

During the withdrawal the advanced units and parties fell back to the Amriya area; the repair and salvage units, air stores parks, M.T. light repair unit and wing base parties retired to the base areas.

On 5 July the change came in the situation; the enemy's attack on the El Alamein position, launched on captured fuel in advance of his supply organisation, was broken. We had gained the security of the El Alamein line, had withstood the enemy's first dash to take it in his stride, and had even improved our tactical position at his expense.

Diagram No. 23 is particularly interesting as it shows the manner in which the serviceability again dropped during the effort to frustrate Rommel's attempt to capture Egypt, but recovered before the end of the operation, and when the enemy's advance was eventually stopped the serviceability figures were higher than when he made his attack. It also shows how the serviceability was built up for the battle of El Alamein (Operation Buster) and continued to rise thereafter.

The period at the end of June and the beginning of July was a critical one for the base maintenance units in Egypt, particularly as rumours of evacuation were continually arising. As a precautionary measure, however, a small

party was sent to Ramleh, in Palestine, to prepare a temporary headquarters for the Maintenance Group and by 5 July it would have been possible for that Headquarters to move into a tented camp and continue operations without delay, telephones included. The idea behind this arrangement was that in the event of our being compelled to evacuate Egypt our forces would split in two, one part going to Palestine and the other south up the Nile Valley. By that means we should have two lines of supply, one through Basrah and the other through Port Sudan. All equipment and stores which were not wanted immediately were moved in those directions. No. 132 Maintenance Unit at Kilo 8 was sent to Gaza in Palestine, and No. 108 Maintenance Unit on the Fayoum Road moved its heavy bomber repair section to Luxor and its light bomber repair section to Beersheba. The move of these units did not interfere with production because the appropriate repair and salvage units had been moved from the Western Desert back to the Delta area and were able to deal with their own types for the time being.

Preparations in the Summer of 1942 for a New Offensive

The retreat to the El Alamein line in July 1942 was followed by a three months' period of defence and 'build-up' for Operation Buster, planned as a complete break through the enemy defences and an advance to Tripoli. During the period of the 'build-up' the Western Desert Air Force was reorganised to meet the needs of newly arrived American bomber and fighter squadrons, and an additional Fighter Group (No. 212) was formed. The Americans brought to the force modern aircraft and a high standard of peace-time flying, but they naturally lacked experience in war, and in particular desert warfare. The problem was solved by infiltrating American personnel gradually into our squadrons, until the whole American force had gained experience. The scheme worked well and the personnel were soon ready to take part in operations. So far as higher command was concerned, the United States forces were represented at every stage where decisions affected their squadrons.

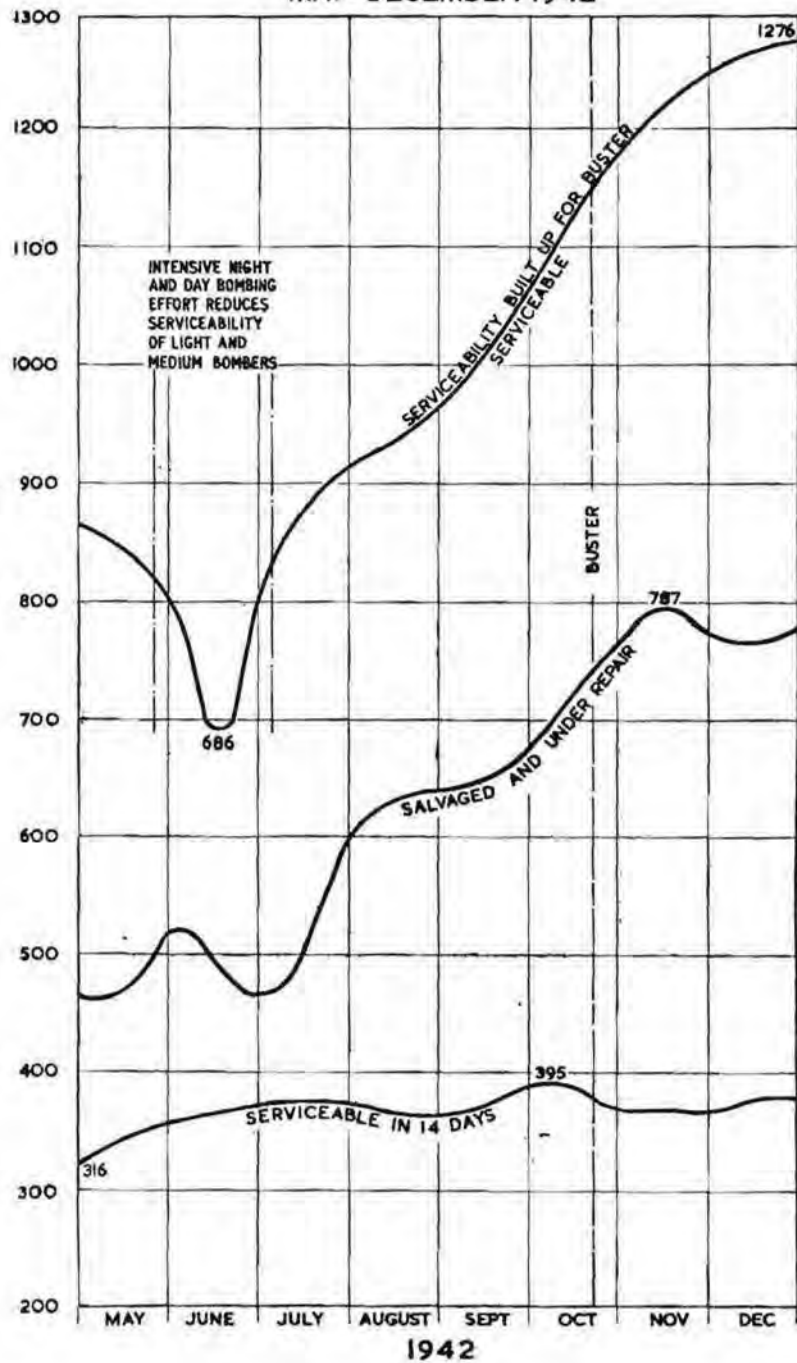
Several improvements were made in the maintenance services in the summer of 1942. During the period of the 'build-up' for the coming offensive the opportunity was taken to refit all the repair and salvage units and to prepare an advanced aircraft depot which was to move behind the Army and Desert Air Force to Benghazi, there to form an intermediate base from which the Desert Air Force could be supported without having to rely on the maintenance units in the Delta 700 miles behind.¹

A redistribution of the work formerly undertaken by the squadron maintenance personnel and the personnel of the repair and salvage units was also introduced in the light of the experience gained during the previous advances and retreats in the desert. The redistribution was effected on the basis of the Air Ministry establishments for a standard wing repair and salvage unit and a standard fighter squadron of 16 unit equipment aircraft. It was proposed (amongst other things) to reduce the numbers of maintenance personnel in fighter squadrons, amend the functions of the repair and salvage units, and to form a mobile aircraft depot to undertake some of the work hitherto performed by squadron and R. and S.U. personnel.

¹ H.Q., M.E., O.R.B., Organisation Section, August 1942.

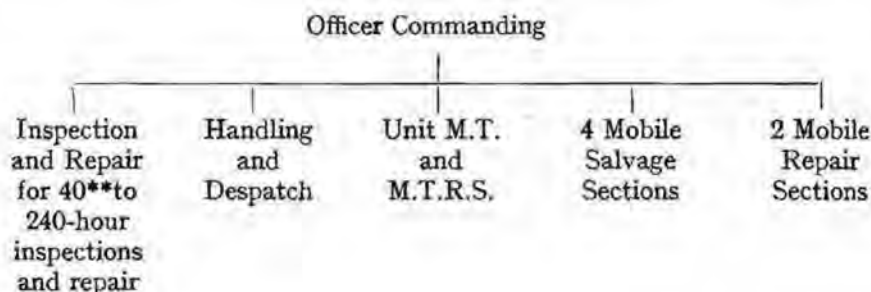
DIAGRAM 23

**AIRCRAFT SERVICEABILITY - MIDDLE EAST
(OPERATIONAL TYPES)
MAY-DECEMBER 1942**



In actual fact, the reorganisation eventually introduced did not entirely follow that proposed. For one thing, although it was formed, the mobile aircraft depot did not function as such because the advance during Operation Buster was so rapid that the operational landing grounds were often 200-300 miles ahead of the M.A.D. and much of the work which the depot had been designed to carry out was undertaken by squadron personnel, advanced salvage sections and R. and S.U.s. Other amendments to the original reorganisation proposed were also made as the scheme came into being, and the final arrangements were as follows.

The organisation laid down by the Air Ministry for a Repair and Salvage Unit was :—



In the Western Desert the following modifications were made to R. and S.U.s serving fighter wings in the forward area :—

- (a) The inspection and repair section was reduced to deal only with 40-hour inspections and minor repairs which could be completed within five days.
- (b) The handling and despatch section disappeared and was replaced by a reserve aircraft section which held reserve aircraft to cover two days' wastage for each squadron served.
- (c) The combined unit M.T. section and M.T. repair section was reduced to the basis of a unit M.T. section only. The surplus M.T. fitters and mechanics were transferred to the M.T. light repair unit (M.T.L.R.U.).
- (d) Three of the four mobile salvage sections and the two mobile repair sections were transferred *in toto* to an advanced salvage unit. The fourth salvage section was retained by the R. and S.U. as being the most convenient method of providing a certain number of skilled personnel and specialist vehicles without involving too many establishment amendments.

When the R. and S.U.s served light bombers, the reorganisation was much the same except that the three salvage sections and the two mobile repair sections were withdrawn from the operational area and were absorbed into the base organisation. With the latest types of light, medium and heavy bombers, technical consideration frequently made it impossible to dismantle the aircraft and remove it on salvage vehicles. In the Western Desert all the Baltimores which crashed and which were repairable were salvaged by repair parties from the base maintenance units, which made them flyable at the site of the crash.

The R. and S.U.s which served bomber types of aircraft therefore lost entirely their salvage function, and in the main confined themselves to minor repairs to aircraft which were flown in and to major inspections. It was often the case, although not always, that mobility for an R. and S.U. serving bomber aircraft was not of paramount importance, and under those circumstances the period of time which the R. and S.U.s were allowed to work on any of the aircraft could be considerably extended. The increasing scope of R. and S.U. work had, however, a direct bearing, not only on mobility but also upon the holding of equipment in the R. and S.U.s and in the air stores parks. One of the contributing factors to the mobility of the air stores parks in the Western Desert was that they were no longer required to hold the range of spares necessary to enable an R. and S.U. to undertake more than a 40-hour inspection.

The repair parties from the base maintenance units were not constituted or established as particular parties, but in each case they consisted of airmen who had, by experience and instruction, become experts in the repair of certain types of aircraft. It was possible by this organisation to put back into the air a considerable number of Wellingtons, Hudsons, and single-engined fighters which crashed at the western end of the Takoradi route. The personnel who achieved these repairs were in most cases drawn from a repair unit located at Heliopolis. A necessary adjunct to this organisation was the establishment of large aircraft capable of being modified into flying workshops, of communication aircraft to carry three or four highly specialised personnel who could supervise other less skilled airmen and of two-seater aircraft to carry engineer officers with special drawings and repair schemes, etc., which otherwise would not have been available to personnel at the site of crashes.

The squadrons themselves were re-formed into three main sections: The 'A' party which included the Commanding Officer, the 'B' party which included the adjutant, and the maintenance party which included the engineer officer, the equipment officer, and sufficient technical personnel to enable the squadron to undertake 40-hour inspections and possibly one unflyable engine change.

The 'A' and 'B' parties each retained the aircraft ground crews which normally existed in each flight. Thus, if a move was ordered, the ground portion of 'A' party moved off while 'B' party and the maintenance party kept the squadron going for the 24 to 36 hours necessary. When the 'A' party was established at the new location, the aircraft and crews moved there by air and the 'B' party and maintenance party followed up by road as quickly as possible.

The personnel thrown up by this squadron reorganisation were formed into what was known in the Middle East as the servicing section. This servicing section was withdrawn from the desert and the personnel worked in base maintenance units, thus providing the extra capacity required to deal with the work no longer undertaken by the squadrons and R. and S.U.s.

The governing principle followed in the maintenance of aircraft in the Western Desert was that no desert unit, squadron or R. and S.U. attempted any work which was of such a nature that would take longer than two days in the squadron, five days in the R. and S.U., or necessitated dismantling portions of the engine or airframe mechanisms. This was done to avoid damage to the machines which would inevitably result from the entry of sand into the moving parts.

Wherever possible all aircraft requiring engine changes were flown back to the base organisation. This produced an immediate improvement in the supply position of engines in that the number of engines (both serviceable and un-serviceable) in transit to the forward areas, or held in stock by R. and S.U.s was greatly reduced ; the workshop reserve of engines was increased which in turn enabled each engine repair section to get down to flow production ; and finally the dead weight of equipment to be carried by each R. and S.U. was reduced enabling it to effect a mobility far greater than had been previously possible.

The titles ' Advanced Salvage Unit ' and ' M.T. Light Repair Unit ' have been used in the previous text. The following is a brief description of each of these units and a note as to their functions.

Advanced Salvage Unit. This unit was formed by withdrawing most of the salvage and mobile repair parties from each of the forward R. and S.U.s. The unit was placed under the command of a squadron leader engineer and was provided with a substantial M.T. servicing section.

The advantages achieved were :—

- (a) The control of the recovery of damaged aircraft was canalised, thus enabling the engineer staff to direct priority of salvage as required by the tactical situation.
- (b) The assistance of a proper servicing section for mechanical transport which enabled vehicles to give much greater service than would have been the case had they been dependent upon an R. and S.U. which in many cases would have been 150 to 200 miles away.
- (c) The personnel manning the salvage vehicles were subject to greater control and more efficient administration. It had been found previously that some airmen in R. and S.U.s remained in the forward areas, often 200 miles away, for extensive periods, with the result that their personal services were neglected, they did not receive the benefit of close supervision by competent officers, and their *esprit de corps* and general efficiency suffered.

The advanced salvage units were established with an adjutant and the necessary clerical personnel to enable all airmen engaged on salvage to be administered from the salvage unit instead of from the R. and S.U.

The function of the advanced salvage unit was the actual recovery of aircraft from the crash site. Its responsibility with regard to transportation was simply to deposit the aircraft with as little extra damage as possible at a focal point which was agreed upon between the engineer staff of the controlling formation and the engineer staff at Headquarters, R.A.F., Middle East. Vehicles of the base salvage section collected the crashes from the focal point and transported them to the base repair organisation as directed by the staff in Headquarters, R.A.F., Middle East.

The advanced salvage unit was itself split into ' A ' and ' B ' parties to ensure full mobility and flexibility. Thus, if the front line advanced, the ' A ' party could be passed forward to ensure immediate recovery of aircraft crashing near the front line whilst the ' B ' party cleared up the area just vacated and then itself joined the ' A ' party or ' leap-frogged ' right over it to an even more advanced position.

M.T. Light Repair Unit. Formed originally by withdrawing the repair element from the M.T. section of each R. and S.U.

It was realised very early in the Western Desert campaigns that provision for the maintenance of M.T. in mobile warfare had been seriously underestimated. The M.T.L.R.U. was, therefore, re-established as an independent, self-administering unit with a very strong body of M.T. fitters and mechanics augmented by the R. and S.U. elements referred to above.

As in the case of the R. and S.U.s this unit was not permitted to undertake any form of repair which would take longer than five to seven days, nor was it permitted to dismantle any component of a vehicle in the desert. Its function was to hold a large stock of serviceable components (which were supplied to it from the base organisation) and to change components of vehicles to make a quick turn-round.

A further refinement was made when a shortage of M.T. spares caused a serious drop in the serviceability of M.T. in the desert. Each air stores park transferred its holdings of M.T. spares (other than those required for its unit M.T. section) to the M.T.L.R.U. together with the equipment assistants who normally held the stock in the air stores park, and the vehicles and drivers used normally for transporting that stock during moves. Thus the M.T.L.R.U. was retained in a mobile state.

Like most of the other units in the desert, the M.T.L.R.U. was split into two parties, but with the variation that the forward party was directly analogous to the advanced salvage unit, whilst the rear or main party was approximate to the R. and S.U.

Experience had shown that where the R.A.F. had units such as wireless sections in the extreme forward areas where they were often under shell fire, unless an organisation was provided which could effect immediate recovery of damaged vehicles untowable by the unit itself, the vehicles were lost even though their actual damage could easily have been repaired. The advanced M.T.L.R.U., therefore, carried a small stock of components which could be changed *in situ*, but the scope of repairs was limited to those which could be completed within two days.

As in the case of aircraft, the base salvage section was responsible for transporting back to the base maintenance organisation all vehicles which were beyond the M.T.L.R.U.'s authorised capacity. This was done by 'towing trains' of sometimes as many as five vehicles. The vehicles of the base salvage section were also used to carry up serviceable components to the M.T.L.R.U. and to return to the base the unserviceable components taken off vehicles at the latter unit.

There was a division of responsibility for the maintenance and supply of the Western Desert forces between the Advanced and Rear Headquarters. The squadron base landing grounds were situated approximately 100 miles behind the operational landing grounds. The M.T. formations were responsible for supplying fuel and explosives to the point where the refuelling and rearming of aircraft was carried out. While stationary at operational landing grounds,

squadrons used their own vehicles to obtain supplies from expense dumps fed by supply and transport column vehicles. When on the move, the S. and T. columns supplied direct to squadrons. The S. and T. columns were also responsible for clearing operational landing grounds in the event of a retreat.

Final Maintenance and Supply Organisation¹

The foregoing paragraphs of this and the previous chapter describe in detail the manner in which the R.A.F. Middle East Command developed its maintenance and supply organisation to meet the increasing problems brought about by the changing course of the war in the Mediterranean. From an extremely modest beginning in September 1939 the organisation had by October 1942 become a vast, but extremely efficient and flexible, supply and technical service capable of being adapted at need to suit either mobile or static warfare.

The Basic Organisation

The fountain-head of the whole of the organisation lay in the Egyptian Delta area. From there contact was maintained with London, Washington, and other centres of the Allied war effort and also with the corresponding Navy and Army departments on all matters of common-user supplies. Stretching out from the Delta area were the sections and units responsible for everything that came under the headings of supply, servicing, salvage and repair.

The Supply Services

The sixty squadrons to be maintained were located in Egypt, the Western Desert, Palestine, Iraq, Aden, Sudan and Kenya. These had to be supplied with spares, bombs, ammunition, fuel, tentage, camp equipment, etc.²

Material was shipped from the United Kingdom, the United States of America or India and unloaded at the docks under the supervision of the embarkation units. These units acted in an advisory capacity to the controlling authority at the docks. They were responsible that priorities of unloading were followed and that R.A.F. equipment was suitably checked and despatched to the correct maintenance unit. Transportation of material to the maintenance units was by rail or by the vehicles of the Mechanical Transport Company. This company consisted of a headquarters and four transport columns with a total carrying capacity of 700 tons. The company augmented its carrying capacity by utilising new vehicles which arrived at the ports to convey equipment to the maintenance units before the vehicles went to the M.T. Base Pool.³

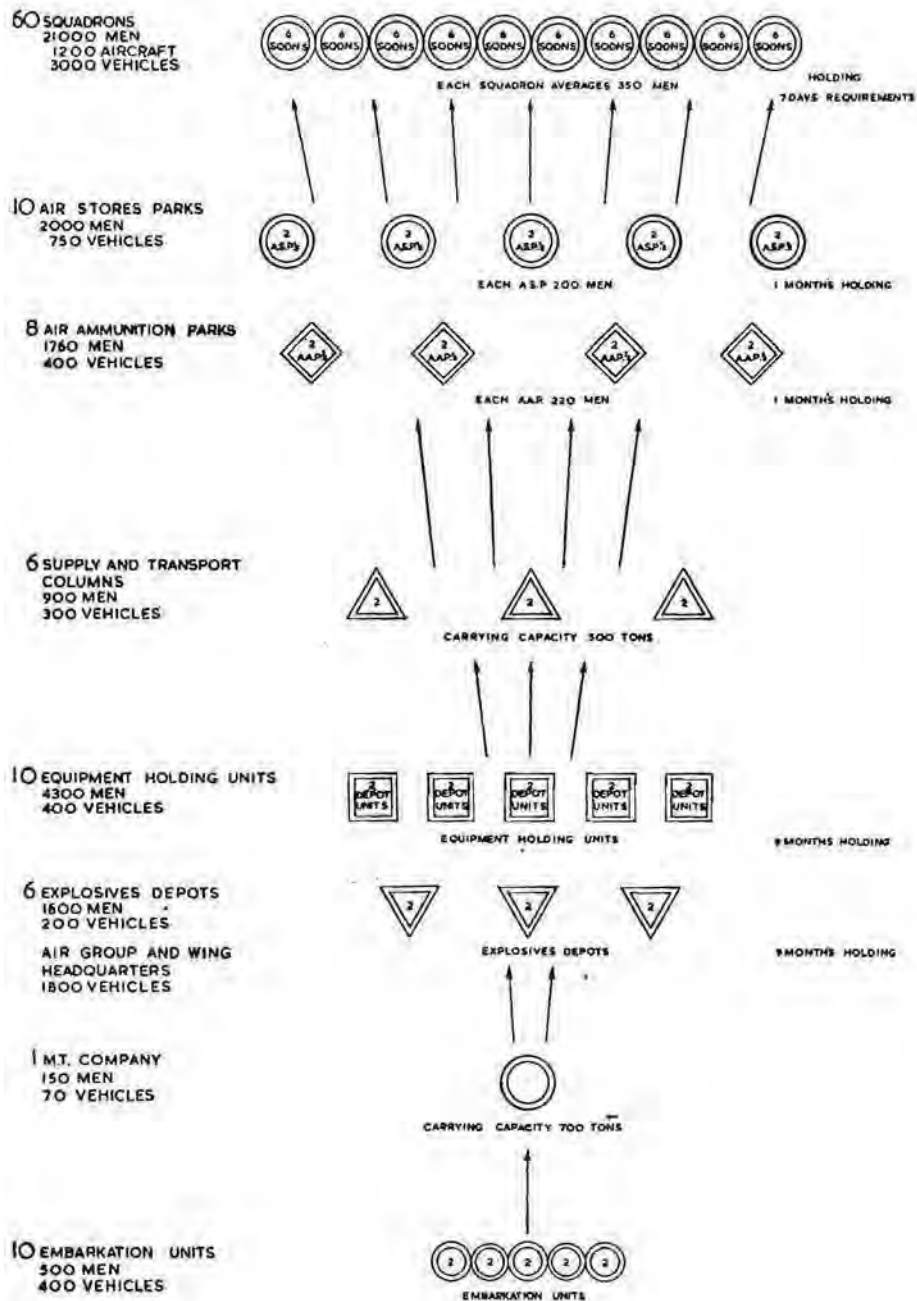
Four of the ten equipment holding units and three of the six explosives depots were located in the Delta area of Egypt. Each of these units held a complete range of spares for the R.A.F. in Egypt, the Western Desert and Palestine and were so disposed that should any one of them have been completely destroyed by enemy action, only 20 per cent of the main holdings would have been lost.

¹ A.H.B./II J1/33.

² See Diagram 24.

³ The M.T. Base Pool is shown on Diagram 25 as part of the M.E. Technical Services.

SUPPLY SERVICES



The provision of equipment for the holding units was carried out by the master provision office which held a record of the quantities of material in each depot. This office was controlled directly by Headquarters, R.A.F., Middle East, which kept the M.P.O. informed of all developments and changes of policy in order that the requirements of the depots could be co-ordinated and the equipment allocated between them to meet eventualities in the correct geographical area. Similarly, the supply of explosives was looked after by a provision office located at No. 101 Maintenance Unit, the largest of the explosives depots, situated in the Tura Caves where the bombs and ammunition were safe from enemy attack.

The equipment from the holding units was issued to the air stores parks, each one of which served approximately six squadrons and four ancillary units. To do this, each A.S.P. stocked an average of one month's requirements for the units it served. Each air stores park comprised a headquarters, a mechanical transport section and an equipment section, and was fully mobile. Its organisation enabled it to detach a small, highly mobile party which could carry approximately seven days' requirements of consumable stores for units operating in the forward area.

Bombs, ammunition and fuel were issued to the air ammunition parks which held one month's requirements for the squadrons they served. Replacement of consumption was carried out on an automatic basis, i.e. each A.A.P. rendered daily returns of the items and quantities consumed by the squadrons, and at frequent periodic intervals the base explosives depots issued the quantity necessary to maintain the air ammunition park up to its establishment. Each air ammunition park consisted of a headquarters section which undertook provisioning; a mechanical transport and workshops section and four dump sections. Each dump section operated two or three dumps of explosives and fuel. The transport of the A.A.P. had a carrying capacity of 500 tons and was allocated by the headquarters of the unit to dump sections as required. The A.A.P.s were fully mobile and moved with the squadrons which they served.

To assist the Force Commander to establish dumps of fuel and explosives on forward landing grounds, or on landing grounds which were not occupied by squadrons, a Force was allotted one or more supply and transport columns. These columns also assisted in the movement of other units of the Force which were not sufficiently mobile or whose transport was temporarily occupied in the movement of fuel and explosives. Thus an S. and T. column could either be used to relieve a squadron of the responsibility of collecting its bombs and fuel, or could be employed for distributing supplies to squadrons on the move. Each supply and transport column consisted of a headquarters section and four transport sections with a total carrying capacity of 500 tons.

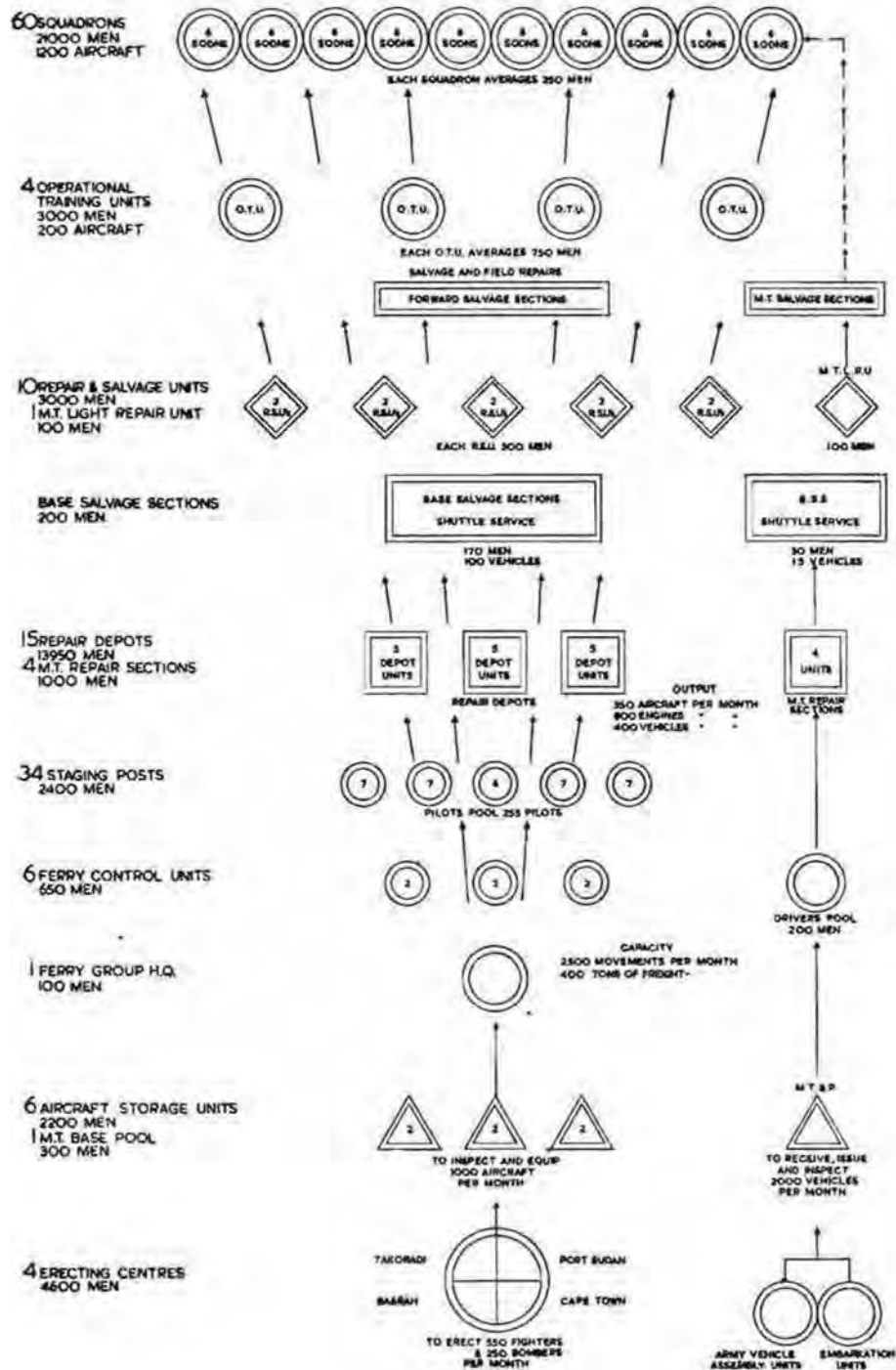
The squadrons themselves held seven days' requirements of consumable stores. These stocks were maintained by demanding on the air stores park to which each squadron was allocated.

The Technical Services¹

The flow of new aircraft to the operational squadrons started at the erection centres, of which there were four; viz., Takoradi in West Africa, Capetown in

¹ See Diagram 25.

TECHNICAL SERVICES



the South, Basrah in Iraq, and Port Sudan on the Red Sea. These units received the aircraft in crates, or as deck cargo from the United Kingdom or the United States of America. The centres erected the aircraft and rendered them serviceable for flying to the aircraft storage units.

The aircraft storage units serviced the aeroplanes after their long flights from the erecting centres and fitted them with the operational equipment to transform them from flying to fighting aircraft. Guns were harmonised, sights fitted and other special equipment such as dinghies, wireless, etc., installed. The aircraft were then tested and made ready for issue. Minor modifications were also carried out at the A.S.U.s, but any alteration beyond the capacity of the latter was undertaken by one of the main depots in the Delta area.

The Ferry Group was responsible for operating the routes and passing the aircraft from the erecting centres to the squadrons via the aircraft storage units. This movement of aircraft over the reinforcement routes called for very accurate control and, for this purpose, ferry control units were formed at Cairo, Khartoum, Aden, Habbaniya, Kisumu and Lagos. Maintenance supply, the salvage of aircraft along the routes, and the supervision of the staging posts were also included in the functions of the ferry group. Aircraft were also flown to the operational training units by the same organisation, to enable new operational pilots to be trained in the conditions likely to be encountered in the fighting area.

Aircraft which became casualties in the battle area were salvaged by the forward salvage sections of the repair and salvage units. These sections were located as near the front line as possible, and it was their function either to repair aircraft on site sufficiently to enable them to be flown to the rear for more detailed work to be done, or to transport them back on specialist vehicles to the repair and salvage units in their immediate rear. From there the aircraft were taken by vehicles of the base salvage section's shuttle service to the main base depots for repair and subsequent reissue.

There were fifteen repair depots in the Command, the majority being in Egypt, but others were sited in Sudan, Kenya, Eritrea, Levant, Iraq and Persia, according to the size of the force in the area and the facilities required. In view of the need for dispersal and because local conditions and the buildings available differed, no two repair depots were alike, their functions being determined by the requirements of the area at the time.

The base depots included aircraft repair sections, engine repair sections, a signals repair section and a general engineering section which consisted of an armament shop, parachute shop, electrical shop, propeller shop, carpenters' shop, instrument repair shop, machine and metal workers' shop and a mechanical transport repair shop.

Every endeavour was made to disperse the base depots as widely as possible, particularly in the Delta area, and in order to utilise the facilities in and around Cairo garages and other suitable buildings were employed. To provide safety from aerial attack a large depot was formed in the Tura Caves near Cairo. This depot undertook the repair of aero-engines, accessories and all other equipment with the exception of airframes.

The Mechanical Transport Arrangements¹

Vehicles for the R.A.F. were received in ships direct from the United Kingdom, the United States of America or South Africa and were assembled at Army vehicle assembly units normally situated at the docks. The vehicles were then taken to the R.A.F. M.T. Base Pool where they were inspected, serviced and delivered to the units to which they were allocated.

An organisation similar to that employed for the salvage of aircraft existed for the salvage of unserviceable vehicles. Parallel to the aircraft repair and salvage units there was an M.T. light repair unit which undertook all repairs within its capacity by the replacement of defective components. All vehicles which could not be repaired under desert conditions were transferred to the M.T. repair sections in the Delta area by personnel of the base salvage section shuttle service.

Major repairs to mechanical transport in the Delta area were carried out largely by civilian organisations under the supervision of R.A.F. technical personnel. A great deal of work was done by garages and workshops in the Cairo and Alexandria area, using civilian personnel and civilian tools and equipment on a contract basis. In the more remote areas the repair of M.T. was undertaken by the Royal Air Force as part of the normal activities of the repair depots.

The Maintenance Organisation during Operation Buster

Operation Buster, or the Battle of El Alamein as it was more often called, commenced on 23 October 1942. There was no doubt, once the offensive had opened, that we had won the supply race. The enemy had not expected us to be in a position to attack before December or January, but, while the Royal Air Force and the Navy had been steadily destroying his stores and equipment, our own reserves had been built up. When the time came for the Eighth Army to advance, both ground and air forces were at last equipped to withstand a long-sustained campaign—and the enemy was not.

The preparation of new and repaired aircraft had been proceeding during the lull before the offensive and indeed did not slacken appreciably at any time. Immediately before the attack there were over 1,100 aircraft serviceable in the squadrons, together with reserves of aeroplanes, engines, M.T. and other equipment ready for use in the Delta area. It is notable that the figure of 1,100 aircraft was not only maintained but actually increased to over 1,400 as the battle proceeded. In January 1943 a peak figure of 1,415 serviceable operational aircraft in the squadrons was reached. During the first two months of the campaign an average of 90 fighters a week was sent from all sources into the desert—a figure of 167 being reached during the first week in November. A steady supply of from 350 to 470 aircraft a month was already coming from the repair units, and in October they were able to turn out 486 airframes and nearly 850 engines—compared with the 102 airframes and 160 engines of November 1941, less than a year before.²

¹ See Diagram 25.

² For details of aircraft serviceability, November 1941 to January 1943—see Appendix 31.

The immediate effect of this output from repair was to make squadrons less reliant on the flow of new aircraft which never came up to expectations. The majority of new aircraft arriving over the reinforcement routes was, in fact, used for the arming of new squadrons and the re-equipping of existing squadrons with more up-to-date types.

The enemy positions on the eve of the battle of El Alamein stretched in a strong defensive line from the coast west of El Alamein to the impassable Qattara Depression, which forbade any outflanking movement. German and Italian forces were intermingled in the defences and behind the front their armour was disposed in groups. Since frontal attacks alone were possible and the density of gun and minefield defences precluded an initial assault by tanks, the Eighth Army planned to clear a gap in the northern sector with infantry, and to follow through with armour. The plan, involving extensive changes of disposition in the battle area and the quick move of armoured forces to the front, could only be implemented successfully if the enemy air forces were prevented from observing and interfering with our movements. The Allied air force operations were amply sufficient to achieve these ends, and by 22 October the preliminary moves of the Eighth Army were complete, and tactical surprise was virtually certain.

At 2140 hours, local time, on 23 October, the heaviest artillery barrage ever heard in Africa preceded the Eighth Army's attacks along the entire front. Twenty minutes later, the most determined assault was made on a six-mile front in the northern sector with the object of making two gaps in the minefields. By dawn the following day these gaps had been made. In support of our troops, and to supplement the effect of the artillery barrage, continuous attacks were carried out during the first night by Wellington and Albacore aircraft, whilst in the immediate rear of the enemy much confusion was caused by night-flying Hurricane aircraft, which strafed such diverse targets as ammunition trucks, field guns, dumps and repair shops.

During the next day (24 October) the infantry in the northern sector consolidated their positions, and throughout the day light bombers ceaselessly attacked enemy vehicles near the gaps in the enemy's minefields, whilst the Hurricane IIDs enjoyed a successful day of 'tank busting.' By nightfall the anti-tank guns had been sufficiently reduced to allow our armour to pass through the gaps, and by dawn of the 25th they had reached the open country beyond. The enemy frequently concentrated his forces with a view to launching a counter-attack, but each effort was prevented from becoming effective by the efficient bombing of our light bombers.

The Eighth Army struck hard due west on the night of 1/2 November and by dawn had forced a way between the enemy armoured divisions. Supported all the time by continuous air attacks the armour now went ahead of the infantry, and on 3 November there were signs of withdrawal by the enemy. Soon the coastal road from Ghazal to Fuka was packed with traffic moving west, and came under the attack of our light bombers and fighter-bombers. The enemy was unable to mass for more than a momentary stand at Fuka on 5 November, and the pursuit rolled on.

The factor which was to limit the speed of our advance was now mainly supplies. Heavy rains on the second day of the breakthrough virtually

entailed the loss of a complete day, since for nearly three days all traffic was confined almost entirely to the one coast road. In the absence of any opposition the move forward of fighter squadrons to Hinaish, Mesheifa and Gambut was effected smoothly and swiftly. Air transport was a large factor in forward supply, particularly of water, and lifts of this vital commodity in mid-November amounted to approximately one hundred tons a day.

During the advance, as soon as the Royal Engineers with the forward divisions reported that an airfield was clear of mines, the advance ground parties of the squadrons and the ground formations moved up. Shortly after, the mechanical transport supply columns held in the forward areas rushed up the petrol and ammunition and the squadron air parties followed. This system, maintained entirely from Royal Air Force resources, worked perfectly and enabled fighter operations to continue uninterrupted throughout a series of seven moves from El Alamein to Martuba over the space of a fortnight.

The retreat of the enemy, who had already reached Benghazi, was hampered by lack of transport and fuel, and in consequence he began to resort extensively to air transport. Our fighter force, now installed at Gazala, concentrated on stopping these operations. On 17 and 18 November, thirteen Ju. 52s were destroyed in the air, and nine Ju. 52s with twenty-four other aircraft, mostly transports, were destroyed on the ground. This compelled the enemy to abandon the use of the Benghazi airfields.

During the final stages of the withdrawal little was done by the enemy to check our advance beyond the extensive mining of roads and landing grounds—many of which were ploughed up. His fighting strength, depleted in tanks, aircraft, fuel and man-power, made it improbable that the stand at Buerat would be prolonged, and so the pursuit continued with the Allied squadrons keeping pace with the Army's advance. Established landing grounds were speedily brought into use and new ones quickly constructed by the Royal Engineers. Air transport was used extensively in bringing up men and equipment. These factors, coupled with the general mobility scheme, enabled hops of 100 miles to be made by complete wings without a pause in the operations.

During the night 15/16 January, the enemy evacuated Buerat and the advance into Tripolitania was now well established with Rommel wholly occupied with the problem of extracting his armies. The supply ports in Tripolitania, Tunisia, southern Italy and Sicily were continually bombarded to prevent this. Shortly after dawn on 23 January, armoured units of the Eighth Army entered Tripoli, and the enemy, realising his forces were still inadequate for the task of giving battle, withdrew to his next main halting place—the Mareth line.

The R.A.F. supply line was maintained smoothly throughout our advance, although there was a reduction from September 1942 onwards of the shipping available from the United Kingdom and the U.S.A. to Middle East ports. In spite of the long lines of communication, transport problems and difficulties in the Western Desert were overcome with the help of the Army, particularly in movements by rail and sea. Excellent co-operation existed between the Royal Air Force and Army staffs.¹

¹ H.Q., M.E., O.R.B., C.M.S.O. Section, 1942-43.

The movement to railhead of aviation fuel and explosives was the responsibility of the Army, but the R.A.F. was able to maintain constant pressure with fighters and fighter-bombers on the retreating enemy through the efforts of our own supply and transport columns which up-lifted fuel, bombs and ammunition from the Army railheads and carried them forward to the newly captured landing grounds. So rapid indeed was the advance of the forward fighting squadrons that only seven days after the Germans broke at El Alamein, the A.O.C., Western Desert, was able to direct intensive long-range fighter offensives on to the enemy lines of communication over 700 miles away. Urgent spares and equipment required by the air stores parks for the advanced squadrons were flown to them in transport aircraft, but the more bulky items were conveyed to the battle zone in the 10-ton vehicles of the R.A.F. M.T. companies. These companies fed into the battle area considerable tonnages of equipment from the maintenance units and ports. At the fall of Tripoli, the M.T. companies were delivering to air stores parks and squadrons, nearly 1,500 miles distant, equipment for which there was neither rail nor sea transport available.

The supply of mechanical transport was maintained throughout the advance. During the three months of November, December and January, nearly 4,000 vehicles were issued to the various units of the Command, of which approximately 1,500 came from repair units in the Delta and Palestine. During this period an average of 550 vehicles were continuously under repair.

There was no shortage of explosives during Operation Buster. Stocks of all types of explosives were maintained during the building-up period for the advance due to the Air Ministry's appreciation of the commitments and their prompt action to satisfy all demands. In the six months from June to December 1942, receipt of explosives in the Command averaged 9,000 tons per month. From November 1942 to January 1943, 13,500 tons of bombs, ammunition and pyrotechnics were sent to the forward area by sea, and a further 12,000 tons by rail.

The stocks of aviation spirit and aero-engine oil were also adequate for requirements and did not at any time fall below four months' reserve. From October 1942 to January 1943, 55,000 tons of aviation fuel and 28,000 tons of lubricating oils were sent forward, of which 19,000 tons went by sea and 38,000 tons by rail.

Supplies of general equipment improved during the operation to an extent that not only were all demands met, but the stocks in the equipment holding units steadily increased even in the more remote areas of the Command such as Iraq, Sudan, East Africa and Aden, and it became possible to stock the depots in those areas more extensively than at any previous period.

Part V
THE NORTH AFRICAN CAMPAIGN

CHAPTER 14

THE NORTH AFRICAN LANDINGS NOVEMBER 1942 TO FEBRUARY 1943

The Plan to Invade North Africa by Combined Anglo-American Forces

While the Desert Air Force in the Middle East was being built up in the summer of 1942 for the advance to Tripoli, preparations were commenced in London for a landing in French North Africa by combined Anglo-American forces.

The possibility of such an expedition had been under discussion since the entry of the U.S.A. into the war in 1941 and the idea was explored during the Churchill-Roosevelt conference in Washington in December of that year. In July 1942 a scheme was finally approved which had as its main objects the securing of French Morocco and Algeria with a view to the earliest possible occupation of Tunisia and the re-establishment of our former communications through the Mediterranean. The success of the enterprise depended partly on surprise and partly upon the degree of opposition or assistance which might be offered by the French forces in North Africa.

The plan of campaign was briefly as follows :—

An American 'Western Task Force' (Commander: Major-General G. S. Patton) was to sail direct from the U.S.A. to capture Casablanca. An American 'Centre Task Force' (Commander: Major-General L. R. Fredendall) would be transported from the United Kingdom with the primary mission of capturing Oran. After accomplishing their initial missions, the Western and Centre Task Forces were to establish and to maintain communications between Casablanca and Oran and to build up land and air striking forces to occupy Spanish Morocco if that should be necessary. Subsequently the Centre Task Force was to turn westwards to link up with the Western Task Force to form a single wholly American Army, ready to meet the threat of a German attack through Spain.

An 'Eastern Task Force,' composed of both British and American troops to be transported from the United Kingdom, was charged, in the first place, with seizing Algiers and the airfields at Blida and Maison Blanche. At a suitable time the British First Army was to thrust eastwards to capture the airfield at Djidjelli and the port of Bougie and advance towards Tunisia.

To the British and American navies fell the vast and complex task of escorting the various convoys to their destinations, protecting them from possible intervention by hostile surface ships and submarines, and giving direct fire support to the assaulting forces. Initial air support too was to be given from aircraft carriers until landing grounds had been captured and the Allied air forces established ashore. The U.S. Navy was to be responsible for carrying out these duties in support of the Western Task Force, and the Royal Navy was to act in a similar manner with respect to the operations inside the Mediterranean.

As regards the Allied air forces, the 12th U.S.A.A.F. was to form a Western Command with Headquarters at Oran, while the R.A.F. assigned to the operation was to form an Eastern Command with Headquarters at Algiers.

Although the initial assaults were to be supported by seaborne aircraft it was essential that the maximum possible strength of aircraft should be available. Consequently it was proposed to fly from Gibraltar 160 fighters to each of the Oran and Casablanca areas and 90 fighters to the Algiers area within three days of the attack. Thereafter the build-up was to reach, at the end of seven weeks, a total in all types of aircraft of 1,244 in the Western Command and 454 in the Eastern Command.

The role of the Allied air forces was to provide air cover as soon as possible for shipping and ground forces, to protect bases and communications against air attack, to assist the Naval forces in the protection of convoys and finally to provide air co-operation and support for the land operations subsequent to the assault phase.

Planning for Operation Torch (the name given to the expedition) did not start until 10 August 1942, and, as the assaults were originally intended to take place on 7 October, the planning staffs, particularly those engaged in the administrative and shipping arrangements, were compelled to work against time in order to arrive at a decision on the composition of the forces to be employed.

The difficulties encountered during the early days of planning were numerous. Torch was the first large-scale amphibious operation to be attempted by combined Anglo-American forces. Many different services were engaged which included the British Army and Navy, the United States Army and Navy and an air element drawn from the British Air Force, the British Fleet Air Arm, the American Naval Air Force and the American Army Air Force. Each force had its distinctive system of organisation and command and the Americans had different conceptions of planning.

General Eisenhower set up his Headquarters originally in London. The staff organisation and methods adopted at the Headquarters were those of the U.S. Army but the personnel consisted of both British and American officers.

The two air forces, British and American, remained separate, the power of co-ordinating their activities resting in theory with the Commander-in-Chief. At the commencement of the air planning, the staffs of the British and American air forces engaged in major problems, both operational and administrative, were merged, in order that similar questions which arose could be approached from the same angle. In the case of detailed organisation and administration, where the systems employed were entirely different, the staffs, although maintaining close liaison, had to work out their difficulties separately.

Role and Composition of the Eastern Air Command¹

The role of the British Air Forces in the North African landing was to :—

- (a) Provide air cover and support for the initial assaults.

¹ Admin. Plans 4/PA/T/9 Appendix A.

- (b) Protect the bases and communications against air attack and, in conjunction with naval forces, against attacks by submarines and surface raiders.
- (c) Disseminate propaganda by leaflet dropping.
- (d) Provide air co-operation and support for the land operations subsequent to the assault.
- (e) Provide an offensive air striking force for strategic bombing.

To fulfil the role, shore-based units of the R.A.F. had to be provided for many varying tasks. The size and composition of the forces required for the operation were governed almost entirely by the limitation of available shipping.

The only means by which the necessary number of fighter aircraft could be brought to North Africa was to ship them to Gibraltar, assemble them there and fly them over. During the three weeks prior to 'D' Day, 300 aircraft were off-loaded, erected and air tested ready for the operation. Other aircraft which had been flown to Gibraltar were also based on the aerodrome there, and on 7 November (the day prior to the assault) there were upwards of 350 aircraft around one runway. This excellent target for the enemy was fortunately not attacked.¹

The preparation of the aircraft at Gibraltar did not proceed without difficulty. The establishment of personnel and the accommodation provided for the work were totally inadequate. The first batch of aircraft arrived before the necessary tools and spares were received. There was insufficient erection and other equipment. Many aircraft had been despatched from the United Kingdom with small but essential items missing. Some components and equipment had been mishandled whilst being removed from aircraft for packing purposes before despatch. It was only by improvisation, local manufacture, the conversion of aeroplane cases into workshops and utilising the stores and personnel of the other Services that the scheduled programme was met.²

The other types of aircraft (both British and American) required were flown from the United Kingdom to North West Africa under arrangements made by No. 44 Group. From the outset of the operation to 31 December 1942, the following numbers of aircraft were despatched :—³

<i>Departure Airfield</i>	<i>R.A.F.</i>	<i>U.S.A.A.F.</i>	<i>Total</i>
Portreath	141	159	300
Predannack	—	134	134
Exeter	23	—	23
St. Eval	8	180	188
Chivenor	—	96	96
Hurn	14	151	165
Lyneham	—	12	12
Total	186	732	918

¹ O.R.B. R.A.F. Station North Front Gibraltar, Sept.-Nov. 1942.

² See Appendix 33 for details.

³ Report by Headquarters, No. 44 Group, Admin. Plans 4/PA/T/8, dated 1.4.1943.

All 'pack-ups' of equipment were given, in the interests of security, 'Field Unit Serial Numbers.' The code for these numbers was also given a very limited distribution, and was not included in the administrative instructions.

Aircraft Servicing, Repair and Salvage Arrangements

The arrangements for the servicing, repair and salvage of aircraft were :—

- (a) *Servicing Commandos.* This was the first occasion on which servicing commandos were used for the maintenance of aircraft. Their duties were to undertake the daily servicing, refuelling and rearming of aircraft during the assault stage and until such time as the squadrons' ground personnel had been landed and were ready to operate. It was intended that the servicing commandos should render only the most urgent and simple servicing assistance as the range of their tools and equipment was necessarily limited.¹
- (b) *Squadron Maintenance Personnel.* Squadrons were to resume aircraft minor and major inspections and unit repairs on the arrival of their equipment and ground personnel. Unit repairs were defined as repairs which could be :—
 - (i) Undertaken on or adjacent to the squadron's base landing ground.
 - (ii) Completed within a period of five days in the case of single-engined aircraft and ten days for twin-engined machines. (Engine changes were considered to be within these categories.)
- (c) *Repair and Salvage Units.* Each wing was allocated a repair and salvage unit the personnel of which were to undertake salvage, repair on site and repair at base of aircraft not falling within the category of unit repair. No minimum or maximum limit of repairs was prescribed as it was considered that the scope of the work to be performed would depend upon the availability of spares and tools, the initiative and skill of the personnel and the operational conditions existing. When called upon to do so by the officer commanding the wing, the R. and S.U.s. were to assist squadrons to carry out major inspections and unit repairs subject to the approval of the chief maintenance officer at Command Headquarters. The R. and S.U.s. were also to undertake the salvage and light repair of mechanical transport.

Airframes, engines, ancillary equipment and mechanical transport damaged beyond repair were to be :—

- (i) Reduced to components and, if serviceable, sent to the air stores parks for reissue
- or
- (ii) Returned in the complete state to the base equipment depot for ultimate return to the United Kingdom.

Attached to each R. and S.U. for administration was a mobile signals servicing unit.

¹ See Appendix 35.

(d) *The Policy as Regards Major Repairs.*¹ The plan of the campaign was based on the assumption that the whole of Morocco, Algeria and Tunisia would fall into the hands of the Allied forces by 'D' Day plus 46, consequently no preparations were made to set up back areas and base facilities for dealing with major repairs of an order beyond the capacity of the six repair and salvage units.

Other factors which led to the decision to provide no major repair facilities were :—

- (i) The limited amount of shipping available.
- (ii) The possibility of replacing casualties by air.
- (iii) It was doubtful whether the civil population would co-operate in supplying labour if existing French factories were taken over.

Maintenance Difficulties during the Landings

The Allied landings in North Africa, like the similar invasions of enemy territories which followed subsequently, were successful. The success of Operation Torch was, however, mainly due to the lack of enemy activity at Algiers during the early days and to the fact that little opposition was offered by the French.

It had been decided that the Allied Force Headquarters would remain in London but that a Command Post would be established at Gibraltar until the Force Headquarters could move into North Africa. Eastern Air Command Headquarters was divided into three echelons. The first, consisting of the Senior Air Staff Officer (Air Commodore Lawson) and three staff officers joined the Naval Commander, Eastern Task Force, in H.M.S. *Buloh*. (Air Commodore Lawson was to assume command of the advanced elements of the R.A.F. immediately after the assault.) The second echelon, comprising the Air Officer Commanding, the Air Officer-in-charge of Administration and the Group Captain, Operations, proceeded to the Command Post at Gibraltar on 1 November. The third echelon of the staff travelled to Algiers by various convoys.²

The Western and Central Task Forces met little sustained opposition. The landing of the Eastern Task Force was also on the whole unopposed, although nominal resistance was offered in some quarters. Maison Blanche aerodrome was captured by the American Army soon after dawn, and at 1030 hours No. 43 R.A.F. Fighter Squadron (Hurricanes) landed. The squadron had taken off from Gibraltar at 0800 hours without knowing that Maison Blanche was in our hands, but with the knowledge that the assault was going well.³

The first R.A.F. ground personnel to land were the advance parties of Nos. 322 and 323 Wings, together with Nos. 3201 and 3202 Servicing Commandos, two A.A. flights, four signals sections, two L.W.S. units and Nos. 59 and 60 Embarkation Units. They disembarked from landing craft with the Army

¹ Report No. 78/1943 of the R.A.F. Establishments Committee.

² H.Q., Eastern Air Command, O.R.B. (Mediterranean), November 1942.

³ A.H.B. Narrative, *The North African Campaign*.

assault troops over the beaches in the neighbourhood of Algiers at dawn on 'D' Day, 8 November 1942. The role of this R.A.F. personnel was:—¹

- (a) To establish an Advanced Wing H.Q. near the beach from where fighter aircraft could be controlled, W/T communications set up and embarkation units operated.
- (b) To proceed to Maison Blanche aerodrome to provide servicing and refuelling facilities, communications and A.A. defences to enable aircraft to operate from that aerodrome immediately after its capture by the Army.

The disembarkation of the R.A.F. advance party did not go according to plan because the sea conditions off the beaches were such as to preclude a satisfactory landing. Many assault craft were wrecked, the signals equipment was lost and it was not possible for communications to be set up as desired.

No. 3201 Servicing Commando was handicapped from the start because the majority of its equipment, tools and orders, instead of travelling with the unit had been sent in another ship which was sunk by enemy action. The landing beach also proved to be unsuitable for the disembarkation of mechanical transport and it was only possible to get one vehicle ashore on 'D' Day. Having no transport the personnel of the Commando thereupon marched to the aerodrome at Maison Blanche, arriving there at 0900 hours. At 1030 hours they commenced to service the aircraft of No. 43 Squadron. Twenty-four hours later the remainder of No. 3201 Servicing Commando's transport was discharged at the docks at Algiers.

The personnel of No. 3202 Servicing Commando were also unlucky. Little care had been given to the loading of their ship in the United Kingdom with a view to priority of landing and much of the unit's transport containing technical equipment was stored in a manner that prevented its unloading until D plus 2. The derricks of their ship also proved to be unsuitable for off-loading vehicles. Many of the stores that were discharged were lost by the overturning of landing craft when approaching the beaches. Most of the petrol was saved, however, because one craft landed on the wrong beach which proved to be more suitable for getting stores ashore. The saving of this petrol was fortunate because it enabled the aircraft of No. 43 Squadron at Maison Blanche and also those of Nos. 81 and 242 (Spitfire) Squadrons which arrived later in the morning of 'D' Day to be refuelled without delay. The petrol was landed over the beaches by the personnel of No. 3202 Servicing Commando and the R.A.F. Regiment. It was taken to Maison Blanche in requisitioned French lorries.²

Nos. 59 and 60 Embarkation Units too had their difficulties. After getting ashore on the 'personnel' beach the units made for what had in England been called the 'hard' beach, to land the necessary vehicles and stores. This beach proved to be as soft as the 'personnel' one and when the first vehicle was driven off a landing craft it immediately sank into soft sand. Although 'tracking' had been included in the equipment for the force it was not landed with the assault troops and it became necessary to manhandle the remainder of the transport on to the one path which ran from the shore to the cliff top.

¹ Nos. 322 and 323 Wings O.R.B.s.

² No. 3202 Servicing Commando Unit O.R.B.

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¹ Nos. 322 and 323 Wings O.R.B.s.

² No. 3202 Servicing Commando Unit O.R.B.

It was not until 1000 hours that the first petrol-laden lorry was safely conjured on to the narrow path and sent forward to Maison Blanche aerodrome. The first of the W/T lorries, which should have been landed at dawn did not reach the shore until late in the afternoon.¹

Throughout the whole of 'D' Day the personnel of the embarkation units were called upon to use superhuman efforts to complete their task of getting equipment ashore. During the afternoon the Americans provided sufficient ground netting to lay one track across the soft sand to the foot of the path up the hill, but the weather deteriorated, the wind freshened alarmingly and it became increasingly difficult to bring the landing craft to the spot where the netting commenced.

At dusk No. 59 Embarkation Unit received a message from Maison Blanche to the effect that a further supply of petrol was essential to keep fighter aircraft in the air. The landing craft that brought the petrol ashore was swung violently by the breakers on the beach, making it extremely difficult for personnel to walk its length unburdened and almost impossible for those called upon to carry an 80 lb. case of petrol in their arms. There was a foot of water in the craft when it arrived and heavy seas broke over it continuously while it was being unloaded. When at last the cases were on shore, the men of the unit formed a chain and manhandled the cases up the hill to the nearest point at which a lorry could be loaded. The petrol was taken to Maison Blanche by an American vehicle driven by an American driver who lost his way during the night but reached the aerodrome at 0500 hours the next morning. When the petrol was unloaded it was found that there was just sufficient to enable all the aircraft of the three squadrons to get into the air. During an attack on Algiers by approximately 30 enemy aircraft that took place at 0930 hours, Nos. 43, 81 and 242 Squadrons between them destroyed 9 Ju. 88s and 3 He. 111s.²

Resistance on the part of the French ceased at Algiers at midday on 'D' Day, and equipment from the assault vessels was brought into the harbour on D plus 1 (9 November).

No advance beyond Algiers was made on D plus 1 as parleys with the French were still being carried on. On the following day, however, information was received that small numbers of Axis troops had arrived in Bizerta and Tunis and it became all the more imperative for the advance eastwards to be accelerated and for the aerodromes at Djidjelli and Bône to be seized without delay in order that the necessary air protection for the assault forces moving by sea and road could be provided.³

Maintenance Difficulties after the Landings⁴

The distribution of supplies was handicapped from the commencement of the operation by the saturation at the docks at Algiers for the first few weeks after 'D' Day. The R.A.F. embarkation staff consisted only of 3 officers and 23 other ranks who were quite unequal to the task of sorting the mountains of

¹ Nos. 59 and 60 Embarkation Units O.R.B.s.

² No. 323 Wing O.R.B.

³ A.M. File C.26023.

⁴ Admin. Plans 4/PA/T/8 and EP/1.

equipment discharged by the 3-4 ships unloading at each of the 14 quays. The result was that not only were the docks swamped with piles of equipment which would not be needed for many weeks but, as there was no means of distinguishing between cases, much unnecessary equipment found its way to the forward areas in place of items urgently required. Several squadrons lost either all or part of their unit equipment through the sinking of shipping and had to borrow from other units or improvise until replacements could be effected from the United Kingdom.

The provision of bombs, ammunition, explosives, aviation fuel and lubricants proved to be adequate mainly because allowances had been made for heavy losses at sea which did not materialise. The earlier consignments of bombs, however, arrived without components, or with wrong components. No fusing links were available in the first month, or if available were not recognised. By the end of January, the process of marrying up bombs and tails had not been completed satisfactorily.

Losses of petrol were caused by leakage from the flimsy four-gallon tins used as containers which also admitted water and provided a source of much engine trouble. (In comparison, the United States Air Force used 50-gallon steel drums for their petrol and motor-driven pumps for refuelling purposes. As the campaign developed the R.A.F. squadrons were able to obtain the loan of the American equipment and dispensed with their old-fashioned manhandling refuelling methods.)

The lack of sufficient vehicles for the transportation of equipment was aggravated by the fact that the M.T. drivers for the most part travelled separately and were often disembarked at different ports. With the need for each unit to obtain its transport quickly, a number of unskilled personnel drove vehicles (many of which were old and badly worn) over difficult roads. This caused much unserviceability and a breakdown of convoy discipline.

Equipment distribution difficulties did not end at the docks area. The R.A.F. movement staff was inadequate, with the result that when R.A.F. equipment reached rail junctions farther forward there were Army movement personnel only to deal with it. These did their best, but they had no key to the unit serial numbers and could only surmise for whom the equipment was intended. This generally ended in it being sent to the wrong R.A.F. unit who again, knowing no unit serial number but its own, could not dispose of the stores to their proper destination. Much of the equipment off-loaded from the first convoy did not reach the correct units until many weeks had elapsed.

The seven days' supply of aircraft spares with which the squadrons were provided proved to be inadequate to keep aircraft serviceable, as nearly a fortnight elapsed from the time the air stores parks landed, found suitable accommodation, collected their equipment and were ready to make issues.

The lack of sufficient spare propellers in the early stages was the cause of considerable unserviceability. The soft state of the aerodromes when the rains commenced caused a large number of aircraft to nose over and break their propellers without any other damage to the machines.

The repair and salvage units were unable to commence work on their arrival owing to the difficulty of locating their mechanical transport and equipment: some of this was lost by enemy action and some had been left behind owing to the shortage of shipping space. One R. and S.U. made an effort to operate with tools borrowed from its mechanical transport and with improvised equipment. It achieved a limited amount of success but much more could have been done had it arrived with its complete establishment.

The Advance Towards Tunisia¹

During the period 10 to 19 November, the First Army had moved forward, and first contact with the Axis troops was made on 16 November in the Béja area and some 35 miles east of Tabarka. Souk el Arba aerodrome was captured by British parachute troops on 16 November, making with Maison Blanche, Blida, Djidjelli and Bône, five aerodromes available for our aircraft. Consequently, while the 78th Division proceeded to move eastwards as fast as the troops and equipment were disembarked, the A.O.C., Eastern Air Command, decided to accelerate the move-in of a number of squadrons. This calling forward of squadrons in advance of the plan, however, threw up two problems. One was that of aircraft servicing and repair facilities and the other the provision of petrol and small arms ammunition. Under the planned arrangements the majority of the squadrons should have been joined by their maintenance personnel, air stores parks and repair and salvage units within a few days of landing in North Africa. Actually, however, owing to squadrons being flown in regardless of maintenance considerations plus the fact that the technical personnel and units were not able to commence work immediately on arrival due to the causes previously described, the squadrons were compelled to operate for some time without unit equipment, adequate servicing and repair arrangements, transport and signals sections.

The lack of adequate maintenance facilities naturally had an adverse effect on the serviceability of aircraft, but the gap was filled to a limited extent by the servicing commandos who were called upon to undertake the servicing of more squadrons and for a considerably longer period than had been originally intended. Instead of being relieved within a few days of the assault, the commandos were compelled to operate for five weeks without rest. Moreover, their activities were not confined to the maintenance of single-seater fighter aircraft for which they had been provided. In turn they serviced Bisley, Beaufighter, Hudson, Wellington and U.S.A.A.F. Mitchell aircraft. They were also forced to assume the responsibility of maintaining the stocks of petrol and small arms ammunition at aerodromes when the Army failed in their task of keeping up supplies.²

Maintenance difficulties also occurred when the first night-fighter operations commenced. It was decided during the planning stages of Torch that it would not be possible to provide night-fighter facilities early in the operation owing to the demand on shipping space for equipment (both Army and Air Force)

¹ For full details of R.A.F. operations during this period see A.H.B. Narrative, *The North African Campaign*. The formation of the Mediterranean Air Command, which entailed a complete reorganisation of the Allied air forces not only in N.W. Africa but also in the Middle East and Malta, resulted from one of the decisions of the Casablanca Conference which took place in January 1943.

² Nos. 3202 and 3203 Servicing Commando Units O.R.B.s.

which was more appropriate to the Army's advance eastwards. Nos. 255 and 600 Squadrons were initially detailed to provide night-fighter cover but they were scheduled not to be brought into use until D plus 28. It was also decided from the security aspect that the radar installations in the Beaufighter aircraft of the squadrons should be removed for the flyout from the United Kingdom and taken to North Africa by sea with the ground parties due to arrive at Algiers on D plus 28. With the rapid advance of the First Army and the difficulty of securing forward aerodromes, the A.O.C., Eastern Air Command, decided to employ the two Beaufighter squadrons as long-range day-fighters. They were therefore called in on D plus 7 and D plus 10 respectively.

On 20 November (D plus 12) the enemy made his first attacks by night on Algiers, and continued for five nights round the full moon. It was then decided to employ the Beaufighter squadrons in their proper role of night-fighting, but without radar the aircraft were of little value. When the enemy attacks by night continued, Headquarters, Middle East, was called upon for assistance. As a result, one flight of No. 89 Squadron, fitted with radar, arrived on D plus 17. A supply of radar equipment was also flown out from the United Kingdom in a Fortress bomber and efforts were made to fit it in a number of aircraft of both Nos. 255 and 600 Squadrons. At this juncture the squadrons were being maintained by members of the aircrew, the ground personnel of No. 608 (Hudson) Squadron and mechanics from No. 106 Repair and Salvage Unit. These found the task of equipping the aircraft for night-fighting extremely difficult without specialist knowledge and gear essential for the work.

Meanwhile the advance of the First Army continued. The Army Commander had hoped to launch his attack on Tunis by 22 November, but delay in getting forward supplies and, above all, bad weather severely restricted operations. By the end of November our forces had reached a line roughly Mateur-Djedeida-Tebourba. By the end of December they were forced to withdraw to a line roughly Cape Serrat-Medjez el Bab-Djebel Mansour. In January 1943, with the rapid advance of the Eighth Army into Tripolitania, a regrouping of the armies in North Africa was decided upon and it was resolved that no further advance would be made by the First Army until about the middle of March.

Throughout the period of the Army's attempt to reach Tunis, the R.A.F. maintenance organisation was being built up. The Base Equipment Depot (No. 351 Maintenance Unit) arrived on 23 November. It had been intended that an advance party for the depot should land 14 days before the main component and first pack-ups of stores in order to select a suitable site, settle accommodation for personnel and make all preparations for the receipt, sorting and storage of equipment. Owing to the disorganisation at the docks, however, the advance party had to be used to run an 'Equipment Transit Dump' which was not clear of other units' stores for some seven or eight weeks afterwards. The result was congestion within the area allotted to the base maintenance unit and a considerable delay in the unpacking and ultimate functioning of the unit.¹

When the depot was eventually established, the personnel establishment and the accommodation allocated to it proved to be inadequate. Approximately 150,000 square feet was required to house the equipment received, but only a

¹ Admin. Plans 4/PA/T/8 Encl. 1A and 9A.

space of 20,000 had been provided. Extreme difficulty was experienced in obtaining additional storage room because the allocation of buildings was in the hands of the Army who naturally gave priority to their own requirements. Eventually some more space in farm buildings was found by the unit commander and the R.A.F. Base Commandant.

The troubles of the repair and salvage units also grew apace. As the result of the delay in their coming into action there was accumulation of aircraft casualties before they had become established, and in their efforts to cope with the situation they became practically immobilised. Then the fact that no repair depot had been included in the force compelled them to take on repairs which would normally only be undertaken by a base depot.

The state of the aerodromes in North Africa presented considerable difficulty both from the operational and maintenance aspect. The two near Algiers—Blida and Maison Blanche—were good, but the congestion of aircraft and equipment sent there in the early stages was aggravated by the large number of French aircraft which had not been evacuated. Other aerodromes were small with no facilities of any kind and barely adequate for modern aircraft. That at Bône, one of the most important, consisted of two narrow runways, one of 600 yards, and the other of 800 yards. It was impracticable to move aircraft off these runways, even in dry weather, owing to the rough nature of the ground. Moreover there were no satellites and no satisfactory dispersal facilities until Summerfeld track was laid as hard standings. During December weather seriously affected air operations. The aerodromes became waterlogged with the incessant rain and although various methods of laying Summerfeld track on rushes or on cork were tried out, they proved to be abortive. At Bône aerodrome a bomb crater revealed that the mud at that particular spot was 18 feet deep.¹

Maintenance Reorganisation, January 1943

In the light of the experience gained during the first two months of the campaign, and to meet the needs of the military situation at that date, steps were taken by Eastern Air Command to reorganise maintenance.

The Command's estimation of the maintenance requirements was contained in a memorandum issued by the new Air Officer-in-charge of Administration on 19 January 1943. The policy was governed by :—

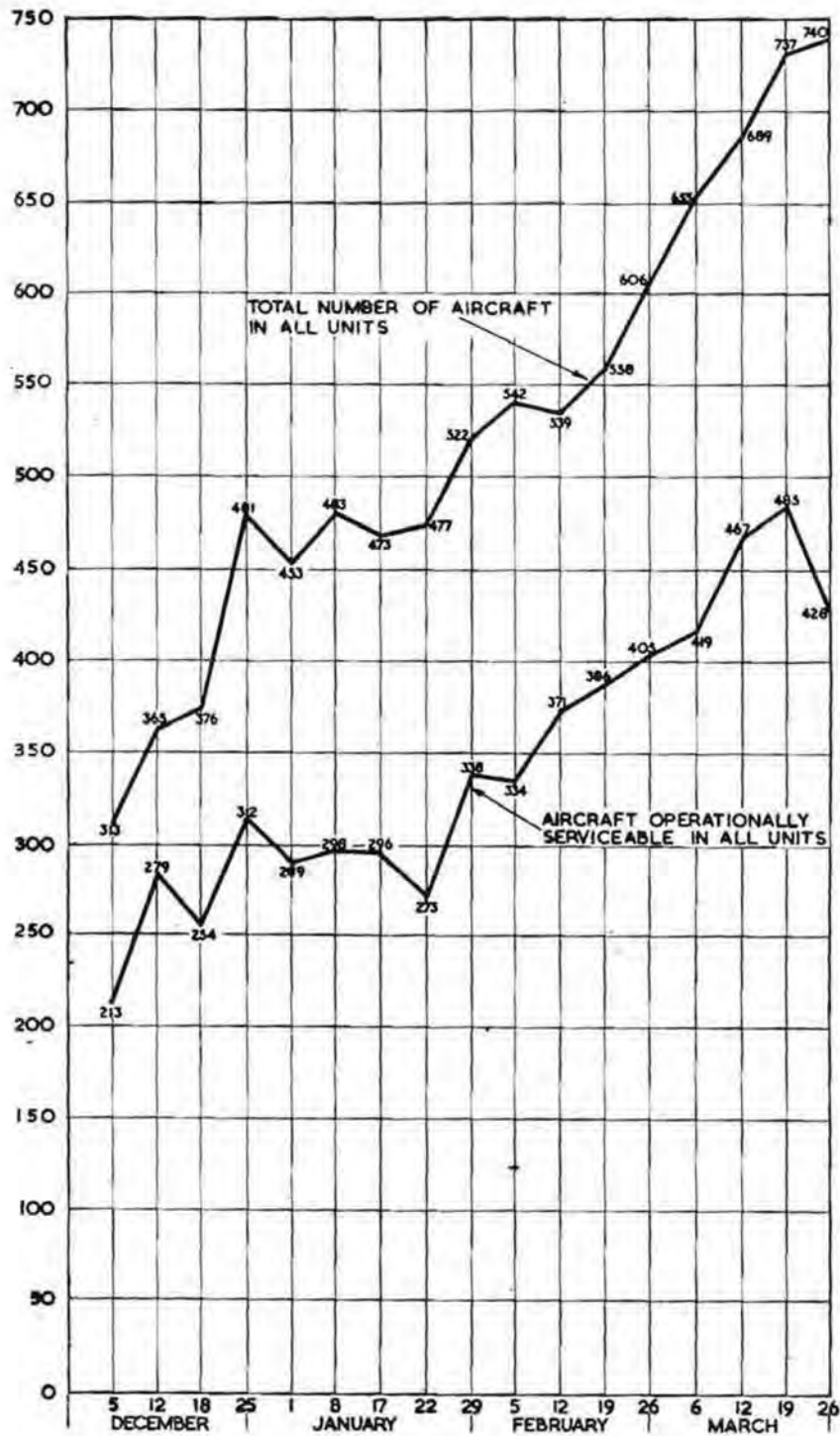
- (a) The distance from the main military base at Algiers and the aerodromes in the forward area at Souk el Arba, Souk el Khemis and Canrobert.
- (b) The limitations imposed upon supply owing to the restricted transport facilities available and the fact that those facilities—road, rail and sea—had to be shared with the First Army and the 12th U.S. Air Force.
- (c) The physical contour in North Africa which rendered difficult and restricted use of road transport to and from the forward area.

To overcome these limitations three maintenance areas were introduced. They were :—

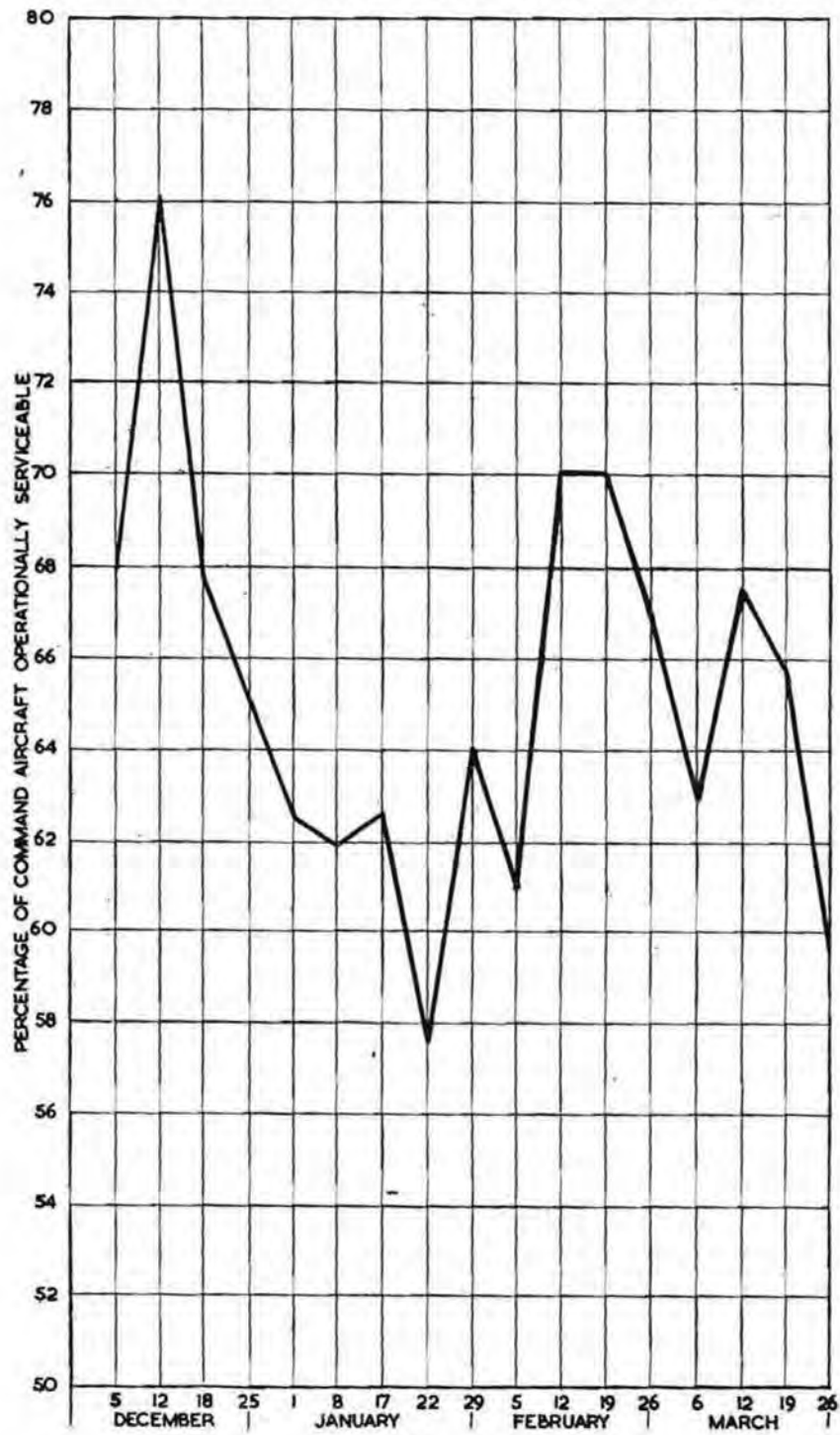
¹ A.H.B. Narrative, *The North African Campaign*.

DIAGRAM 26

**NORTHWEST AFRICA, OPERATION TORCH
WEEKLY AIRCRAFT STATE, DECEMBER 1942-MARCH 1943**



NORTHWEST AFRICA, OPERATION TORCH
SERVICEABILITY CHART, DECEMBER 1942 — MARCH 1943



- (a) The Forward Maintenance Area, including the aerodromes above mentioned plus Bône and any other landing grounds in the above forward area brought into use at a later date.
- (b) The Line of Communications Maintenance Area, including the aerodromes at Constantine, Philippeville, Djidjelli, Sétif and any other aerodromes constructed at a later date within the boundary of the area.
- (c) The Base Maintenance Area, including aerodromes at Maison Blanche and Blida, and any new ones in that area.

The maintenance personnel in the forward area were reduced to a minimum to enable squadrons to be placed on a mobile basis capable of movement with their own M.T. at short notice. The remainder of the personnel were withdrawn and absorbed into rear echelons.

Air stores parks in the forward area were also reduced to hold 'immediate issue' stocks only, the surplus personnel being used to form an advanced maintenance unit in the line of communications area. The repair and salvage units were divided between the line of communications area and the base area, leaving only small mobile sections to work with the squadrons in the forward area. The line of communications maintenance area was designed to support the units in the forward area, to relieve that area of heavy equipment and to avoid the long haul from Algiers.¹ Units in the area being mainly static, pooling of R. and S.U. and A.S.P. resources was possible. Besides supporting the forward units, the line of communications area required to maintain the squadrons operating in that area, following generally the wing organisation pattern.

In the base maintenance area the wing organisation became eclipsed, squadron ground personnel being absorbed into the station organisation. A base maintenance unit was established at Hussein Dey, together with two air stores parks which were amalgamated. Two repair and salvage units were located at Maison Blanche and Blida respectively. Aircraft repairs were effected at all aerodromes where the work was possible, otherwise the aircraft were withdrawn either to the R. and S.U.s in the line of communications area or to the base area.

¹ On 3 January 1943 No. 15 Supply and Transport Column arrived from the United Kingdom and was employed in the base area in the neighbourhood of Algiers.

CHAPTER 15

THE FINAL OPERATIONS IN NORTH AFRICA FEBRUARY TO MAY 1943

Inception of Mediterranean Air Command

Within a few weeks of our victorious offensive at El Alamein the greater portion of the Mediterranean seaboard was in our hands. As was to be expected the air frontiers between the Middle East forces and those in Algeria and Tunisia soon overlapped, the air forces in Malta being the first to become involved in dual responsibilities. But as enemy supplies to Africa assumed increasing importance, the A.O.C.-in-C., Middle East, directed a proportion of the effort, not only of Malta but of No. 205 Group, No. 201 Group and the Western Desert Air Force, towards those targets which were of benefit both to the Middle East and North West Africa. The functions of these formations were definite but not rigid and the assistance of one could be enlisted for the task of another. On consultation with the Naval and Army Commanders the A.O.C.-in-C. was thus able, under the system of centralised air command, to allocate the effort of his squadrons as the situation demanded.

When the opposing forces in Tunisia settled down to build up resources for the decisive struggle, the enemy's supply lines to North Africa again assumed increasing prominence in the air offensive. As these objectives were common to both General Eisenhower's and Air Chief Marshal Tedder's air forces, and the success or failure of operations against them directly affected both fronts, the existing system of co-ordination was put to the test. At General Eisenhower's request on 28 December the Commanders-in-Chief, Middle East, sent officers to Algiers to advise in producing plans to the best mutual advantage.

By 6 January 1943 the volume of supplies reaching the enemy through the Tunisian ports, particularly by day, was causing grave concern to General Eisenhower. The situation was reviewed by his commander, who considered that unless something was done the position on the First and Eighth Army fronts would deteriorate. As the intensive period, which had hitherto prohibited reorganisation, had subsided with the failure to reach Tunis, General Eisenhower now decided that control of the American and British air forces in his theatre should be centralised. The matter received urgent attention at the Combined Chiefs of Staff Conference at Casablanca in January 1943 and agreement was reached that for the whole Mediterranean area there should be one Air Commander-in-Chief whose Headquarters would be with General Eisenhower at Algiers. The Mediterranean Air Command was formed under Air Chief Marshal Sir A. W. Tedder on 17 February 1943.¹

Expansion of the Middle East Maintenance Organisation for the Tunisian Campaign²

In the meantime it had become apparent when the British forces from the Middle East entered Tripolitania that a large proportion of the maintenance support for the Desert Air Force and other forces in the forward area would

¹ See Diagram 28, S.D. 155 (1943) and A.H.B. Narrative, *The North African Campaign*.

² H.Q., M.E., O.R.B., C.M.S.O. Section, Feb. to Mar. 1943.

have to be located much nearer the operational theatre than the Egyptian Delta, and that both technical and supply services would be needed in the Tripoli area. In January 1943, immediately before the capture of Tripoli, a scheme was prepared by the R.A.F. Headquarters maintenance staff whereby an engineer officer and a section of R.A.F. Regiment were to enter Tripoli with the advanced Army troops to secure factories and workshops. Those taken over were the Fiat works, complete with a large number of machine tools and equipment, the Savoia-Marchetti works and later the Alfa-Romeo workshops.

(a) The Technical Services in the Tripoli Area

The immediate need in the Tripoli area was for engine, airframe and mechanical transport repair facilities to be established and for the salvage arrangements to be reorganised. Castel Benito aerodrome was selected as the site for the main aeroplane repair section and No. 4 Aircraft Repair Unit was transferred from Aqir in the Levant to form this A.R.S.

An engine repair section was transferred from Ramleh, Palestine, to the Fiat Service Station in Tripoli and supplemented by an engine repair section from No. 107 Maintenance Unit at Kasfareet, Egypt. Detachments to form a mechanical transport repair section were obtained from the Levant, Iraq and Benghazi, and installed in the Fiat factory. A stores-holding element was sent forward from No. 136 Maintenance Unit, Benghazi, to provide an equipment section. These sections formed the nucleus of the Tripoli maintenance unit which commenced to function on 1 February 1943.

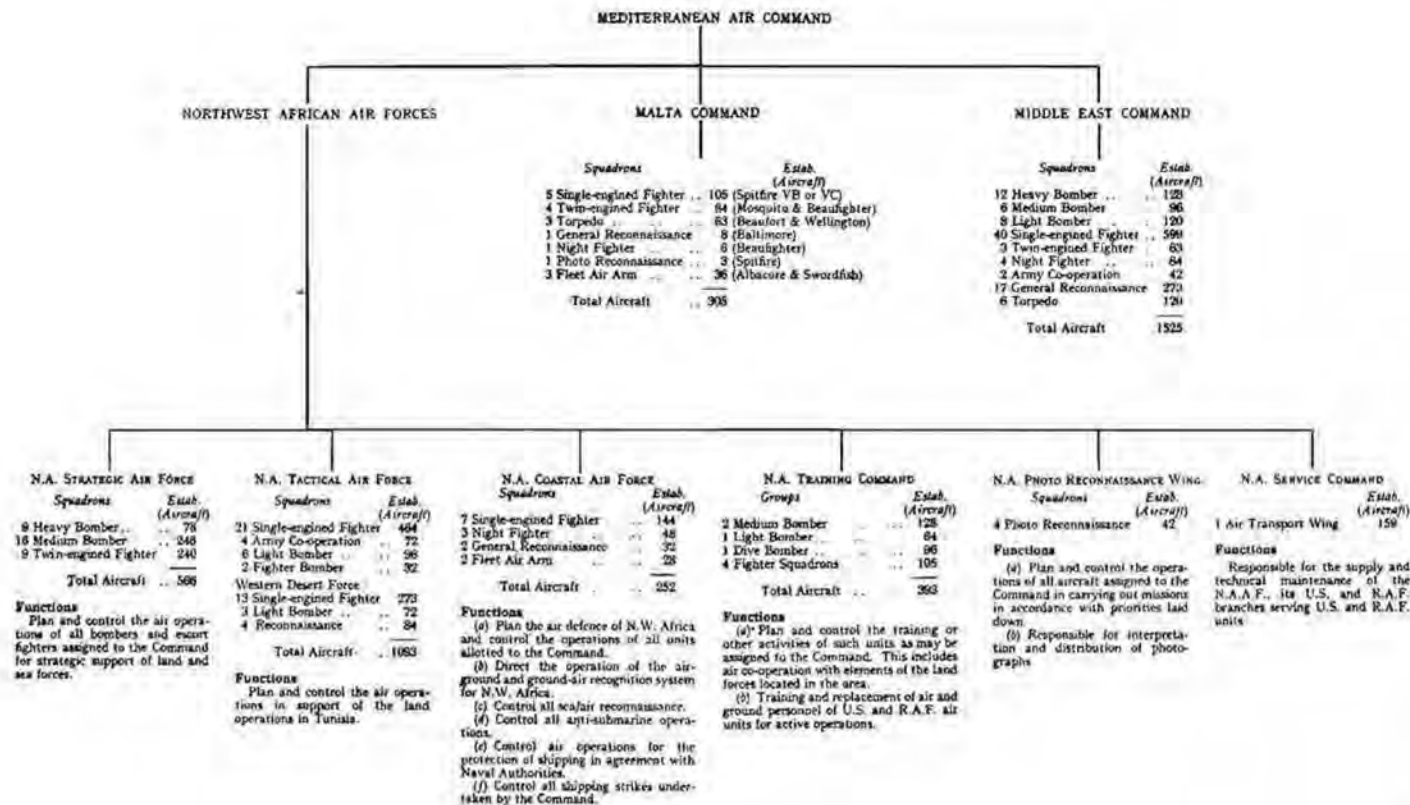
On 14 February 1943 No. 113 Maintenance Unit was moved to Tripoli from Hurgharda, Egypt. On its arrival the various technical sections in the Tripoli area were absorbed into No. 113 M.U. which was then organised as follows:—

Headquarters .. .. .	..	..	..	Fiat Service Station
Aircraft repair section	..	..	..	Castel Benito
Engine repair sections	..	..	..	Fiat Service Station
				Savoia-Marchetti Works
				Alfa-Romeo Works
Machine shop .. .. .	..	..	..	Parola
M.T. repairs .. .. .	..	..	..	Fiat Factory
Plating shop .. .. .	..	..	..	Via San Martino
Vulcanising shop .. ..	..	..	..	Via Villorosi
Compressed gas plant ..	..	..	..	Via Palmieri

The buildings and workshops into which the technical sections moved were extremely damaged and were in a filthy condition. Before work could be started a great deal of cleaning up and adaptation had to be put in hand to make the buildings suitable for their new role.

With the arrival of more forces in the Tripoli area and the need to use Castel Benito aerodrome for operational and transport squadrons, it became necessary to find additional capacity for aircraft repairs. Another A.R.S. was therefore formed at El Mellaha to deal with fighter aeroplanes. This was made up by transferring in its entirety (i.e. personnel and equipment) No. 3 Middle East Repair Unit from Ismailia, Egypt. The move to El Mellaha was made by road and the unit was renamed No. 159 Maintenance Unit. It commenced work in April 1943. Other extensions were the formation of instrument and propeller repair shops.

**MEDITERRANEAN AIR COMMAND ORGANISATION,
17 FEBRUARY 1943**



During the period of the build-up of the maintenance organisation in the Tripoli area, all the personnel, equipment and spares were supplied by the Middle East organisation as there were no other sources of supply. Some of the transfers were made by air, several large convoys went by road, while the heavier equipment was sent by sea. The latter form of transport was, however, at a premium at that period and the road convoy system had eventually to be enlarged considerably to bridge the gap.

(b) The Repair and Salvage Units

At the opening of the Battle of El Alamein there were sufficient R. and S.U.s to deal with all arisings, but with the lengthening lines of communication the resources of those units were stretched to the limit. In addition to carrying out the repair of aircraft within the limits of their capacity they had also to maintain a constant supply of aeroplanes to the wings they supported. This necessity led to a rearrangement of the forward sections. The Advanced Salvage Unit which had come into being by combining the forward salvage sections of the R. and S.U.s was retained and renamed No. 1 Forward Salvage Unit. Additional forward salvage sections were formed in Tripolitania to keep in touch with squadrons while the rear sections held the reserve aircraft as well as continuing their normal functions. At the same time the R. and S.U.s in support of the air forces in Cyrenaica and Egypt had also to throw off detachments to deal with damaged aircraft over the much larger area which they now covered. In those areas, although aircraft casualties were fewer, the number of miles run by the transport of the R. and S.U.s in the collection of 'crashes' steadily increased.

(c) The Repair Arrangements in the Egyptian Delta

At the outset it was realised that the maintenance organisation in the Tripoli area could not compete with all the work arising forward. Fighter and light bomber aircraft types of the Desert Air Force were repaired in the Tripoli area; it was necessary, however, to fly back to the Delta all medium and heavy bombers requiring repairs after they had been made airworthy for the journey. In addition, it was found more economical to fly aircraft back to Egypt for engine changes than to transport engines over the long distances to the forward areas. This policy was implemented successfully in spite of an ever-increasing backlog of repairable aircraft salvaged after El Alamein. In addition, advantage was taken of the returning M.T. columns to transport unflyable aeroplanes beyond the capacity of Nos. 113 and 159 Maintenance Units to the Delta.

The engine overhaul facilities provided in the Tripoli area were also insufficient to meet all requirements and a large proportion of the work was carried out by the Delta maintenance units. The transit backwards and forwards of this equipment presented a problem, but it was overcome by using road, sea, and, to a limited extent, air transport.

The necessity for providing additional maintenance units in the Tripoli area resulted in a considerable depletion of the personnel and equipment of the Delta organisation, particularly as the latter during the spring of 1943 was also called upon to feed the growing maintenance services in North West Africa and Malta. Moreover, the work in the Delta showed no signs of decreasing. There was an accumulation of damaged aircraft, aero-engines and ancillary equipment salvaged after the El Alamein campaign to be attended to, work beyond the

capabilities of the forward R. and S.U.s was still coming in and, as a proposed North African reinforcement route had not yet come into being, aircraft off the Takoradi route had still to be modified and inspected prior to issue to the Desert Air Force. This, combined with the locating, preparing, packing and despatching of urgently required tools and equipment to the units in the new operational theatres, placed an extremely heavy load on the Middle East maintenance organisation with its reduced personnel. To fill in the gaps left by the loss of the valuable personnel sent to the new units, additional civilian labour was employed and trained to skilled standards, a measure which, however, brought little relief until some time had elapsed.

(d) *The Supply Services in the Tripoli Area*

It soon became obvious that a large stores-holding unit would also be required in the Tripoli area to support Nos. 113 and 159 Maintenance Units and to meet the demands of the squadrons through the air stores parks. A site for this was found at Zavia, 28 miles from Tripoli. No. 114 Maintenance Unit, which had formerly been used for aircraft storage at Wadi Saidna in Egypt, was transferred to Zavia and reorganised as the main equipment unit. It opened in its new role on 1 March 1943.

The air stores parks were at the same time reorganised and redistributed. Four of them were located in the forward area to issue stores and equipment at short notice. The remainder were kept in the rear to serve No. 201 Group and units of Air Defences, Eastern Mediterranean.

One of the needs disclosed by the rapid move of the Desert Forces was that for an advanced aircraft replacement pool. Such a pool was formed at No. 136 Maintenance Unit, Benghazi, and served to forward fighter and light bomber aircraft repaired or erected in the Delta, or arriving over the Takoradi reinforcement route, until such time as aircraft became available from an erection centre proposed at Casablanca on the North African route. The pool at No. 136 M.U. held seven days' wastage, whilst a further 48 hours' wastage was kept in the appropriate repair and salvage units.

Another necessity was to build up stocks of explosives, aviation fuels and oils within reach of the forward squadrons. From February to May 1943 the following average daily supplies were despatched (mainly by sea) from the Middle East depots to the Benghazi and Tripoli areas :—

To Benghazi	.. Explosives	.. ..	200 tons per day
	Aviation fuels and oils	.. ..	300 tons per day
To Tripoli	.. Explosives	.. ..	150 tons per day
	Aviation fuels and oils	.. ..	500 tons per day

Eventually the following reserve stocks were built up and maintained by adjustments in the shipping programme :—

At Benghazi	.. Explosives	.. ..	8,000 tons
	Aviation fuels and oils	.. ..	10,000 tons
At Tripoli	.. Explosives	.. ..	6,000 tons
	Aviation fuels and oils	.. ..	15,000 tons.

Distributions from the main railheads and ports in the Middle East throughout the period mentioned were carried out by three air ammunition parks and one advanced depot. At the same time the existing enemy bulk petrol installations were repaired, developed and brought into use for the supply of aviation fuel to the R.A.F.

(e) Supply and Transport Columns

The striking forces in the Tripoli area were supported by Nos. 4, 5, 6 and 10 Supply and Transport Columns whose high mobility enabled stores and equipment in short supply to be readily available when and where it was required. Other columns—Nos. 9 and 11—supported the bomber squadrons in Cyrenaica, whilst No. 7, manned by Palestinians, operated a shuttle service between the railhead and Benghazi, and, for a time, on to No. 114 Maintenance Unit at Zavia. Nos. 51 and 52 M.T. Companies conveyed stores and equipment between ports, railheads and maintenance units.

The Problem of an Allied Maintenance Organisation

The amalgamation of the British and American air forces under one command presented many administrative problems, one of which was the system of aircraft maintenance to be adopted. There was a marked dissimilarity both in the basic and detailed technical organisation of the two Services. In contrast to the R.A.F. system whereby the supply and technical services were administered by a chief maintenance officer and his staff of equipment and engineer officers at the Air Command Headquarters, the United States Army Air Force included a separate 'Air Service Command' as a component of the force. The Commanding General of this Air Service Command exercised a dual function :—

- (a) He was the commander of all maintenance resources, including technical administration, supply, movement and works 'in the field.'
- (b) He was also a staff officer of and reported direct to the main Air Service Command, Patterson Field, in the United States.

The British and American systems of first and second echelon maintenance were not comparable. American tradesmen were divided into fewer trade groups and classifications than were those of the R.A.F. Consequently, U.S.A.A.F. establishments were in some measure more economical than our own. Also, in place of the team of skilled men of various trades which the R.A.F. provided to service the components of each individual aeroplane, the U.S.A.A.F. employed a 'Crew Chief' who was highly specialised and who had sole responsibility for the servicing and serviceability of the aircraft. To perform any task necessary the Crew Chief called upon squadron personnel as required. Other differences were in the phasing of inspections and the statistical methods employed.

On 5 February 1943 a meeting was held at the Air Ministry under the chairmanship of the Air Member for Supply and Organisation to discuss the new headquarters organisation in the Mediterranean. During the meeting particular attention was paid to the functions of the American Air Service Command in North Africa and the proposed establishment of Air Headquarters, Mediterranean, to cover its responsibilities in regard to maintenance and administration. A further conference dealing with these subjects was held under the same chairmanship on 6 February 1943.

It was agreed at these two meetings that the American Air Service Command in the Mediterranean should be responsible for 3rd and 4th echelon repair and salvage¹ and for the supply of equipment, bombs and ammunition for both the R.A.F. and the U.S.A.A.F. in North West Africa. It was considered that this could best be achieved by the two forces each retaining their individual equipment, repair and salvage units. It was thought, however, that ammunition depots and bomb dumps could be combined to serve both the R.A.F. and the U.S.A.A.F. It was also agreed that it would be necessary for the Royal Air Force to be represented on the Headquarters staff of the Air Service Command to ensure that the services for the R.A.F. for which the Command was responsible were, in fact, carried out.

A further recommendation was that a maintenance staff should be provided for Air Headquarters, North West Africa, to be responsible for dealing with the Air Service Command in interpreting policy laid down by the Air Officer Commanding, Northwest African Air Forces, including priorities for the distribution of equipment and for the supervision of maintenance matters affecting the units in the Command.

As regards Mediterranean Air Headquarters it was decided that the maintenance element should consist of a planning staff only with the addition of a statistical organisation to ensure that the Air Headquarters was kept fully informed of all maintenance matters and consequently in a position to intervene as circumstances required. It was also decided that the control of priorities was a further responsibility to be centralised in Air Headquarters.

Following the decisions of the two meetings, the Air Ministry Establishments Committee proceeded to the Mediterranean on 18 February 1943 to examine generally the organisation problems confronting the staffs and formations of the British and American air forces in their task of re-embodiment of their combined resources within a common framework, and to make recommendations on the establishment requirements peculiar to such a policy. It was the view of the establishments committee that the following factors governed the consideration, assessment and construction of the establishments eventually agreed upon :—²

- (a) Staffs must be on the 'fused principle' as opposed to a 'parallel' system in order to achieve economy in Allied man-power, the welding of staff systems and co-ordination of effort.
- (b) Since British and American staff systems differed, the system to be adopted must be readily understood at least by the Commanding and Senior Officers of Formations.

The Committee therefore decided that :—

- (a) The assessment of the Headquarters staff establishments should be expressed by the numbers of bodies required, irrespective of nationality, on standards similar to those applied to the R.A.F.
- (b) The staff system of a Headquarters must be governed initially by the nationality of the senior officers, viz., where a Commanding Officer

¹ i.e. work performed by Repair and Salvage Units and Base Depots respectively in the R.A.F. and the Advanced and Base Maintenance Depots in the U.S.A.A.F.

² R.A.F. Estab. Committee Report No. 78/1943.

was British, the British system should be used basically, and where an American officer was in command the basic system should be American.

Under the establishments the head of the maintenance staff at the Headquarters of the Air Commander-in-Chief, Mediterranean, was given the title of Director of Maintenance and Supply. In the R.A.F. it had hitherto been customary to establish 'Directors' in formations outside the Air Ministry. In North West Africa, however, the Senior American Air Staff Officer was known as the Director of Operations and Plans, and it was thought politic in the case of the Mediterranean Air Command for the R.A.F. to depart from the normal principles and establish the Senior Maintenance and Supply Officer as the Director of Maintenance and Supply. An Air Ministry proposal that the officer responsible for the co-ordination of the work of the supply and technical services of the Northwest African Air Forces should be established as the Deputy Air Officer-in-charge of Administration was not given effect to. Instead an Assistant Chief of Staff (an American Brigadier-General) was provided to take charge of the organisation and maintenance section.

The staff of the Air Service Command at first included no R.A.F. officers. It soon became apparent, however, that having regard to the interposition of the Command in the executive chain under the American system of maintenance organisation, the number of engineer staff officers provided for the Headquarters of the Northwest African Air Forces was excessive and that they would be better employed in the Air Service Command. Consequently, with the exception of the senior engineer and equipment officers, the remaining members established under the Assistant Director A.4 at H.Q., N.W.A.A.F. were transferred to H.Q., N.W.A.A.S.C.

Improvement in the Maintenance Organisation under Mediterranean Air Command¹

Air Chief Marshal Tedder, when he assumed his new appointment, took with him from the Middle East his Chief Maintenance and Supply Officer to fill the post of Director of Maintenance and Supply, Mediterranean Air Command.

On taking up his appointment the new Director took energetic action to extend the maintenance organisation. The first step taken was to reach agreement with the Directors of the Air France factory at Maison Blanche, and the resources of that factory with all its French technicians were made available to the R.A.F. Similarly, contracts were placed with the Caudron Renault Company at Boufarik. The manager of the latter factory was a skilled aeronautical engineer who had been employed on aircraft production in France before the war. His contribution on the technical side proved to be invaluable. In a very short space of time his works were overhauling Merlin aero-engines and eventually repairing Mosquito wings and fuselages—a process which up to then had not been attempted overseas. He also devised special tools for the re-splicing of Rotol propeller blades which reduced the man-hours previously required on these repairs by about 50 per cent. The factories at Maison Blanche

¹ R.A.F. Estab. Committee Report No. 78/1943. O.R.B. Northwest African Air Service Command, 1943. O.R.B. Northwest African Air Forces, 1943, and information from officers employed in M.A.C.

and Boufarik were manned largely by a collection of various nationalities—French technicians, Italian prisoners, Czechs, Spanish refugees, young and not so young local women, etc.

In addition to these two factories an aircraft repair depot (No. 144 Maintenance Unit) was formed in the Algiers area from personnel of No. 106 Repair and Salvage Unit which was reduced to a cadre basis. The depot comprised :—

- (a) An aircraft repair section at Maison Blanche.
- (b) Engine repair sections at Maison Blanche and in garages in Algiers.
- (c) General engineering shops at Maison Blanche.
- (d) Instrument and armament repair shops in accommodation requisitioned by the Army in Algiers and handed over to the R.A.F.
- (e) Mechanical transport repair section in a workshop in Algiers which already contained machine tools for reboring, cylinder grinding and crankshaft grinding. (This was in the hands of the French authorities but they were persuaded to hand it over.)

The various sections of the depot were manned by Royal Air Force, U.S.A.A.F. and French personnel. Some sections were in the charge of R.A.F. officers, others were looked after by U.S.A.A.F. engineers. The unit was planned to carry out the following :—

- Complete overhaul of 130 Merlin engines per month ;
- Major inspection of 120 Spitfires per month ;
- Major inspection of 30 Hurricanes per month ;
- Complete overhaul of 60 M.T. vehicles and the required number of accessories per month.

Assistance in the repair of mainplanes, radiators, oil coolers and the production of machined parts was rendered by the Air France factory at Maison Blanche.

No. 1 (N.A.) Aircraft Repair Unit was formed on 18 March 1943 at Sétif from the personnel of No. 111 Repair and Salvage Unit and the maintenance echelons of No. 325 Wing and No. 326 Wing. No. 111 R. and S.U. was reduced to a cadre basis. The unit, which was afterwards renamed No. 155 Maintenance Unit, was planned to carry out the following for Nos. 325 and 326 Wings :—

- 40 (two star) hour inspections ;
- All major inspections ;
- Category ' B ' repairs ;
- Mechanical transport repairs in the area from a line drawn north to south through Bougie to a line drawn north to south through Bône.

No. 2 (N.A.) Aircraft Repair Unit was formed on 12 March at Blida from the personnel of No. 107 Repair and Salvage Unit which was reduced to a cadre basis. The unit was housed in hangars which had hitherto been used by the French Air Force repair organisation and, by arrangement with the French, the French Air Force mechanics, after a period of instruction in the operation and maintenance of modern British aircraft, were absorbed into the R.A.F. organisation. The unit, which was afterwards renamed No. 156 Maintenance Unit, was planned to undertake the following programme :—

Wellington aircraft	}	10 major repair and 10 major inspections of each type per month plus 40 (two star) hour inspections of each type as required.
Hudson aircraft		
Mosquito aircraft		
Accessories	..	Repairs and inspections as required.

With the expansion of the French air forces equipped by the British and Americans, additional French mechanics were trained and employed at this unit and contributed considerably to the repair arrangement introduced to meet the battle casualties in North Africa.

An aircraft erection unit (No. 145 M.U.) was formed on 19 March at Casablanca to assemble 180 Spitfires and Hurricanes per month sent by sea from Great Britain. This unit ultimately replaced the original main reinforcement depot at Takoradi in West Africa. The aircraft were flown to aircraft storage units at Oujda and Sétif and after preparation were called forward to replace casualties in the squadrons.

The base equipment depot (No. 351 Maintenance Unit) which landed with the original invasion force was expanded nearly ten-fold, and the equipment and spares previously concentrated in one group of buildings on the sea front at Hussein Dey on the eastern outskirts of Algiers, where they were very vulnerable to bombing, were dispersed in farmhouses and wine stores in the hinterland behind Algiers.

The explosives and fuel for the air forces were at the time the Mediterranean Air Command was formed still being dealt with by the Army, an arrangement which did not always prove satisfactory. In due course, when the personnel became available, the R.A.F. took over responsibility for the storage of their own explosives. In addition, an air ammunition park with three dump sections was formed in the forward area, under the control of Tactical Air Force Headquarters at Constantine.

Originally, six air stores parks were provided for the North African force, i.e. one for each wing. These units were reorganised as follows :—

- (a) Three air stores parks (Nos. 132, 133 and 135) remained located with the three wings of No. 242 Group in the forward area. The holdings of these parks were reduced to practical dimensions, the object being that they should be on what was known as Mobility A.1, i.e. the unit should be able to move in one lift at one hour's notice. The establishments of the parks were adjusted to correspond with the true conception of mobile A.S.P.s.
- (b) One air stores park (No. 134) was converted into an advanced equipment park to serve the three air stores parks in the forward area with an airborne range of equipment only. This measure was necessary on account of the great distance and the inadequate communications between Algiers and the A.S.P.s in No. 242 Group : namely, 400 to 500 miles, with only one suitable road and one railway line.

- (c) Of the other two A.S.P.s, one (No. 131) was located in the Algiers area to serve Maison Blanche and Blida; and the other (No. 136) at Sétif to serve No. 325 Wing which was part of the static fighter defences. Together therefore the two parks served the static units in the North West African area and did not correspond to the small A.S.P.s established for the mobile wings.

The salvage arrangements were completely reorganised. No. 1 North African Salvage Unit was formed on 21 March 1943 to undertake salvage in the forward area for all units of No. 242 Group. The unit comprised eight mobile sections which were provided as follows:—

- Two from No. 107 Repair and Salvage Unit.
- Three from No. 108 Repair and Salvage Unit.
- Three from No. 110 Repair and Salvage Unit.

The work performed by No. 108 R. and S.U. allotted to No. 322 Wing, and No. 110 R. and S.U. allotted to No. 324 Wing was reduced to only minor repairs and 40 (star) hour inspections. Any work likely to exceed seven days was transferred to No. 144 Maintenance Unit. The only salvage undertaken by Nos. 108 and 110 R. and S.U.s was urgent aerodrome clearance.

The work of No. 109 R. and S.U., allocated to No. 326 Wing was similarly reduced to minor repairs capable of being undertaken in seven days and 40 (star) hour inspections. Any work necessitating a longer period than seven days was transferred to No. 1 Aircraft Repair Unit, Sétif. No. 109 R. and S.U. retained, however, four mobile salvage sections to deal with arisings in the Ain Beida area in conjunction with the American Service Centre at Youks les Bains.

Salvage in the Sétif area was undertaken by the four salvage sections of No. 1 Aircraft Repair Unit, and in the Algiers area by the four salvage sections of No. 144 Maintenance Unit.

Salvage dumps were established at Montesquieu, Le Khroub and Sétif. Damaged aircraft were conveyed to the nearest salvage dump from which they were collected and taken or despatched to the appropriate repair unit. The collection of multi-engined and Hurricane aircraft from dumps was the responsibility of No. 144 Maintenance Unit which used for the purpose the semi-high loader transport vehicles withdrawn from squadrons. Single-engined fighter aircraft except Hurricanes were despatched to No. 144 M.U. by rail.

The mechanical transport organisation was also redesigned on the Middle East pattern. The original Air Ministry establishments for the wings in North Africa concentrated the greater part of the load-carrying vehicles in the Wing Headquarters. It was intended that the wing should allocate vehicles to their units when necessary to enable them to have some form of mobility. This proved uneconomical and resulted in many vehicles being only partially employed. To obtain a greater degree of flexibility a proportion of the wing transport and M.T. personnel was withdrawn and formed into Nos. 1 and 2 (N.A.) Supply and Transport Columns. Additional vehicles and personnel to complete the columns were obtained from units in the North African Air Service Command.

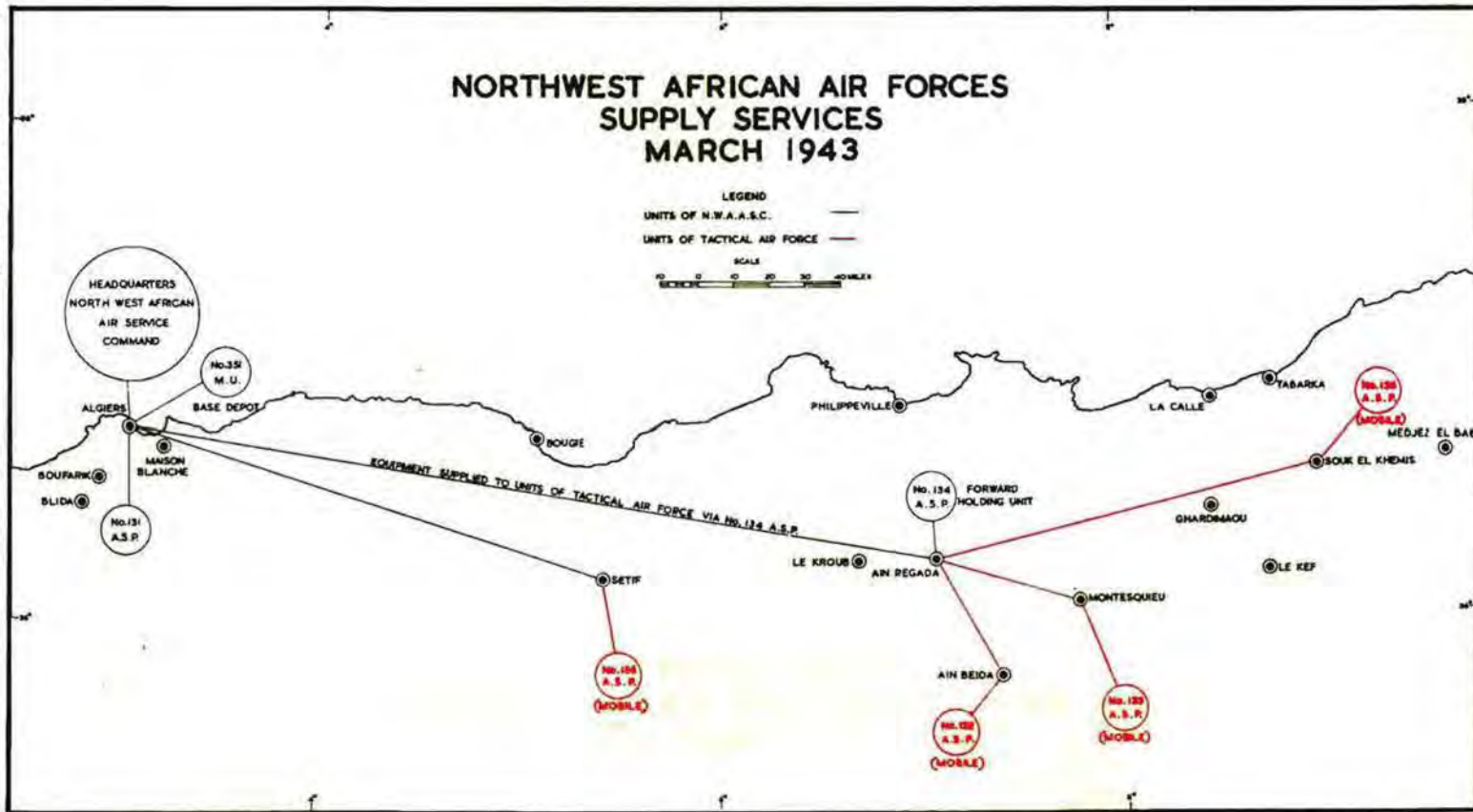


DIAGRAM 29

NORTHWEST AFRICAN AIR FORCES AIRCRAFT REPAIR AND SALVAGE PLAN MARCH 1943

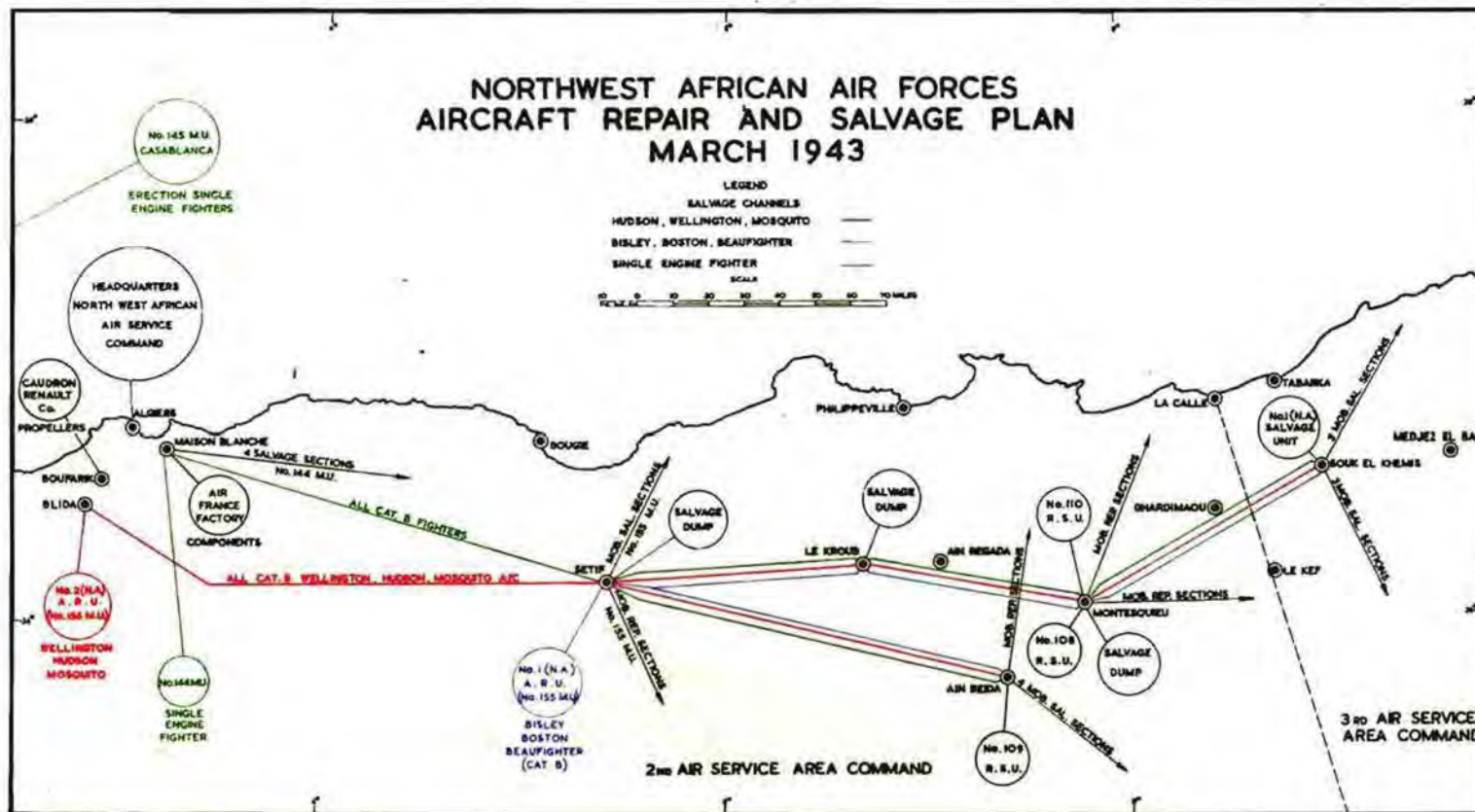


DIAGRAM 30

NORTHWEST AFRICAN AIR FORCES MECHANICAL TRANSPORT ORGANISATION MARCH 1943

SCALE
0 10 20 30 40 50 60 70 80 90 100

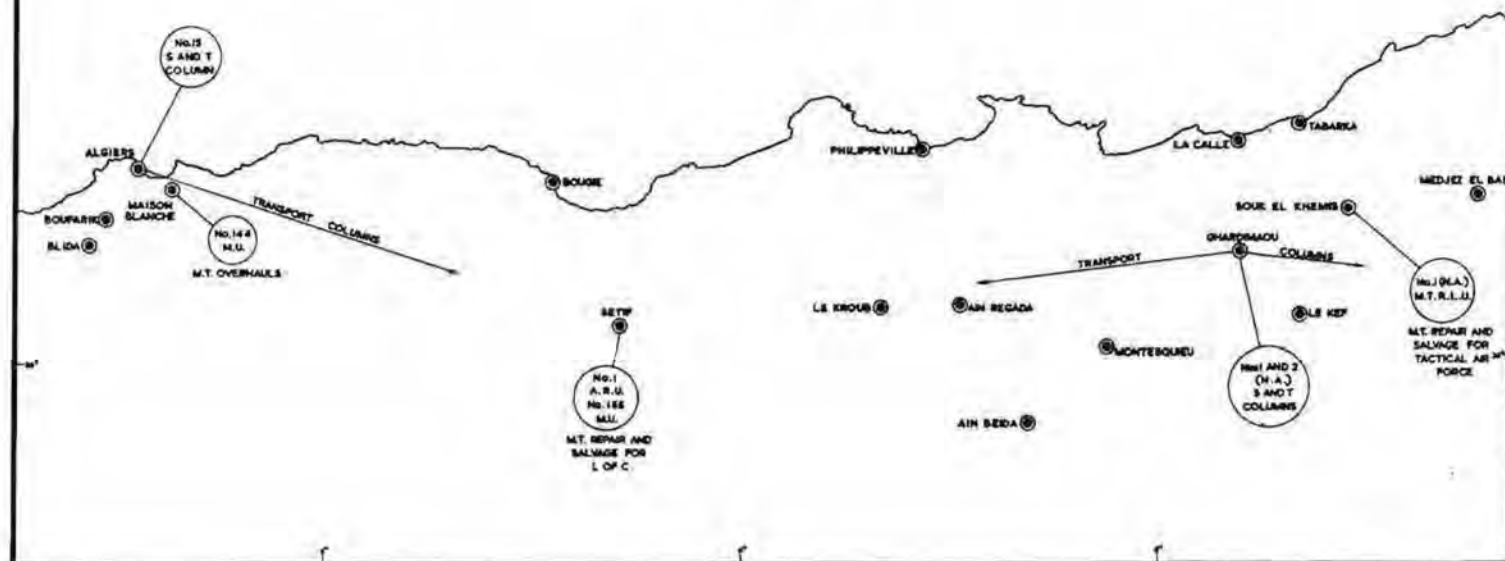


DIAGRAM 31

In order to deal with mechanical transport casualties in the forward area, the M.T. salvage and repair sections were withdrawn from Nos. 108, 109 and 110 Repair and Salvage Units and formed into No. 1 (N.A.) M.T. Light Repair Unit. The work of this unit was limited to salvage, the exchange of components and repairs capable of being done within seven days; vehicles requiring work beyond this period and damaged components were despatched to No. 144 M.U. for repair. After formation an advanced section of the unit was located at Souk el Khemis, adjacent to No. 1 Advanced Salvage Unit. The section was made responsible for the repair of vehicles beyond the capabilities of units in the Tactical Air Force, provided the repairs could be carried out within 48 hours. No. 1 (N.A.) M.T.L.R.U. held a pool of new or renovated vehicles, spare engines and three weeks' stock of spares for units in T.A.F. The advanced section held seven days' stock of spares for the forward area. In the L. of C. area, M.T. repair and salvage was carried out by the M.T. repair and salvage section of No. 1 Aircraft Repair Unit, Sétif. In the Algiers area the work was undertaken by No. 144 Maintenance Unit.

The number of maintenance personnel in the squadrons in the forward area (i.e. in No. 242 Group) was reduced to deal with the following only:—

- (a) Daily and between-flight inspections.
- (b) 40-hour inspections and anything else which could be completed within 48 hours.

40 (star) hour inspections and repairs not exceeding seven days were undertaken by the wing R. and S.U.s as previously described. The non-mobile squadrons were established to deal with:—

- (a) Daily and between-flight inspections.
- (b) Up to and including 40 (star) hour inspections.

No R. and S.U.s were established for these squadrons and work beyond their capacity was performed:—

- (a) In No. 325 Wing by No. 1 Aircraft Repair Unit, Sétif.
- (b) In No. 323 Wing by No. 144 Maintenance Unit, Maison Blanche.
- (c) In No. 328 Wing by No. 2 Aircraft Repair Unit, Blida.

This was not orthodox practice but was necessary because of the shortage of R.A.F. technical personnel which compelled the telescoping of second and third echelon maintenance of static squadrons.¹

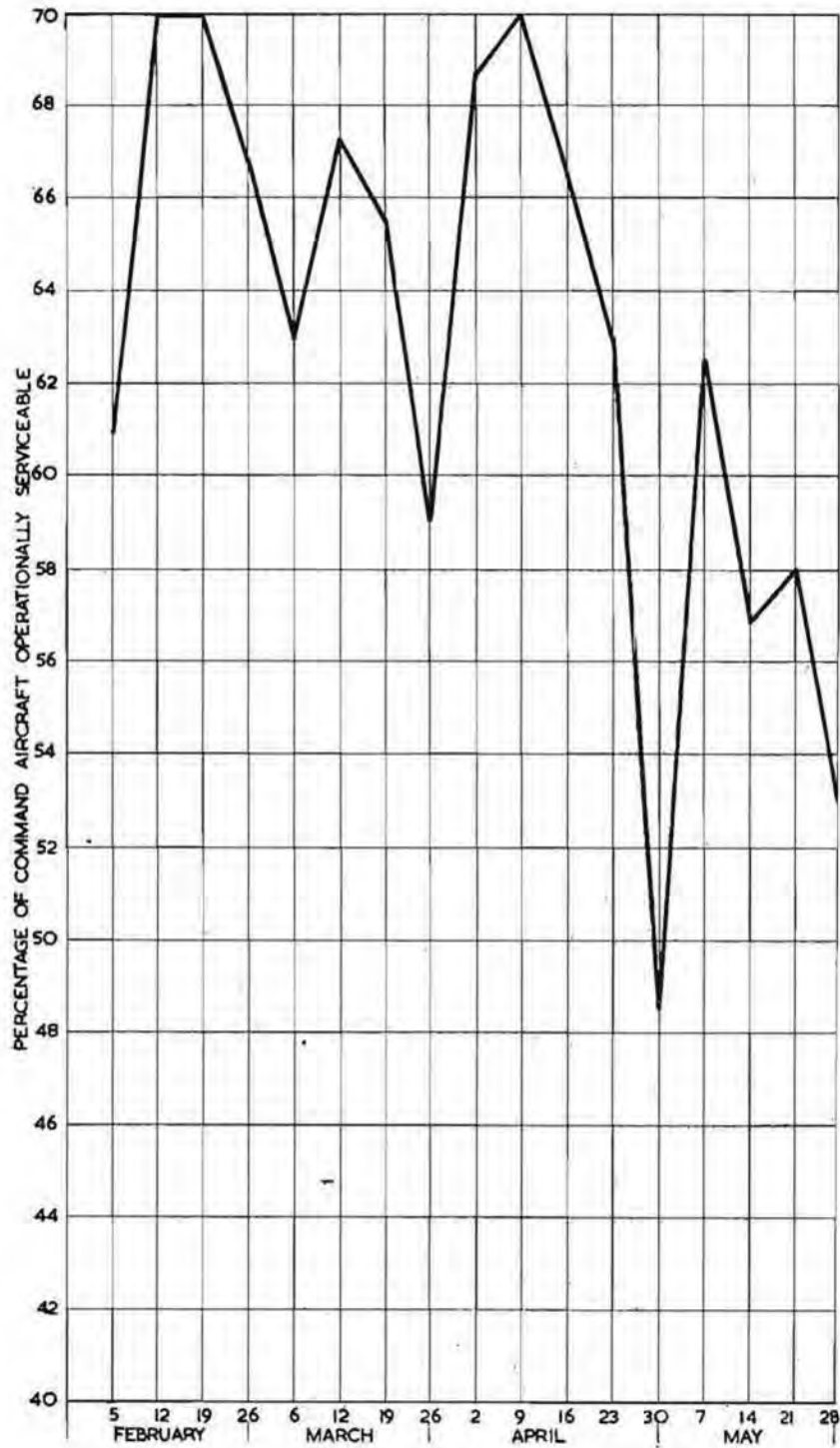
Concluding Phases in the North African Campaign²

Concurrently with the reorganisation of the Allied Air Forces in the Mediterranean, a new military command for the co-ordination of the group of armies and corps in North Africa came into being. On 20 February 1943 the 18th Army Group was formed. General Sir H. R. L. G. Alexander, Commander-in-Chief, Middle East, was appointed Deputy Commander-in-Chief, Allied Forces, and Commander-in-Chief, 18th Army Group, composed of the British First and Eighth Armies, the United States II Corps and the French XIX Corps. (The Eighth Army passed from the Middle East Command to the Allied Force when it crossed the Tunisian border.)

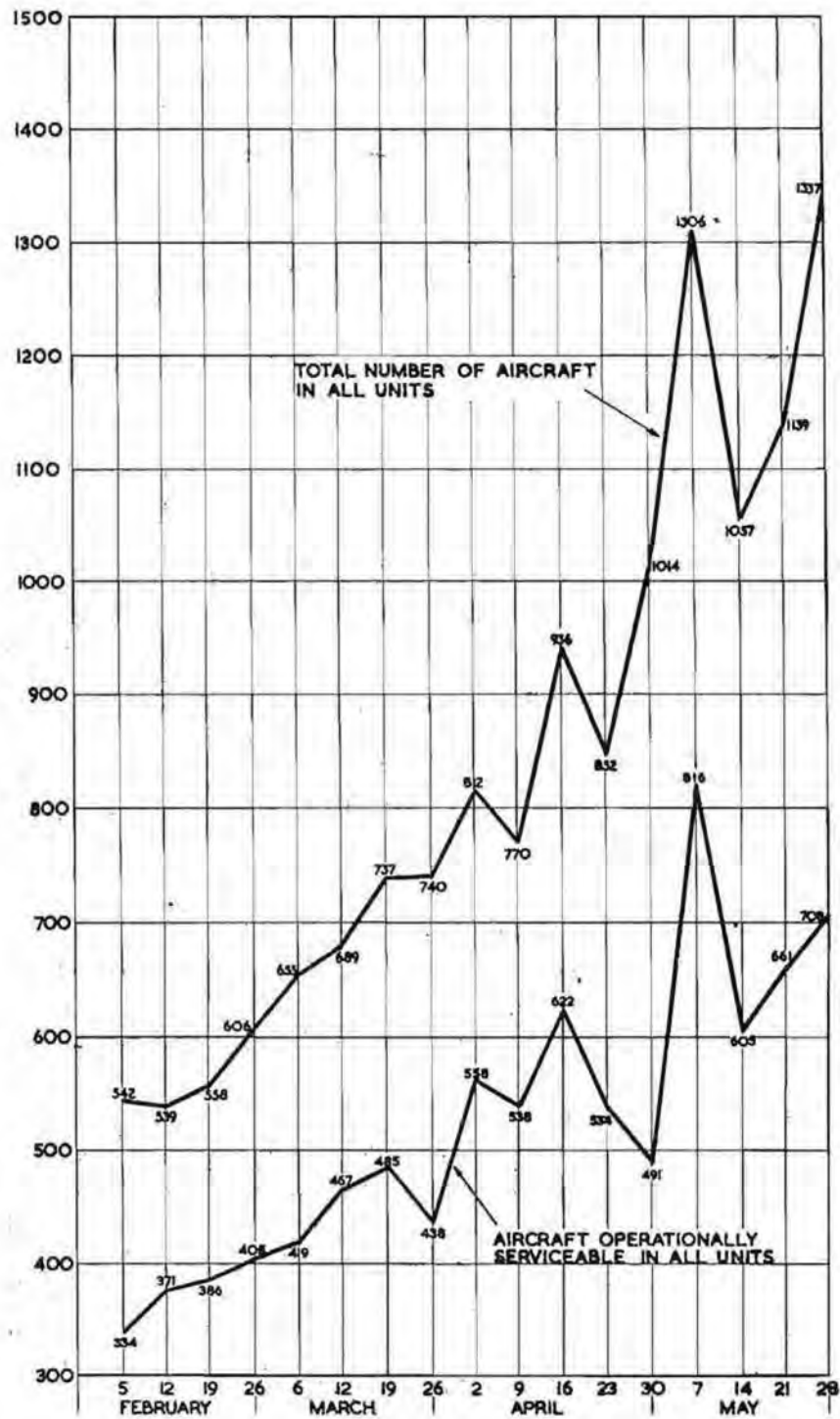
¹ Diagrams 29-31 show the maintenance reorganisation introduced by the Mediterranean Air Command in North Africa.

² A.H.B. Narrative, *The North African Campaign*.

NORTHWEST AFRICAN AIR FORCES (R.A.F. ELEMENTS)
SERVICEABILITY CHART, FEBRUARY — MAY 1943



**NORTHWEST AFRICAN AIR FORCES (R.A.F. ELEMENTS)
WEEKLY AIRCRAFT STATE, FEBRUARY - MAY 1943**



During the period of the regrouping of our armies, the Eighth Army was halted east of the Mareth Line and the Axis held a strong defensive barrier, with all the advantage of interior lines of communication, from the Mareth Line in the south along the Eastern Dorsal northward to the dominating features which controlled the entrance to the plains of Tunis and Bizerta.

The Eighth Army opened its attack on the Mareth line on the night of 20/21 March and by the end of the month the enemy's positions had been breached. Rommel hastily prepared a new line of defence from the coast along the Wadi Akarit westward to the hills of Djebel Zemlet el Beida, but on 6 April the Eighth Army forced the Akarit positions and Rommel's forces withdrew northward that night, abandoning much equipment and many prisoners. In the afternoon of the same day, forward patrols of the Eighth Army and of the United States II Corps joined in the region of Oued el Zitoun, and a complete collapse of the Akarit line forced the withdrawal of the Axis forces facing the United States II Corps positions near Guettar and Maknassy.

On 8 April the British First Army's IX Corps attacked the Fondouk gap in the Eastern Dorsal and on the morning of 11 April some of its advance units entered Kairouan. Here they made junction on the same day with X Corps from Eighth Army advancing from the south.

The enemy continued to retreat and in the pursuit up the coast, land, sea, and air elements combined in driving him from his ports and aerodromes. By 7 April he had lost most of his forward airfields, and on 10 April combined air and ground attack drove him from the port of Sfax. On 12 April the port of Sousse was occupied. Both these ports were badly damaged but were ready for use by 13 April and 22nd respectively. The first convoy from Tripoli with supplies for the Eighth Army arrived at Sfax on 14 April and by the end of the month the port had discharged more than 14,000 tons of cargo.

The general offensive was resumed on 22 April following the Eighth Army's attack on Enfidaville, and after bitter fighting Tunis was captured on 7 May and a week later all organised enemy resistance in the Cap Bon peninsula ended.

After six months of varying fortune, Africa was cleared of all Axis forces; from bases in Tunisia the Allied Air Forces commenced to pound the airfields and ports in southern Europe and the ports of North Africa were ready to receive the ships, equipment and men, who, two months later, were to invade enemy soil.¹

¹ Diagrams 32 and 33 show the percentage and numbers of serviceable R.A.F. aircraft in the Northwest African Air Forces during the final stages of the North African Campaign. It will be noted from these diagrams that the numbers of operational aircraft available dropped at the end of March as the result of the intensive fighting which took place at that period and again at the end of April during the first phase of the final offensive. It will be seen, however, that the position was restored during the seven days that followed these periods which indicates that the supply, servicing and repair organisation was adequate to meet requirements.

Part VI
THE INVASION OF SICILY AND
THE ITALIAN CAMPAIGN

CHAPTER 16

MALTA

The Maintenance Organisation of Malta in September 1939

On the outbreak of war, the Royal Air Force at Malta comprised the Headquarters, R.A.F., Mediterranean, situated at Valetta, No. 202 Flying Boat Squadron at Kalafrana, and R.A.F. Station, Hal Far, which contained a small aerodrome used as a shore base for aircraft from carriers and a flight of aircraft to provide flying practice for the officers of the Headquarters.¹

The maintenance base was at Kalafrana and consisted mainly of an aircraft workshop with a personnel of approximately 60 R.A.F. and 120 Maltese and an engine repair shop having 40 R.A.F. and 100 Maltese. The work of these shops included repairs to Fleet Air Arm aircraft, the flying boats of No. 202 Squadron and the aircraft of the Headquarters Flight. In addition the base undertook the storage and maintenance of all the equipment used by the Royal Air Force on the island.

In September 1939 No. 202 Squadron moved to Gibraltar, and a maintenance and repair party was formed at Kalafrana to undertake major inspections which might be required to aircraft coming from Gibraltar and Alexandria, to which places the Fleet Air Arm maintenance party and most of their equipment had been transferred at the end of August. It was not until June 1940, after the entry of Italy into the war, that an R.A.F. local defence unit was formed and then it only comprised 4 sea Gladiators. When one of these became unserviceable, the remaining three, the only ones available for the defence, became known as Faith, Hope and Charity. Shortly afterwards, four Hurricanes on their way to the Middle East were retained. Hal Far, however, proved to be unsuitable for modern types and the defence unit had to be transferred to Luqa.² In the absence of a sufficient number of aircraft, the main problem was to keep every one serviceable. There were no spares for the Gladiators and all repairs were carried out with material cut down and adapted from Fleet Air Arm Swordfish aircraft parts. One of the Gladiators was patched so often in this way that it became known as the 'Gladfish.' Replacement engines for the Hurricanes also presented difficulties.

Development From June 1940 to December 1942³

From June 1940 onwards, Malta was responsible for the repair and maintenance of Gladiators, Hurricanes, Swordfish, Sunderlands, Hudsons, Skuas, Seals, Londons, Glenn Martins, Wellingtons, Blenheims and Fulmars in addition to various training types of aircraft. It handled eleven different types of engine. Most spares were lacking and needs had to be met by improvisation and local manufacture from the raw materials available.

¹ R.A.F. Station, Kalafrana, O.R.B., 3 September 1939.

² O.I.S. Med. Cmd., June-Oct. 1940, Appendix A.

³ Air H.Q., Malta, O.R.B., 1940-41.

There was a great shortage of skilled personnel and every device was employed to economise the labour of those available. Aircraft hands were locally trained to assist in aircraft handling, refuelling and between-flight inspections, supervised by a Group I tradesman. In spite of shortages in personnel and equipment, the constant air raids and damage to technical and living facilities, failures attributable to faulty maintenance were almost non-existent. Personnel, however, worked long hours to maintain a serviceability of only 50 per cent.

The basic policy of the Command during the winter of 1940-41 was primarily reconnaissance of enemy harbours, aerodromes and shipping. Bombing raids were carried out on these targets, especially after the arrival at the end of June of No. 148 Wellington Squadron. Initially there were no maintenance crews acquainted with Wellingtons, but after a short delay an organisation was built up round a nucleus of experienced tradesmen who arrived from the parent station of the squadron, Marham, Norfolk.

The development of Malta as a base for offensive operations added considerably to the variety of the technical work and administration, and the combined necessities of repairs and maintenance had to be separated as often as possible to avoid the misdirection of technical energy by the operational units. In the case of the fighter squadron (No. 261) this was achieved by force of circumstance, as the operational part of the squadron was based at Ta Kali, and the 'garage' party went to Hal Far; the disadvantages of this arrangement were of minor importance compared with the gains. The seclusion afforded to the heavy maintenance party was of inestimable value, and the total time required for any given piece of maintenance was reduced below any figure obtainable were the squadron operating as a single unit, even though the same 'garage' system might be in use.

The Wellington squadron never had the personnel strength to permit of any but minor repairs, and the brunt of the repairs of the serious damage to these aircraft was borne by Kalafrana. The general policy was to keep the maximum number of aircraft serviceable with the minimum number of man-hours, even though by so doing the remainder of the aircraft might be out of service for a longer proportional time than that saved by this short-term policy.

The variety of aircraft types continued to grow, and in the period October 1940-February 1941 another five varieties were repaired and/or serviced, viz., Loire 128, Special Photographic Spitfire, Bombay, Walrus and Whitley, making a total of eighteen types in eight months.

There was no development of serious importance from the maintenance point of view during the remainder of 1941. The striking force was progressively increased and a second fighter squadron—No. 185 (Hurricanes)—was established at Hal Far in April. The spares situation became somewhat less acute and the personnel establishment was expanded, though the requirements always remained considerably in advance of available facilities. The work on civilian shelters and similar defensive measures did not leave sufficient motor transport available for the projects which were recommended for the dispersal and protection of aircraft, stores and workshops.

In January 1942 the damage to aerodrome buildings and to the aerodromes themselves was extensive and a considerable number of aircraft were damaged and destroyed on the ground. Rain was abnormally heavy and the durability of the dispersal areas was disappointing; aerodromes were unserviceable for

days at a time. Invaluable assistance was rendered by the Army who supplied more than 2,500 men for aerodrome work ; dispersal areas were improved and additional ones, together with new taxiing tracks, were constructed.

In February the increased weight of attack became really serious. Damage to facilities, shortage of labour and time lost in air raids, combined with the abnormally bad weather—it was the wettest winter for 40 years—reduced serviceability to a low level. The fighter serviceability was further reduced by a shortage of spares. Fighters had to provide escort for reconnaissance and bombing aircraft leaving and returning to Malta and this, with the water-logged state of the aerodromes and other difficulties, brought about a serious reduction in the offensive effort.

The Blenheims were returned to the Middle East to reduce the congestion at Malta and in March it was found necessary to return also No. 37 Squadron, as it was not possible to maintain an economical number of the squadron's Wellingtons in a serviceable state. The whole of the maintenance personnel of the Command was pooled and adjusted to speed up and maintain fighter serviceability. Great efforts were made to increase and improve the dispersal facilities, especially the erection pens. In this work invaluable assistance was given by the Army ; 1,300 soldiers were detailed for the construction and enlargement of pens at Luqa, Hal Far and Ta Kali and 200 were employed at each aerodrome for the repair of runways and tracks after attacks. When batches of new aircraft arrived, soldiers were employed on refuelling, re-arming and general maintenance duties. The Malta police did similar excellent work alongside the soldiers, but the civilians continued to give trouble in spite of inducements in the nature of danger pay.

During March 1942, 31 Spitfires from Gibraltar were flown in by H.M.S. *Eagle*, and a further Hurricane squadron with 21 aircraft arrived from the Middle East. It was still not possible, however, to average more than 12 serviceable aircraft per day in March and this figure fell to 6 in April, when, for a period in the middle of the month, it was not possible to have any fighter aircraft airborne at all due to unserviceability. 46 Spitfires arrived on 20 April. The arrival of these reinforcements lent new life to the defence. From the lesson learnt on the former occasion plans were made for the rapid turn-round of future arrivals of new aircraft.

- (a) Each aircraft on arrival was met and directed by a runner to a dispersal pen.
- (b) Each pen had ready a supply of petrol (in tins, for refuelling by hand owing to shortage of bowsers and the number of aircraft to be dealt with simultaneously), oil, glycol and ammunition ; there were armourers, fitters, electricians and two soldiers to assist, lent by the Army.
- (c) The necessary arming, refuelling, etc., was then done, and within 35 minutes of touch-down serviceable aircraft were able to be 'scrambled.'
- (d) A great deal of motor transport was lent by the Army and this was a factor essential to the success of the turn-round.
- (e) To report serviceability and bring aircraft to readiness a complex signals organisation was necessary owing to the large distances between aerodrome control and dispersal pens. For this, Army W/T sets, despatch riders and visual signals were used.

(f) Each pen had an experienced Malta pilot ready to take over the machine.

(g) Crews remained in the pens all day, being fed there, and ready to deal with each aircraft immediately it landed again.

With the arrival of a further 60 Spitfires on 9 May, air superiority was regained. The same arrangements for rapid servicing enabled aircraft to land, refuel and rearm and take off again within 12 minutes. The intensity of fighter operations then reached a new record, two or even three sorties a day being required of serviceable aircraft. Such a standard would have been impossible of attainment without the assistance of the Army, since the practice of holding a maintenance crew permanently at each dispersal was extravagant in man-power. There were at least two soldiers in each crew and these crews were at their posts for 15 hours a day. The personnel in the repair shops were similarly called upon for exceptional efforts. A normal home station, supported by a maintenance unit and carrying 32 aircraft, had an establishment of over 2,000 men, whereas Malta, without a supporting maintenance unit, had 1,950 men, excluding outside help, to maintain a wide range of aircraft averaging 130 in number during March, April and May.

Although the shortage of M.T., petrol and rollers had held up the construction work after the assistance of the Army had relieved the labour problem, 27 miles of dispersal track and over 260 dispersal points had been completed between 1 June 1941 and 12 May 1942. At Luqa the tracks were built to take Wellingtons, and Luqa remained the only aerodrome capable of operating that type and the only runway which remained serviceable during the heavy rains of the winter of 1941-42.

Any possibility of putting workshops underground had to be shelved as the miners were all employed on the construction of civilian underground shelters. The only alternative was dispersal, and 60 per cent of the aircraft repair work at Kalafrana was moved to Gzira, including instrument, armament, airscrew and tank repair and coppersmith shops. Stores were distributed to 27 houses throughout the Island. Tentative plans were, however, made for the accommodation underground of workshops, hangars and living facilities. The destruction of the main stores in May was a serious blow, though dispersal reduced the losses to a minimum.¹

In May 1942 it was necessary to withdraw personnel from the workshops to assist with the servicing of the newly arrived fighters, and the output for May was stated to be a low rate.²

The following figures show the output in May and subsequently :—

	1942 Aircraft Engines		Salvaged Airframes	Salvaged Engines
May	8	19	46	51
June	15	25	16	45
Aug.	8	13	17	41
Sept.	10	33	11	32
Oct.	11	44	36	51
Nov.	11	29	12	32
Dec.	4	36	16	64

¹ No. 143 M.U. O.R.B.

² R.A.F. Station, Kalafrana, O.R.B.

Further reinforcements reached Malta during June, 27 Spitfires arriving on 3 June and 32 more on 9 June. A convoy arrived from the west on 15 June. The enemy attacks were greatly reduced whereas Malta was able to resume an offensive of greater magnitude than before, the striking power being increased by the arrival of Beaufighters, Beauforts, Wellingtons and Baltimores.

The average daily serviceability of the Spitfires during the course of operations was 95 per cent, the total number of serviceable aircraft being 165. To maintain so high a rate of serviceability it was necessary to draw heavily on the aid of the Army. All work was stopped at the Command repair shops to provide a nucleus of skilled tradesmen in the dispersal pens; Army assistance included 34 officers, 1,138 men, 114 trucks, 14 bren-carriers and 16 motor-cycles.

During August 1942 work was started on the movement of the general engineering section machine shop to the caves at Tal Handak. This section and the electrical repair and salvage section completed their moves during October. The transfer of the engine repair section, except for the test bench and cylinder bay, was completed by the end of November.

The enemy resumed heavy daylight bombing raids at the beginning of October, but the fighter defence proved too strong for him and he resorted to fighter-bomber nuisance raids. The attacks did, however, necessitate the temporary suspension of work on the output of aircraft, personnel concentrating on repair and production of components and forming dispersal parties on the aerodromes.

Although the Axis offensive never became dangerous after the spring of 1942, it was not possible for Malta to maintain a powerful offensive for any considerable period owing to the acute shortage of aviation fuel. On 30 November 1942 there was only a week's supply of fuel for Malta's 14 squadrons. From this time onwards, however, after a convoy reached the Island from the east bringing considerable supplies of petrol, the Malta squadrons were able to assume a general offensive policy, which was maintained against southern Italy, Sicily and North Africa and the supply convoys to Tripoli and Tunisia until the Axis surrender in North Africa on 13 May 1943.

As the danger of renewed Axis attacks became increasingly remote, the dispersal of facilities at Malta became more of a handicap than an asset. In February 1943 a large part of the general engineering section was moved from Tal Handak back to Kalafrana.

The formation of the Maintenance Wing, Malta, took place in November 1942. Prior to this date such repairs as had been carried out on bomber aircraft at Luqa had been on a very limited scale. As early as the beginning of 1941 a civilian party, controlled by the airframe repair section at Kalafrana, had been sent to Luqa to carry out such repairs as were possible with the very limited equipment at its disposal. Towards the end of 1941 the party was augmented by personnel from Luqa and was absorbed into the organisation of that station. Its work continued throughout 1942, almost entirely on Wellingtons.

CHAPTER 17

THE INVASION OF SICILY, OPERATION HUSKY

The Plan to Invade Sicily by Anglo-American Forces

The decision to undertake the invasion of Sicily was made at a conference held at Casablanca in January 1943, by the Combined Chiefs of Staff in consultation with the President of America and the Prime Minister of Great Britain.

The planning staffs of both countries were directed to report on the earliest feasible date for the invasion, and on 22 January 1943 the target date was set provisionally for the favourable period of the July moon. The Allied C-in-C. was charged with the overall responsibility for the detailed planning, and with the necessary preparation and execution of the actual operation, the object of which was to seize and hold the island of Sicily as a base for future operations.¹

The plan of campaign was briefly as follows :—

The first phase was to consist of preparatory measures by the air and naval forces to gain air superiority, and to neutralise enemy naval efforts. The second phase was to be the simultaneous assault on the south-eastern corner of Sicily by eastern and western task forces. The western task force, consisting of the U.S. Seventh Army, was to sail from the North African ports, whilst the eastern task force, comprising the British Eighth Army, was to sail from the Middle East. The two convoys were to rendezvous south-west of Malta on D minus 1 day ready for pre-dawn landings the following morning, the main objectives of which were to be the seizure of airfields and the ports of Syracuse and Licata. The assault was to be preceded by British and American airborne landings from airfields in North Africa. The third phase was to be the establishment of a firm base from which to conduct operations for the capture of the ports of Augusta and Catania and the Gerbini group of airfields. Finally it was planned that with these facilities in their possession the Allies would then be able to proceed with the reduction of the island.

As regards the Allied Air Forces, a scheme was drawn up for an eastern air task force to support the Eighth Army and attached units and a western air task force to assist the U.S. Seventh Army. In the initial stage the greater part of the former would be based in Malta, under the command of the A.O.C., Malta. The American squadrons allotted to support the U.S. Seventh Army were to be derived mainly from Tunisia and accordingly came under the command of the A.O.C. of the western air task force. Both air task forces were to be under the control of the A.O.C. Northwest African Tactical Air Force.

The Allied medium and heavy bomber squadrons of the Northwest African Air Forces were to continue to operate from the North West African mainland, and the U.S. and R.A.F. heavy bombers under the control of the Ninth U.S. Air Force were to continue to function from Cyrenaica.

¹ C.C.S. 171/2/D.

The Air Commander-in-Chief, Mediterranean, was to control all air forces taking part in the operation from a Command Post established at La Marsa which was virtually one large headquarters embodying all the Commands.

After the completion of the first phase of the operation the role of the Allied Air Forces was to provide an air escort for the assault convoys, and after the landings to provide air cover over the beaches by night and day, with the subsidiary task of attacking enemy movement towards the assault areas. Once the landing had been established they were to maintain air superiority and operate in direct support of the advancing land forces. Finally they were to prevent as far as possible a successful evacuation of the island by the enemy.

The air position of the Tactical Air Force operational units prior to the invasion was :—

- (a) The main fighter force located at Malta, Gozo and Pantelleria.
- (b) A small fighter force, under XII Air Support Command, retained for tactical bomber escort and located on airfields on the eastern side of the Cap Bon peninsula.
- (c) A tactical bomber force located at airfields on the Cap Bon peninsula.
- (d) A fighter-bomber force under the Desert Air Force retained in the Tripoli area.
- (e) Lightning (P-38) Groups of the Strategic Air Force temporarily allocated to the Tactical Air Force at Mateur (North Africa).

Relative Air Strengths¹

The Allied Air Forces in the Mediterranean area were infinitely stronger than those of the Axis. For all operations connected with the Sicilian invasion it was estimated that a front-line strength of approximately 4,000 aircraft was available. This figure did not include the large American glider force.

The R.A.F. squadrons provided the majority of the single- and twin-engined offensive and defensive fighters and coastal aircraft, whilst the bomber and air transport forces were composed principally of American units. The night bomber force, however, consisted mainly of R.A.F. Wellingtons, Liberators and Halifaxes.

On the eve of the invasion the German and Italian air forces had a total of 1,800 to 1,900 aircraft, excluding transport types, based in Italy, Sicily, Sardinia and southern France.

The serviceability of enemy aircraft in the Mediterranean area in general was estimated to average 50 per cent., whilst in the battle area it was undoubtedly less.

Arrangements for the Supply of Aircraft

The output of repaired aircraft from the Delta would be ferried to No. 136 Maintenance Unit, Berka ; from the repair organisation at Tripoli to No. 117 M.U., Azizia ; and from North West African repair units to No. 162 M.U., Sétif. New aircraft would be delivered and distributed as follows :—

¹ A.H.B./II J1/33.

- (a) British single-engined fighters : erection at Casablanca and Gibraltar, passing through a pool at Ras El Mar to Sétif or Azizia according to whether they were destined for N.A.A.F. units and U.S.A.A.F. operating from overseas bases or for the Middle East units and R.A.F. units operating overseas.
- (b) American single-engined and certain twin-engined fighters : erection at Dakar, Casablanca, Oran and Algiers and delivery to units by N.A. Training Command.
- (c) British twin-engined types : flown to Ras El Mar from United Kingdom bases and allocated in bulk to Sétif or Azizia for N.A.A.F. or Middle East units respectively, distribution under N.A.A.F. or M.E. control.
- (d) British heavy bombers : flown to Ras El Mar and distributed by Mediterranean Air Command to N.A.A.F. or M.E.
- (e) American twin-engined types and heavy bombers : flown from U.S.A. to Marrakesh and distributed to N.A.A.F. as required.

Although the majority of aircraft would arrive via the North African route, the southern route also would be used : British single-engined types would be erected at Takoradi and serviced at No. 135 M.U. ; American single-engined aircraft for both R.A.F., M.E., and the Ninth Air Force would be erected at Accra and No. 107 M.U. and serviced in the Delta area. All these aircraft would be passed through No. 136 M.U., Berka, and up to No. 117 M.U., Azizia, as required. Baltimores for R.A.F., M.E., were being flown from U.S.A. to Takoradi, serviced in the Delta area and passed forward through Nos. 136 and 117 M.U.s. All British multi-engined types, including those for India, would be routed via North West Africa, though certain heavy bombers for the U.S. Ninth Air Force would continue to be flown into Egypt from U.S.A. via Khartoun.

The method of distribution of aircraft from the holding units was covered in Middle East Maintenance Instruction No. 3 and in the corresponding instruction from Northwest African Air Service Command. No. 214 Group in Tripolitania, No. 212 Group in Cyrenaica and No. 206 Group in Egypt were responsible for movements of reinforcement aircraft in their respective areas, the reinforcement of fighter and light bomber squadrons operating in Malta and Sicily being directly controlled by No. 214 Group. N.A.A.F. units operating from the mainland were to be reinforced from squadron pools under the control of H.Q., Coastal Air Force and H.Q., Tactical Air Force, replacements being called up from No. 162 M.U., Sétif, through Northwest African Air Service Command.

The Role of Malta in the Maintenance Plan¹

The part played by Malta in Operation Husky was extensive as it was almost ideally situated geographically in relation to North Africa and to Sicily, the island to be invaded.

Until the eastern air task force was established in Sicily the greater part of it was based in Malta, under the command of the A.O.C. of the Island. From this advanced base the air task force was able to play its full part in providing air coverage for the invasion.

¹ MS.103790/M, Plans.

Preparations for the Invasion of Sicily

The preparations for the use of Malta as an air base for an attack on Sicily had commenced in January 1943. Arrangements were made for the redistribution of stores to enable the Island to build up supplies from a starvation level to the immense organisation required to maintain a force which became, finally, 35½ squadrons working at maximum effort.

In February 1943 the depot was reconstituted as No. 143 Maintenance Unit and its expansion was commenced by the establishment of 'C' and 'D' Groups at Marsa and 'F' Group at Casal Pawla. Requisitioning of accommodation proceeded on a large scale. Temporary assistance during the invasion of Sicily was provided by personnel from Nos. 33 and 36 Air Stores Parks.

The servicing and repair resources were divided into a Malta servicing wing and a Malta maintenance wing. The servicing wing came into being, taking the servicing parties or repair and inspection echelons from fully established squadrons to form station servicing units and combining the latter into a servicing wing. The station servicing units were normally controlled by station engineer officers and undertook all inspections and repairs on site capable of being completed within 7 days, other than the minor inspections and repairs completed within 48 hours which were carried out by the squadrons.¹

The maintenance wing consisted of (about 40) squadron personnel who were formed into working parties for repair of airframes and engines which were beyond the facilities of the squadrons or servicing wing. These personnel were under the maintenance wing for technical control but were accommodated and administered under station arrangements. Apart from airframes the maintenance wing undertook repairs to engines involving the change of main components and the rectification of minor defects, always provided that the total held did not exceed their workshop's capacity; all others, more especially major repairs, were to be returned to the mainland.²

The maintenance wing repair sections handled all Category II and III aircraft, and were responsible for the preparation of all aircraft for 'Flyout' repairs.³

The build up of the air forces in Malta and Sicily was to proceed on the following lines. Initially Malta was to be filled with single-engined fighters. As airfields became available they were to move into Sicily where they would be maintained by the servicing commando units until the arrival by sea of their own flight personnel. Their place in Malta would be taken by fighter-bombers which would, in their turn, also move on to Sicilian airfields, under the control of the Desert Air Force. Malta was then to call in the light bombers and retain only 5 Spitfire squadrons for protection of the Island and of shipping to Malta and Sicily. The only hitch in this plan was a delay in bringing into use the aerodromes in the Licata-Gela area due to the omission to move supplies forward from the beaches.

¹ S.927 Eng.

² MS.103789.

³ All aircraft, on sustaining damage, were categorised as follows :—

Category I	..	..	..	..	Repairable in 7 days.
Category IIA	..	..	..	..	Repairable (Flyout).
Category IIB	..	..	..	..	Repairable by Maintenance Wing or (Ship out).
Category III	..	..	..	..	Burnt or missing.

For Operation Husky the maintenance policy with regard to Malta was as follows :—

- (a) *Supply.* To build up, prior to D minus 21, stocks of equipment of all kinds to cover the known increased commitments.
- (b) *Repair.* To restrict the amount of repair work to be done in Malta, wherever possible, and to use the maximum facilities existing on the mainland. This was necessary because of the limited repair capacity of Malta in relation to the number of squadrons involved and the difficulty of moving both serviceable and unserviceable equipment into and out of the Island.

The function of the maintenance organisation on Malta was therefore limited to :—

- (a) Daily maintenance, servicing of aircraft and M.T. up to 48 hours. } In squadrons.
- (b) Repairs to aircraft up to 7 days on site, including minor inspections and engine changes. } Maintenance Wing, Malta.
- (c) The salvage and despatch of airframes, engines and accessories beyond 7 days. } Maintenance Wing, Malta.
- (d) M.T. repairs by the motor transport repair section. } Maintenance Wing, Malta.

All aircraft requiring engine changes and repairs in excess of 7 days were to be flown to the mainland, and where this was not possible they were to be transported by air or sea at the first opportunity.¹

The Maintenance Organisation for the Eastern Air Task Force

The Major Repair Policy

No special maintenance organisation was set up prior to the assault as it was decided to base the major repair arrangements for Operation Husky upon the normal existing maintenance units in North Africa and the Middle East. The factors which led to this decision were :—

- (a) The anticipated duration of the campaign and the size of the island of Sicily.
- (b) The available capacity of the existing maintenance organisation on the mainland and the security of the lines of communication to them.
- (c) The impending invasion of Italy and the need to establish a major repair and supply organisation there as soon as possible.

The Servicing, Repair and Salvage Arrangements

The build up of the servicing, repair and salvage organisation on Sicily was planned to commence on 'D'-Day and to continue through five stages, culminating on D plus 42 with the reversion of the responsibility for the maintenance of the air forces on the island to the U.K.²

The arrangements for units and their function during each successive stage of the operation were as follows :—

¹ The details of the maintenance organisation on Malta for Operation Husky are set out in Appendix 40.

² A.H.B./II J1/193.

*Stage 1 (A).*¹ The initial servicing arrangements were largely based upon the employment of the servicing commandos who were to be the first technical units of the air forces to land. In the first place they were to organise fuel and ammunition dumps at airfields or airstrips and to ensure the rapid refuelling and rearming of aircraft; secondly, to undertake as much minor repairs and servicing work as possible until the arrival of squadron ground personnel in *Stage 2*. Aircraft repairs beyond their capacity were to be flown to base or collected in a dispersal area. Each unit was to land with sufficient technical equipment to maintain four fighter squadrons for nine days. To cover this requirement it was decided to employ six servicing commando units as follows:—

- 'D' Day : R.A.F. S.C.U.s Nos. 3201 and 3203, ex North West Africa. To be equipped with Spitfire V and Kittyhawk spares and equipment and, in addition, to cover the servicing of Spitfire IX aircraft.
- 'D' Day : R.A.F. S.C.U. No. 3230 mounted in the Middle East.
- D plus 3-7 : R.A.F. S.C.U. No. 3232 ex Middle East, by ferry from Malta.
- D plus 5 : R.A.F. S.C.U. No. 3226 ex U.K. To be equipped for the servicing of Spitfire V and Beaufighter night squadrons.
- D plus 5 : R.A.F. S.C.U. No. 3204. To be equipped for servicing Spitfire V and also to cover Spitfire IX aircraft.

In addition, R.A.F. S.C.U. No. 3231 was held in reserve at Malta for ferrying to Sicily should the need arise.

Stage 1 (B). When advised that airfields or airstrips were ready and that supplies of petrol, oil and lubricants (P.O.L.) and explosives were available, the squadrons were to fly into Sicily as planned.

Stage 2. Squadron 'A' ground parties, established to a nine-day light assault scale and complete with M.T. and squadron equipment, were to be ferried into Sicily from Malta, or, where the supply of transport aircraft would permit it, flown direct to their respective airfields. On arrival they were to take over the one flight of the squadron, leaving the other to the servicing commandos.

With the arrival of the squadron 'B' parties, who would take over the second flight of the squadrons, the R.A.F. S.C.U.s were to become temporary repair and salvage units on the basis of one servicing commando unit to each wing. The wings were to assist and direct their operation. At this stage the R.A.F. S.C.U.s were also to assist squadron personnel in aircraft repairs, the limit now being raised from 24 hours to 48.

Stage 3. D plus 14. No. 40 Air Stores Park (A.S.P.) with 28 days' pack-up for five Kittyhawk squadrons and five and a half Spitfire squadrons, No. 59 Repair and Salvage Unit (R. and S.U.) and No. 3 Motor Transport Light Repair Unit (M.T.L.R.U.) with 28 days' M.T. spares pack-up were to be conveyed in from Tripoli. No. 135 A.S.P. with 28 days' pack-up for nine Spitfire squadrons and one Beaufighter squadron, and No. 108 R. and S.U. were to be ferried in from North West Africa.

¹ I.P.S./107/Eng.

Stage 4. D plus 28. The reinforcements for Nos. 40 and 135 A.S.P.s with 28 days' additional pack-up and additional equipment for the R. and S.U.s.

Stage 5. D plus 42. The responsibility for the maintenance of the air forces on the island reverts to the United Kingdom.

The Function of the Repair and Salvage Units (R. and S.U.s)¹

The main function of these units during the operation was to be the rectification of easily repaired aircraft for return to service as soon as possible. It was anticipated that the salvage of aircraft on Sicily would be adversely affected by the difficult nature of the terrain, which would not only restrict motor transport access to crashed aircraft, but would also increase the time required to collect damaged aircraft to such an extent that their collection would become uneconomic. Instructions were therefore issued to adopt a policy of 'cannibalisation' with the object of making as many aircraft serviceable as possible in the shortest time. The mobile salvage parties were to be deployed for collecting aircraft for bringing back to the R. and S.U. base, but the range of their operations was not expected to exceed an average of 30-40 miles. Owing to the mountainous nature of the terrain, opportunities for repair on site for 'flying-in' to the main base or Malta were expected to be rare and aircraft would usually have to be dismantled for transporting on 3-ton tenders.

The Function of the Mechanical Transport Light Repair Units

As all the vehicles to be used in the initial stages of the operation were to be new, the main function of the M.T.L.R.U.s was to be the repair of damaged M.T. by the replacement of components and the salvaging of vehicles either for repair or reduction to produce. The range of the M.T. salvage parties was restricted to the proximity of their base because of the anticipated congestion on the narrow roads of the island. The supply of M.T. spares up to D plus 28 for vehicles common to the Services was an Army commitment and the R.E.M.E. units would therefore also be available to render assistance to R.A.F. M.T. on repairs which were outside the immediate facilities of the M.T.L.R.U.s.

The wastage of M.T. up to D plus 28 was expected to be considerable and instructions were therefore issued for extra care to be taken of vehicles during this vital period, especially in view of the fact that no substantial replacements might be possible until D plus 42.

An Outline of the Operational Aspect of the Sicilian Campaign²

The initial landings on Sicily were made as scheduled despite a heavy sea swell, and as only slight opposition was encountered from the coastal batteries all planned beachheads were rapidly established. On 10 July the ports of Syracuse and Licata were captured, together with the landing grounds at Pachino and Licata.

By 11 July the enemy were in a position to launch a counter-attack in the Gela area but this was repulsed after some small initial success. The port of

¹ IPS/107/Eng.

² A.M. File CS.23602.

Augusta and the airfields at Comiso and Ponte de Olivo were taken on 12 July and the following day an advance was in progress on all sectors ; the assault on Sicily had been successful and the requirement was to enlarge the bridge-head.

Airborne landings were synchronised with the seaborne assaults. These consisted of approximately 350 aircraft under the control of Troop Carrier Command and were made in the Syracuse area (glider-borne mainly) and in the Ponte de Olivo area (parachute troops). The Tactical Bomber Force operated in conjunction with these operations with diversionary attacks in the Catania area and bombing attacks in the vicinity of the dropping zones which included incendiary bombs as navigational markers. Night-flying Hurricanes of No. 73 Squadron from Malta were also employed to blanket the searchlights with cannon fire.

The glider-borne operations were adversely affected by strong winds from the north west which caused gliders to be cast off too soon and a proportion landed in the sea, or just on the shore. Operations in the central sector went as planned. This was the largest airborne operation yet attempted by Allied forces, and bearing in mind the limited experience of the crews in the transport aircraft, the result was reasonably satisfactory.

It had been appreciated that the enemy would use his full air effort against the shipping and beaches from early on 'D' Day, with the object of disorganising the whole operation at the outset. The plan formulated to counter this development was to provide continuous air patrols over the beaches during the hours of daylight, and by night to have Malta-based night-fighters controlled from L.S.T.s moored off the beaches. The anticipated high scale of enemy air effort did not materialise in full, and by last light on 'D' Day 12 craft only out of a total of some 2,000 ships and numerous other craft had been damaged by air attacks.

The 13 July saw a general advance from the bridgeheads in all sectors, but in the Eighth Army area, however, the thrust along the coast to Catania on 16 July met stiff opposition and little progress was made. This situation persisted in the Catania sector and denied the use by the Allies of airfields in the Gerbini plain.

Meanwhile, the U.S. Seventh Army was pushing vigorously north and west from their bridgeheads on the south coast and captured Enna on 20 July and Palermo on 22 July. There was little opposition and the speed of advance was strikingly rapid, so that by 24 July the western half of the island of Sicily was captured together with a vast number of Italians. The Seventh Army now turned eastwards where it encountered increasing German resistance along the north coast and on the inland road through Nicosia and Troina.

At the end of July, pressure was being exerted on the enemy in all sectors and there was a slow but steady advance. On the Eighth Army front the Canadians had captured Agira and were moving on Regalbuto which was captured on 2 August, this was followed on 5 August by the occupation of Catania and a further movement northwards.

In the face of difficult terrain and strong opposition, the Seventh Army were at this time making little progress, but on 6 August, however, Troina was captured and an advance started towards Caesaro which was occupied on 8 August. In the coastal region two successful seaborne landings were made behind the enemy lines and quickened the tempo of movement somewhat.

On the evening of 16 August the Seventh Army entered Messina and firing ceased early the following morning. The capture of Sicily had been achieved, and 6,500 Germans and 125,000 Italian prisoners taken.

From the time of the breakout of the land forces from the beachheads the role of the air forces became protective cover for shipping, beaches and ports, direct assistance to the land forces, and the prevention of the withdrawal of enemy forces to southern Italy.

The continuance of protective cover whilst concentrations of shipping remained was essential. The scale of fighter protection required by day was, however, appreciably reduced after the 13 July when the enemy suffered severe losses from what proved to be his last heavy day attack.

The Maintenance Organisation at Malta during the Operation

The maintenance project at Malta proved satisfactory, the serviceability rose from 87 per cent on D minus 1 day to 95 per cent after 3 days of maximum effort and was, on the average, 88 per cent for the Unit Equipment aircraft of all Spitfire squadrons during the period 8-17 July. This was due in large measure to the 30 replacement aircraft, called forward on 'D' Day, which enabled a station reserve to be maintained for the immediate issue of replacements. The servicing echelons were withdrawn from units to work with the Command maintenance organisation and flights were limited to daily inspection and minor adjustments only.

Maintenance Wing, Malta, took on all the work it could handle, though many of the casualty aircraft were sent from Sicily for repair in the Middle East maintenance units. The following figures illustrate the volume of work falling upon the Kalafrana base organisation, as compared with the other months of 1943.

	1943	<i>Airframes Repaired</i>	<i>Engines Repaired</i>	<i>Airframes Salvaged</i>	<i>Engines Salvaged</i>
January	..	21	38	10	55
February	..	20	33	8	57
March	33	36	13	36
April	14	40	12	62
May	18	29	15	39
June	10	18	21	48
July	21	40	41	105
August	..	17	19	17	94
September	..	12	10	4	44
October	..	18	17	10	34

In August 1943 the Maintenance Wing was reorganised. The armament repair section was moved from Gasan's Garage, Gzira, to Kalafrana and the propeller repair section from Muscat's Garage, Gzira, to Gasan's Garage, thus freeing Muscat's Garage for the use of the equipment branch. The general engineering and motor transport repair sections were moved to a repaired hangar on the north slipway, freeing the original engine repair shop for aero-engine repairs which were subsequently moved back from the caves at Tal Handak. The parachute repair section also was moved to Gzira.

The Beach Organisation

The initial landings were made as scheduled despite a heavy sea swell on the beaches. Due to the slight opposition encountered from the coastal batteries and to the adequate air cover provided, all planned beachheads were rapidly established.

Among the first R.A.F. formations ashore were the newly created 'beach bricks' whose function was, first, to supervise the unloading of R.A.F. stores and the passage of R.A.F. units across the beaches and, secondly, to provide detachments for the explosives, petrol, oil and lubricants (P.O.L.) and general stores dumps in the Army maintenance area. The governing principle worked on was that no stores or member of the R.A.F. should be able to cross the beach at any stage of the landing without the knowledge of the Beach Brick Commander. There were three types of beach brick used in Husky, created respectively by the United Kingdom, North Africa and the Middle East.

- (a) The United Kingdom beach organisation was composed of two bricks under a sub-base H.Q. It included two large M.T. repair sections of 18 men each to deal with drowned vehicles.
- (b) The North African beach organisation operated with a sub-base H.Q. and three bricks. In this case the brick establishment of 2 officers and 24 ranks in each brick, with an operation sub-base H.Q. of one squadron leader and a small staff.
- (c) The Middle East bricks each consisted of 5 officers and 35 other ranks, including 2 officers and 17 other ranks for explosives duties and earmarked for eventual transfer to the air ammunition parks.

In general, the R.A.F. beach brick components were successful in carrying out the tasks for which they were designed, and there is no reason to suppose that the case would have been different had stiffer opposition been encountered in the early stages of the invasion.

Supplies of Petrol, Oil, Lubricants and Ammunition

The plan did not envisage the entry of an air ammunition park (No. 121 M.U. A.A.P.) into Sicily until D plus 14. Until then the supplies of P.O.L. and explosives were to be handled by the dumps formed, and controlled by each beach brick. In fact, No. 121 M.U. dumps were opened at Pachino on D plus 3 and at Priolo, north of Syracuse, a few days later. Through these it was able to centralise and control the flow of supplies from the beaches.

THE CAPTURE AND OPERATIONAL DATES OF AIRFIELDS IN
SICILY UP TO 31 JULY 1943

Name	Map Ref.	Size of Strip in yards	Work Commenced	Airfields Operated
*Pachino	H.9691	1400 × 300 1100 × 200	July 10	July 14
Mancini	H.9698	1200 × 100	13	15
Lentini East ..	H.8457	1200 × 80	17	22
Lentini West ..	H.8057	1200 × 175	21	25
Cassibile	J.1021	1500 × 100	14	16
San Francesco ..	H.8354	1100 × 50	27	31
Agone	H.9559	1200 × 100	18	22
Scordia	H.7854	1200 × 100	26	31
Palagonia	H.6058	1250 × 125	29	31
Agrigento	G.6552	1533 × 50	17	20
*Bisceri	H.4433	1400 × 150	16	19
*Comiso	H.5422	1800 × 55	12	13
*Ponte Olivo ..	H.2837	1667 × 360	12	15
Gela West	H.2032	1850 × 50 1930 × 60 1870 × 60	16	19
Gela East	H.2429	2000 × 67 2200 × 100		
Licata South ..	G.9136	2000 × 67	11	16
Mt. Lungo	H.1534	2000 × 50 1500 × 50	21	26
Commelli	H.1237	1667 × 67		
*Castelvetrano ..	F.9299	1300 × 72	29	31
Termini East ..	B.8730	2000 × 50	27	31
Termini West ..	B.8130	2000 × 50	27	30

* Airfields in existence but in need of repair or improvement.

No optimum build-up had been planned and had it not been for the flexibility of the Malta ferry full advantage could not have been taken of the rapid advance of the ground forces.

The Servicing Commandos¹

The fact that the servicing commandos were not employed to the extent anticipated was due to the following reasons. In the first place the landing grounds were not ready quite as early as had been expected and this delayed the 'fly-in' of squadrons so that full advantage could not be taken of the flexibility of the Malta ferry to land squadron ground personnel.² This, together with the low casualty figures of personnel and aircraft, tended to make the servicing commandos largely redundant.

¹ IPS/100/6/1 Admin. A.M. File CS.23602.

² The role, organisation and equipment of the servicing commandos for Operation Husky are shown in Appendix 36.

The first servicing commando unit to land in Sicily, No. 3201, went ashore near Pachino early on the morning of 'D' Day—10 July. Pachino airfield was occupied the next day and from 12–15 July the commando personnel worked from dawn to dusk, and even through the night, servicing the Spitfires of No. 244 Wing.

The squadron 'A' parties arrived on 15 July and two days later two commando flights moved forward to Cassibile. In the following days they serviced Kittyhawks of No. 239 Wing and aircraft of No. 57 U.S.A.A.F. Pursuit Group.

The second commando unit in Sicily landed at Syracuse from Malta on 17 July and spent the next two days collecting and dispersing supplies. They were in operation as a servicing unit for less than a day before the squadron 'A' parties were flown in. They were subsequently moved to Agone and Lentini, but the squadron personnel arrived before the first aircraft.

Sufficient commandos were used to service 16½ Spitfire squadrons and 2½ Beaufighter squadrons, but it was some time before they were able to provide service for the squadrons as satisfactory as would have been expected from personnel trained with the squadrons. The three North West African commando units Nos. 3201, 3202 and 3203 were, however, highly trained technically and had been operating continuously in N.W. Africa since the Torch landings. The remaining five units had been newly formed. As the units were able to walk ashore and occupy airfields which had already been cleared by the assault forces their commando training, given at some expense in technical efficiency, was of minor value. Their specialist value was also short lived, as after the initial stages of the campaign they had to be absorbed into squadrons and other technical units, and this raised considerable administrative problems.

It was felt that had less favourable circumstances been encountered in Sicily, the commandos would have been justified as they would have provided valuable flexibility in enabling squadrons of different types to land at new airfields at short notice; would have relieved the military authorities by their ability to defend their positions and aircraft; their training would probably have enabled them to maintain their efficiency under fire to a greater extent than could have been expected from squadron personnel; by absorbing the first shock of casualties they would have saved squadron personnel who would have generally been more difficult to replace, and finally, by the elimination of commando units from an initial assault an appreciable increase in equipment scales would have been necessary for the squadron advanced parties, which would consequently have suffered in mobility.

As a result of the experiences in Sicily certain alterations were made in the training and equipment of the servicing commandos. The most important change was the inclusion in the equipment establishment of a mobile crane to remove crashed aircraft from the runways without further damage to the aircraft or runway surface. The commandos landed in Normandy in 1944 were equipped with mobile cranes, and although it was not possible to provide them in time for the initial landings in Italy, No. 3204 Commando took with it a Coles crane, when it moved from Pachino to Gioia in Italy at the end of October 1943. Other alterations included increased stocks of highly expendable items, the

supply of spare tyres already mounted on wheels and ready to fit, and the provision of at least one vehicle with an engine-driven pump and an open 44-gallon storage drum for refuelling. Pending the arrival of large containers the four-gallon petrol cans could be emptied into the large drums thereby saving much valuable time in refuelling.

Squadron Maintenance¹

As already stated, the squadron 'A' parties were able to move into Sicily virtually at the same time as their aircraft, or at the worst the following day. This fact, together with the low aircraft casualty figures and the efficiency of the organisation for the supply of replacement aircraft, enabled an average serviceability of 88 per cent to be achieved and maintained. Some difficulty was experienced, however, with these replacement aircraft not being equipped to suitable operational standards. As a result of complaints along these lines a small party of maintenance personnel was sent to No. 117 Maintenance Unit to assist in the final inspection of aircraft prior to issue, an inspection schedule being used which was based on the experience of Malta's Spitfire squadrons.

Squadrons were able to operate efficiently even on their reduced establishment, although this meant that maximum effort had to be called for from all tradesmen. They were also able to carry out minor inspections without assistance from the servicing commandos, providing the latter undertook the minor and temporary repairs to aircraft, including those which had to be repaired prior to being flown back to base.

The squadron ranges of spares had been sacrificed for mobility and it had been planned to resort to heavy cannibalisation; the early arrival of a detachment of No. 40 Air Stores Park with a wide range of spares made this completely unnecessary, whilst the tactical situation would have permitted a much wider range of squadron stores to have been carried.

The reduced squadron establishments did, however, place a severe physical strain on the personnel involved. Had enemy resistance been heavier it would have become vital for the balance of the squadrons and their supporting units to have arrived not later than D plus 10-15.

Air Stores Parks²

No air stores park had been planned to land in Sicily before D plus 14, as it had been felt that an early landing would not be justified. It was thought that the spares position would be fully covered by unit stocks, 'robbing' of casualties and the 'fly-in' of replacement aircraft.

In actual fact the flexibility of the Malta ferry enabled the commanding officer and an advanced detachment of No. 40 A.S.P. to be landed over the beaches on Cape Passero, near Pachino, on D plus 3. Immediately after landing they proceeded to a site alongside the airfield at Pachino where they set up a water distillery for aircraft batteries and coolant systems. Within an hour of the commencement of fighter operations the propeller assembly party was busy

¹ A.M. File CS.23602.

² A.M. File CS.23602 and O.R.B.s Nos. 40 and 135 A.S.P.s.

assembling and fitting a replacement propeller to a Spitfire. Heavy issues of propellers to replace those damaged on landing continued to be a major commitment, whilst there was a heavy demand for distilled water and other vital but highly consumable items.

On D plus 8 the detachment followed the 'A' parties of No. 244 Wing to Cassibile airfield, leaving behind two men and a vehicle with No. 121 Air Ammunition Park to handle supplies of breathing oxygen and long-range tanks, and to accept demands from No. 239 Wing squadrons. These vehicles had fortunately arrived in three Dakotas that day.

The landing of No. 40 A.S.P. 'A' party was brought forward and a visit to the Syracuse docks by the commanding officer revealed that their ship was, in fact, in the outer harbour. They were quickly disembarked and proceeded to join the advanced detachment which they absorbed; issues began immediately.

The senior equipment officer visited the docks and instructed personnel there to route all R.A.F. equipment to No. 40 A.S.P. for distribution. Issues to No. 244 Wing were heavy, and as No. 135 A.S.P. had not landed it was also agreed to supply No. 239 Wing as well.

The unit's vehicles continued to collect R.A.F. equipment from the eastern and southern beaches, but this work was slowed down due to the lack of adequate signposting.

A stage had now been reached where some control over issues was desirable in order to ensure equal distribution of items which were difficult to obtain. Recourse was therefore made to a system which had been evolved and proved in the Western Desert. New items, other than those of a consumable nature, were only issued on the production of an unserviceable or repairable item, or a satisfactory explanation of the disposal of the item to be replaced. By D plus 14 a regular Dakota air freight service between Castel Benito and Cassibile was in operation and it became possible to send back repairable items on the returning aircraft.

No. 135 A.S.P. arrived at Syracuse from Tunis on D plus 19 and went forward to Lentini to serve No. 322 Wing. They had to leave their mobile oxygen plants behind with No. 40 A.S.P. because of the difficult mountain roads, but nevertheless these vehicles eventually made the journey, because a few days later No. 40 A.S.P. also moved to a site north west of Lentini. They left behind a small rear party at Cassibile airfield to receive and despatch air freight.

The supply of equipment by air from Tripoli continued satisfactorily. At the beginning the A.S.P.s were supplied from the Middle East supply organisation, whilst repairable equipment was returned to Nos. 159 and 113 Maintenance Units at Tripoli, where it was repaired and returned by air. The N.W.A. Service Corps could not agree to a similar arrangement being made with No. 144 Maintenance Unit at Maison Blanche, but insisted that repaired items must be put into stock at No. 351 M.U. and issued on demand. Arrangements had therefore to be made to continue the original system and to supplement it by supplies from No. 114 M.U. at Tripoli.

With the cessation of enemy resistance on Sicily on 17 August the consolidation of resources commenced with a view to following as rapidly as possible on the heels of the ground forces when they invaded the Toe of Italy.

There can be little doubt that the landing of an advanced detachment of an A.S.P. in Sicily so much earlier than had been planned was an unqualified success. It proved valuable in maintaining aircraft serviceability and reduced the robbing of casualty aircraft to negligible proportions, thus making the acceptance of this principle during such an operation quite unnecessary.

Repair and Salvage Units¹

It had been planned to land a repair and salvage unit on D plus 14, but No. 59 R. and S.U. did not, in fact, disembark at Syracuse until 23 July. Had it not been for the urgent requests for their presence by No. 40 A.S.P. their arrival would have probably been even further delayed due to the lowering of the R.A.F. priority of 'shipping-in' units.

The R. and S.U. found twelve Spitfires awaiting engine changes and repairs when they arrived at Cassibile. A week later a working party consisting of six cranes and twelve men was attached to No. 244 Wing at Lentini for repair and salvage work.

During the month of August six Spitfires were received for repairs and engine changes, two of these being complete rebuilds, whilst a total of 198 aero-engines was handled or distributed. Aircraft repaired and issued included ten Spitfires and one Beaufighter. One Walrus aircraft was salvaged, repaired and re-erected for 'fly-out,' and during the same period twelve Spitfires were salvaged and passed back to Catania.

As can be seen from the above figures aircraft wastage was remarkably low, but nevertheless the absence of a small R. and S.U. advance party, equipped with cranes, was keenly felt as it delayed the removal of crashed aircraft from the runways of airfields. The method employed was to drag the aircraft off the runways, with a consequent increase in damage to both the aircraft and the landing surface.

Mechanical Transport²

No. 3 Mechanical Transport Light Repair Unit disembarked at Syracuse on 7 August and was installed in the Fiat engineering works two days later. Vehicles and components requiring repairs started to flow in on 9 August together with demands for M.T. equipment. A serviceable pool of vehicles and components was established from which issues were progressively made in exchange for unserviceable items being fed in. Thus units did not have to wait whilst repairs were carried out unless the item was outside the range of the pool, and even then a substitute could sometimes be accepted.

During the rest of the month there were 1,193 issues made by the equipment section whilst miscellaneous repairs and repairs to components amounted to 366 and 128 respectively. There were 160 vehicles received for repair of which 98 were rendered serviceable, an additional 35 had to be returned to the base pool as being beyond the unit's capacity.

¹ A.M. File CS.23602 and No. 59 R. and S.U., O.R.B.

² A.M. File CS.23602 and No. 3 M.T.L.R.U., O.R.B.s.

Arrangements had also been made for the Army to supply M.T. spares for the R.A.F. until D plus 28, and this arrangement worked very smoothly.

Maintenance in Sicily after the Campaign¹

After the successful completion of the campaign in Sicily the tide of battle moved forward into the Toe of Italy, taking with it most of the Sicilian squadrons and associated units.

It had been decided at the La Marsa Conferences to place the administration of Sicily under Air Headquarters, Malta, and under these circumstances it became desirable to form a separate maintenance unit at Catania. Previous to this the reduced maintenance requirements of the island had been handled by a detachment from No. 144 Maintenance Unit at Maison Blanche, but this was unsatisfactory in view of the great distance between parent unit and detachment.

To meet this requirement No. 118 M.U. was formed at Catania early in November 1943, its main functions being as follows :—

- (a) to provide repair, servicing and salvage facilities up to the stated scope for R.A.F. squadrons and units located in Sicily.
- (b) to supply all forms of R.A.F. equipment—except explosives and P.O.L.—to R.A.F. squadrons and units.
- (c) to dispose, as directed, of any unserviceable airframes, aero-engines and mechanical transport that were at that time lying in Sicily.

The repair and servicing of aircraft was limited to those repairs which could be effected in 21 days and to minor inspections. Major repairs were to be returned to the mainland.

No. 118 M.U. continued to supply the maintenance requirements of the 5½ squadrons operating from Sicily and to clear the island of all aircraft and equipment which had been left behind after the invasion.

Lessons Learned from Operation Husky²

Operation Husky provided many lessons for the planners of future combined operations. Many of the lessons from Husky underline those which were already available from Operation Torch.

The following are the major points of interest to the R.A.F. from the maintenance angle :—

Disembarkation and the Beach Organisation

- (a) It was proved most desirable for an advanced administrative element of the Air Task Force headquarters, headed by the deputy A.O.A. or his equivalent and including officers from the equipment and movements staff, to be landed as early as possible. Its main purposes should be to co-ordinate movement of units and supplies and to make local decisions as occasion may demand. It should be fully mobile in 'Jeeps' and be provided with pack wireless communication.

¹ A.H.B./II J5/111/5.

² 71102/S.M.P. TAF/101/Org. Lessons from Husky and A.H.B./II J1/193 Mediterranean Tour Report. General text and references thereto.

- (b) Beach brick commanders should be brought into the picture during the early stages of the planning so that they can advise and check on R.A.F. loading and stowage from start to finish. This would also enable them to give local advice on any unexpected alterations in the priority of unloading as they would have a knowledge of R.A.F. needs *vis-à-vis* those of the Army.
- (c) There is no ideal establishment for a beach brick as this will vary with local conditions. Beach bricks should in general, however, be self-supporting and be equipped with adequate transport. Signposting of the beach areas is vital and sufficient materials must be included for this to be done properly.

Supplies

- (a) These should be planned on the basis of an optimum build-up to enable full advantage to be taken of a good ground situation.
- (b) R.A.F. supplies, although small in comparison with those of the Army, are vital and must come ashore when planned. They should be clearly addressed to units and not by field security numbers which are often meaningless and lead to delay, confusion and even total loss.

Servicing Commandos

- (a) Servicing commandos must be as well trained technically as they were in commando work if they were to be of any real independent value.
- (b) Their period of useful service in a comparatively small campaign was brief and it was therefore vital that they should have been landed at the right place, at the right time and with the correct equipment with which to do the job. One Commando, shipped in the U.K., had all its personnel in one ship and its equipment in another. As the ships were directed to different parts of the island the unit was not able to link up until long after its usefulness as a Commando was past.

Miscellaneous Points

- (a) A small repair and salvage element with a crane should go in with the squadron and wing 'A' parties for the purpose of removing crashes. The tool range should cover several types of aircraft.
- (b) The main R. and S.U. party should be shipped complete as soon as squadron 'B' parties have left, handing over any uncompleted work to the forward element of a base maintenance unit, which should be in position and ready to take over.
- (c) Fighter squadrons cannot operate for very long at reduced scales of maintenance personnel, the balance of squadrons and their supporting units should have been fed in within 10-15 days. As this was not done, wastage in aircraft, transport and equipment became high. In Husky it was only possible to accept this situation owing to the relatively low scale of enemy opposition. Sickness and the physical tiredness of the men rapidly lower the standard of maintenance. The standard of maintenance in Husky remained remarkably high under the circumstances.

- (d) An advanced mechanical transport light repair unit should accompany the squadron and R. and S.U. parties, as R.A.F. units could not always be conveniently situated so as to get help from the Army.
- (e) In general, it was found that essential air force units with a minimum of transport were given a high priority in the assault, but were apt to be shut out in the subsequent follow-up convoys. In the case of all units, ' B ' and ' C ' should be shipped together : ' C ' parties of some R. and S.U.s did not arrive until after D plus 50, whilst the ' C ' party of the M.T.L.R.U. did not arrive until the latter half of September 1943. This consisted mainly of vehicles and spares which were badly needed to support a further move forward.
- (f) It was strongly recommended that if, in any future operation, shipping would not permit the move of a complete air stores park advance party with the squadrons, then a small detachment consisting of propeller assembly personnel, together with miscellaneous vital spares, should be shipped to arrive with or immediately after the squadrons.

CHAPTER 18

THE ITALIAN CAMPAIGN

The Outline Plans for the Invasion of Italy

The campaign in Sicily finished on 16 August and it was not until later in the month that the outline plans for the invasion of the Italian mainland began to assume their final shape, namely, first a holding and diversionary thrust by the Eighth Army elements across the Strait of Messina—Operation Baytown¹—with small-scale harrying leap-frog landings up the north coast of Calabria,² followed a few days later by an all-out lunge at the Salerno area—Operation Avalanche—coinciding with a seaborne landing in the port of Taranto on the same day—Operation Slapstick.³

Maintenance Requirements

The maintenance requirements of the air forces during the initial stages of the Italian operations were to be met by the now established pattern of beach units, servicing commandos and the advanced elements of the air stores parks and repair and salvage units. When airfields had been captured, stocked and put into operation the build-up of the squadrons would follow, the increased servicing requirements being covered by the 'shipping-in' of squadron personnel and the rear main parties of the other ground units. Repairs during this period which were beyond the capacity of the maintenance organisation would, in the main, be held pending the arrival of a base maintenance group. Aircraft replacements would be flown in to form a reserve pool of aircraft, all of which would be prepared to operational standards. As soon as the necessary facilities had been captured and the reasonable success of the operation assured, it was planned to move into Italy from North Africa a base maintenance group *en bloc*. When this group had become firmly established it was anticipated that, with Middle East and United Kingdom backing, they would be able to supply and maintain the air forces in Italy until the successful conclusion of the campaign.

Operation Avalanche was a combined Allied amphibious assault with the American XII Air Support Command as the controlling formation. British units were, however, well represented. It was the major operation in the invasion and the one which presented the most difficult maintenance problems. It has therefore been selected for more detailed study in preference to the other operations, which have only been referred to when it was necessary to complete the overall picture.

Maintenance Plans for Operation Avalanche⁴

The administrative and logistical planning for Avalanche, although in some sense less involved than that for the landings in North Africa and Sicily was nevertheless still unavoidably complicated. Three main factors prevented

¹ 3 September 1943.

² Of these only Operations Hooker and Ferdy were carried out.

³ The operational aspects of the assaults and the subsequent campaign are outside the scope of this chapter.

⁴ Maintenance Plans. A.H.B./II J1/328/2/1.

any hope of simplification. First, the three local bases in the theatre from which the operation could be launched, namely, Sicily, N.W. Africa and Middle East, were far apart and, in the first two cases, still in the last stages of a campaign. The distinctive and apparently unfuseable systems of British and American administration constituted the second complication, whilst thirdly came the influence of the last-hour switch from Operation Buttress to Avalanche. It was decided to load certain ships for Buttress with both men and vehicles and then to switch them to Avalanche if it should assume priority. Buttress, however, was to have been essentially a British-controlled operation from the air standpoint, with the Desert Air Force playing a prominent role, whereas Avalanche was to be predominantly American, with the XII Air Support Command as the controlling formation.

Supplies

Throughout the Sicilian campaign a plan for building up supplies in Malta and Sicily was proceeding, and by the time Avalanche was launched there were in Sicily sufficient supplies to maintain the entire Tactical Air Force over a minimum of fourteen days of intensive effort. Malta was to furnish items unobtainable in Sicily, such as oxygen in bulk. The next geographical stage was from Sicily to the mainland of Italy, where the target was to provide by the end of the first week for seven days' maximum and seven days' intensive effort, in that order. Thereafter, intensive effort would be the basis of calculation, and for this a reserve of fourteen days' supplies, including aviation petrol and oil, bombs, oxygen, small arms ammunition and pyrotechnics, was hoped for.

In view of the loss and confusion which occurred to both equipment and supplies in previous operations, due to inadequate or coded markings, it was decided that all boxes, crates, etc., should be clearly marked so as to denote both the unit and the nature of their contents. No indication, however, was to be made to the role of the unit or the destinations to which it might be proceeding. R.A.F. unit supplies were to be further identified by means of a blue diagonal band.

Major Repair Policy¹

As the invasion of Italy progressed the order of battle for the R.A.F. would rapidly become more and more formidable. The base maintenance support for the air forces during the initial stages of the operations would necessarily have to come from Algeria and the Egyptian Delta, but it was realised that these were too far away to fulfil the total requirements for any length of time. If the build-up of squadrons in Italy proceeded according to plan, then a point would soon be reached when their sustained maintenance requirements could only be met by the establishment of a base maintenance organisation on the spot.

The long-term plans for the maintenance of air forces in North Africa and Italy from September 1943 were on the following lines. The Director of Maintenance and Supply, Mediterranean Air Command, was to exercise general control and give direction on policy to H.Q., R.A.F., Middle East, on the one

¹ Maintenance Plans M.A.C. MAC/S/7215 and A.H.B./II J1/328/4/1.

hand and N.A.A.S.C. on the other. As soon as the air forces were established in Italy, a base group under N.A.A.S.C. would be established there to control and operate the base maintenance units.

These units were to be transferred from Tripoli and Maison Blanche and established in the Naples area as soon as possible after its capture. They were to deal with aircraft repairs, engine overhauls and general engineering services. As more and more R.A.F. personnel were moved over to Italy the French were to take over in their place in North West Africa until only a nucleus of R.A.F. personnel was left. The maintenance units supporting the Coastal Air Force squadrons still operating from North West Africa were to remain there. At this stage the main executive control would be transferred to Naples, leaving a maintenance group or wing in N.W. Africa which would also be responsible for a certain amount of major repairs for aircraft operating from Malta.

It was planned that No. 351 Maintenance Unit should remain the provisioning office for N.W. Africa, Malta, Sicily and Italy. Fuel and explosives for Malta and Sicily were to be shipped there direct, whilst all equipment and supplies for the air forces in Italy were initially to be shipped from North West Africa, but at the earliest opportunity No. 351 Maintenance Unit was to submit demands for explosives for direct shipment to Italy. A base equipment depot was to be established at Naples as soon as possible after its capture.

The determining factors in the choice of an area in Italy for the establishment of the base organisation were port facilities, potential technical and domestic accommodation, security and good lines of communication. Having selected the area some attempt was made to allocate accommodation to meet the needs of the three Services, and consequently, in August 1943, the Director of Maintenance and Supply, Mediterranean Air Command, put forward bids for R.A.F. requirements. However, experience had proved in both Algiers and Tunis that, in the event, final allocation was a matter which could only be settled on the spot by a reconnaissance party. D.M.S. therefore requested that the formations should select a senior officer from No. 114 M.U., one engineer officer from No. 113 M.U. and an administrative officer who could speak Italian to join the general reconnaissance party from H.Q., N.A.A.S.C.

The Beach Organisation¹

Three of the beach groups used in Operation Avalanche had R.A.F. components. These were No. 3 Beach Group with Nos. 68 and 69 R.A.F. Beach Units, No. 21 Beach Group with Nos. 81 and 82 R.A.F. Beach Units and No. 35 Beach Group with No. 35 R.A.F. Component. The first two beach units were founded on the U.K. establishment with a mechanical transport light repair section (M.T.L.R.S.) forming approximately half the personnel; the second two beach units were based on the North African establishment whilst the No. 35 Component had a Middle East establishment. All three had additional M.T. added to them for the operation and this undoubtedly increased their efficiency. The allocation of one Jeep and one 3-ton vehicle to each beach unit and one Jeep for the use of the squadron leader at base sub-area headquarters was to prove most satisfactory.

¹ N.A.T.A.F. File A.H.B./II J1/188/1. Report on Avalanche, Wing Commander R. D. George, 'Movements.'

Whilst the bulk of the supplies during the operation were routed to the southern beaches, which were manned by U.S. Service Command personnel, the Italian terminal point of the Milazzo ferry was on the northern beaches, so that nearly all the R.A.F. and U.S.A.A.F. units and their vehicles were to pass through the British beach organisation.

Aircraft Maintenance¹

The pattern of technical maintenance planned for *Avalanche* was similar to that already successfully employed in *Operation Husky*.

The initial servicing requirements were to be met by two servicing commandos, who were to proceed on the assault convoys from N.W. Africa and Sicily respectively. Each Commando had to be prepared to 'service' four Spitfire squadrons, half a tactical reconnaissance squadron (Spitfires) and half a night-fighter squadron (Beaufighters). For each of these squadrons they were to carry a seven days' range of suitable spares and night-flying equipment.

The squadrons were split into two self-contained parties, each consisting of approximately half the squadron ground personnel and each capable of servicing the whole of the squadron. As soon as the situation permitted first the 'A' and then the 'B' parties were to be ferried in, first to assist and finally to take over from the servicing commandos. Each party was to carry a seven days' range of technical spares which had been adjusted in accordance with the experience gained in the invasion of Sicily. They were also to carry one complete rearm of ammunition.

It was anticipated that the advance parties of the air stores parks to support the fighter squadrons would move from Sicily into the Naples/Salerno area on approximately D plus 12. A propeller assembly party was to be included and the stocks of spares of highly consumable items were to be sufficient to maintain the aircraft until the arrival of the main party of the air stores park with a 30-day range of spares.

The absence during *Operation Husky* of a small repair and salvage unit equipped with a crane for removing crashes from runways had been keenly felt, and arrangements were therefore made to land a suitably equipped advance party in the Naples area on approximately D plus 12. It was planned, in the light of past experience, to build up to full strength as soon as possible both the air stores parks and repair and salvage units.

The chain of technical maintenance and the limits of work were to be as follows:—

- (a) A servicing commando in the assault stage was to undertake daily servicing and any other work within its capacity.
- (b) Squadron ground parties would undertake inspections, engine changes and repairs up to 48 hours.
- (c) The R. and S.U. advance party was to undertake salvage and repairs up to four days, under the direction of the servicing commando and the wing. When the parent R. and S.U. arrived it was to assume the direction of all technical work beyond the capacity of squadrons, including that of the servicing commandos, and the limiting factor of four days would then be raised to seven.

¹ N A.T.A.F. Admin. Plan Outline and Detail. A.H.B./II J1/189/57, A.H.B./II J1/328/2/1.

In all cases flyable aircraft needing repairs or engine changes were to be flown back to base so as to relieve the pressure of work in the forward areas, their final disposal being the responsibility of the reserve aircraft holding units. Replacement aircraft were to be called forward by the wings and squadrons direct from the rear headquarters Desert Air Force in accordance with current procedure.

Mechanical Transport

It was decided that all the vehicles due to arrive over the beaches in the initial stages of the operation should be waterproofed prior to embarkation and de-waterproofed immediately after landing. All the two-wheel drive vehicles were to be fitted with skid chains on the driving wheels. Petrol tanks were to be filled only to 90 per cent capacity to allow for expansion and to minimise the danger of leakage. As much reserve petrol as possible was to be carried in jerricans, whilst units using diesel oil were also to carry their own immediate reserves. Further supplies of petrol (M.T.) during the initial stages were to be drawn from beach dumps and later from the nearest American truck companies. Units were made responsible for undertaking all repairs to their own vehicles until the arrival of the motor transport light repair units for which no embarkation date was specified.

The Beach Units¹

The beach units from North Africa and Tripoli landed about noon on 'D' Day and had established transit areas, etc., before nightfall. The first Air Force consignment from Sicily did not land until shortly before midnight and consisted of 10 L.C.T.s provided by the 15th Army Group in replacement for those which the U.S. Navy had allocated for this purpose but diverted elsewhere.

The completion of the original 'D' Day programme was not reached until 12 September, and on the following day the D plus 1 and D plus 3 personnel arrived, but then the craft were again diverted by the U.S. Navy, on their own initiative, and no further Air Force units were embarked for seven days. Subsequently the ferry programme ran smoothly. On no occasion were the craft diverted by the Fifth Army and their readiness to help the air forces in every way possible was most apparent throughout. The successive arrivals at the beaches were dealt with expeditiously and reached their destinations without incident, with the exception of a few units or detachments who ignored their instructions to report to the transit area and tried to proceed to their locations direct. As a result, some followed roads which were dead ends owing to blown bridges whilst others were only stopped at the last moment from driving into the enemy lines. In both cases they added unnecessarily to the congestion of traffic on the roads.

The total number of personnel and vehicles handled by the northern beaches from 'D' Day to D plus 14 amounted to 136 units, comprising 7,164 men and 1,290 vehicles. The organisation may be said to have functioned smoothly as in every case the airfields were adequately stocked and the ancillary units in position by the time the military situation permitted their use. This enabled the aircraft to be called forward without delay.

¹ A.H.B./II J1/139/43. Report by Wing Commander R. D. George.

Mechanical Transport during the Initial Stages of Operation Avalanche

For the first time in a landing it can be said that the air forces had sufficient transportation for their essential needs. On the American beaches an Air Corps Q.M. Truck Company Detachment was to have covered the requirement, but as they were landed over the British beaches and could not reach their areas until D plus 5, they served to reduce the burden which would otherwise have been carried by the British Division. In the British area the Army moved the P.O.L. and ammunition to the dumps satisfactorily, and the servicing commandos with help from the Americans were able to provide sufficient transport to collect supplies from the dumps and stock the airfields as they became available. By the time the new airfields were prepared and bombs were required a complete company or supply and transport column was necessary.

The Servicing Commandos¹

On completion of the Sicilian campaign the commandos were re-formed for use in Italy. No. 3232 Servicing Commando Unit landed in the Reggio area from Sicily with the first assault on 3 September 1943.² A week later half the unit was moved to Vibo Valentia airfield which had been captured by the second wave of the assault, north of Reggio. The remainder of the unit moved up on 19 September. No. 3231 Servicing Commando Unit embarked at Catania on 15 September and landed the next day near Taranto to take over Grottaglie airfield which had been occupied by the First Airborne Division. It encountered negligible enemy interference. On 25 September it was relieved by No. 3230 S.C.U., and moved north to Gioia in support of No. 239 Wing. Nos. 3202 and 3203 S.C.U.s which had been held in reserve during the Sicilian operations, landed in the beachhead at Salerno on 10 September, followed by No. 3226 Commando on 11 September. No. 3226 came in for the first enemy night air attack; detachments took up positions to defend their landing strip against an expected enemy attack which did not, however, materialise. Dumping was carried out with shells passing overhead in both directions.

On 12 September the first fighters came in, followed by some Fleet Air Arm Seafires. On 16 September three squadrons of Spitfires arrived. No. 3202 S.C.U. was moved from Monte Corvino airfield to undertake the inspection work. By 24 September sufficient squadron ground staff had arrived to take over all servicing and the commando units turned to repair and salvage unit work. After the first week following the initial landings the units had difficulty in finding sufficient employment and it seems that much congestion could have been avoided by withholding the squadron personnel for a further few days, as the S.C.U.s were well able to provide all the service necessary.

On 26 September Nos. 3230 and 3232 S.C.U.s joined forces to form the Desert Air Force Reserve Pool, which was established at Lecce in the extreme south east of Italy.

The Officer Commanding No. 3230 S.C.U. assumed command of the combined units. The accumulation of aircraft at Lecce, which was not well provided with

¹ Unit O.R.B.s.

² Operation Baytown.

dispersal facilities, soon assumed dangerous proportions and by 8 October nearly 300 aircraft of the R.A.F. and U.S.A.A.F. were on the airfield. It was accordingly decided to transfer the reserve aircraft pool to Bari, to which aerodrome No. 3232 S.C.U. moved on 1 November. Another Servicing Commando Unit, No. 3201, was already established at Bari, having arrived on 9 October to service aircraft of the Tactical Air Force Communication Flight. Control of the pool was assumed by No. 3232 S.C.U. assisted by No. 3201, until the arrival of No. 117 Maintenance Unit from North Africa in the latter half of November. No. 3230 S.C.U. was left to clear up the aircraft remaining at Lecce and in this work it was assisted by No. 3204 S.C.U., which was the last servicing commando unit to leave Sicily, arriving on 8 November.

Although in the initial stages of these operations, Nos. 3230, 3231 and 3232 S.C.U.s were under the administrative control of Headquarters, Middle East, they were brought completely under the control of Northwest African Air Forces on 1 October 1943, along with the Desert Air Force Headquarters and other units detailed in Middle East Air Order No. 953. The Desert Air Force and units operating with it had, of course, been under the operational control of N.W.A.A.F. since the commencement of the campaign in Tunisia.¹

Following the link-up with the Salerno beachhead the position rapidly became stabilised. No. 113 Maintenance Unit was formed at Naples at the end of October and to it were attached Nos. 3202, 3203 and 3226 S.C.U.s. No. 3202 moved to Gioia on 30 October, however, and was employed there until 14 December, assisting various units in transporting stores and helping with the servicing of No. 322 Wing aircraft. On this date the unit moved, on instructions from H.Q., Desert Air Force, to Foggia to assist No. 109 Repair and Salvage Unit, but found on arrival that it was not expected and its services not required. On this occasion No. 3202 S.C.U. passed its time as best it could for the ensuing five weeks, returning to Naples on 20 January for disbandment along with Nos. 3203 and 3226 S.C.U.s.

There was no further work for Nos. 3230 and 3204 S.C.U.s after they had cleared up the aircraft left by the sub-Reserve Pool at Lecce. No. 3204 was disbanded on 20 January, also No. 3232 which had been operating with No. 117 M.U. at Bari. No. 3230 S.C.U. was withdrawn, together with No. 3231 S.C.U., at the end of December. The latter unit had done valuable work, at first operating forward landing grounds with No. 239 Wing and later in support of No. 51 Repair and Salvage Unit at Foggia. These two units were sent back to the Middle East and subsequently absorbed into that Command.²

The one remaining unit, No. 3201, which had been servicing the communications aircraft and assisting No. 117 M.U. at Bari, was moved to Corsica in early January 1944, reaching Bastia on the 11th. During the following nine months it serviced a wide variety of aircraft of the various Allied air forces, and, though not used for the initial assault, was landed in southern France on 1 September 1944. It was not destined to follow up the advance, however, and after a month at Marignane its long career came to an end; it was withdrawn to Italy and disbanded in October 1944.

¹ M.E. File S.58177.

² M.E. File MS. 58851.

The one unit which was not employed in Sicily or Italy was No. 3225 S.C.U. Much discontent was caused by the policy of Middle East Headquarters whereby this unit was robbed of a considerable proportion of its personnel to make up the strength of the units formed in the Middle East. There is little doubt, however, that the policy was wise, as the incorporation of men who had been through a very thorough training at home and were full of keenness to do an active job must have had a beneficial effect on the units recruited from personnel, who, though they may have been full of enthusiasm, had nevertheless served some time overseas already, largely in base maintenance units. No. 3225 S.C.U. retained its identity, was reinforced and continued its training. It was ready to move at short notice if required and was able to lend valuable assistance to various units in the Middle East before it was disbanded along with Nos. 3230 and 3231 S.C.U.s on 1 February 1944.¹

The movements of the units which have been detailed above cover the principal moves of the unit headquarters. Additionally there were innumerable occasions on which detachments of varying size were sent out to service squadrons on adjacent airfields, to assist other units or to salvage crashed aircraft. One notable instance was the attachment of a section from No. 3201 S.C.U. to No. 600 Squadron. This section served the squadron in Sicily and moved with it to Salerno on 1 October 1943.

Squadron Maintenance²

Following the link-up with the Salerno beachhead the position rapidly became established. As our advance in Italy continued the squadrons of the Tactical Air Force—first the fighter and fighter-bombers and then the light bombers—moved on to captured Italian airfields as soon as they were serviceable or operated from newly constructed airstrips, so that contact was kept with the withdrawing enemy forces. Squadron ground personnel and equipment were moved forward to the new airfields by means of air transport.

As at the 25 September there were two R.A.F. Spitfire wings, one U.S. Spitfire group, two U.S. A.36 groups and one U.S. Warhawk group operating from landing grounds in the Fifth Army's sector, and one R.A.F. Baltimore wing and one U.S. Boston group, two R.A.F. and S.A.A.F. Spitfire wings, two U.S. Warhawk groups, and one wing of R.A.F., S.A.A.F. and R.A.A.F. Kittyhawks operating from areas under the Eighth Army's control. In addition, R.A.F., U.S. and S.A.A.F. reconnaissance squadrons were disposed at various points in the two areas in order to extend their range of observation.

As the vanguard of fighters and fighter-bombers moved northwards accommodation soon became available for the remaining squadrons of the Tactical Air Force and behind them the squadrons of the Coastal and Strategic Air Forces.

The squadrons were flying upon an accumulated capital of squadron serviceability and reserve aircraft. This expenditure could be prolonged but not halted by the efforts of the A.S.P.s and R. and S.U.s—sooner or later squadron

¹ M.E. File S.58925.

² Squadrons' O.R.B.s.

serviceability would begin to fall off sharply. Before this point was reached it was essential to restore the balance by the establishment of a base maintenance organisation in Italy.

The general serviceability of the squadrons throughout the campaign was maintained at a consistently high level, despite the fact that airfields in the winter were turned into quagmires by the prolonged and heavy rains, whilst in the summer the sun turned them into dust bowls and made the aircraft too hot to touch. Practically all the airfields had had their hangar accommodation destroyed and all servicing had therefore to be done in the open air as there were no inspection tents. Consequently, in bad weather many man-hours were lost due to this lack of accommodation.¹

Normally a wing of four or five squadrons was backed by a repair and salvage unit or wing servicing section and so long as the squadrons remained with the wing the workshop facilities were adequate. There were, however, occasions when operational necessity isolated squadrons from their R. and S.U.s for considerable periods. The difficulty was partly overcome by throwing off detachments from the R. and S.U.s but there was no provision for proper workshop facilities. Quite a number of squadrons had therefore to design and build their own workshop trailers from requisitioned or scrap materials. Generally speaking, the efficiency of squadrons was in direct proportion to their ability to improvise.

Air Stores Parks²

The advanced parties of Nos. 135 and 136 Air Stores Parks landed over the beaches at Salerno on 12 September and 2 October 1943 respectively. They soon established themselves and commenced issues almost immediately. They were quickly reinforced by their main parties, and although during the following months they had many changes of location they continued throughout to supply the needs of the various wings. Supplies came in by sea and air from the Middle East and by February 1944 the stock position was good.

The propeller assembly sections worked particularly well and special stands were manufactured and fitted to lorries so that a stock of assembled propellers was always available for immediate issue. The cleaning of sparking plugs, a vital and heavy commitment, had in the past been carried out by the A.S.P.s, R. and S.U.s and even the squadrons themselves. This had inevitably led to a certain amount of confusion and it was therefore finally decided to make the R. and S.U.s responsible for this work.

As the campaign progressed the A.S.P.s continued to receive supplies direct from the Middle East, although gradually these were supplemented from the newly formed base group. Items for repair had been building up and restricting the mobility of the A.S.P.s; these could now be returned to base. The major supply units were established; the air stores parks had bridged the gap. They could now give their whole attention to close squadron support.

At the beginning of June 1944 the following A.S.P.s were established in Italy to serve the squadrons and ancillary units in the Commands indicated :—

¹ Report 2 by S.E.S.O. A.H.B./II J1/93.

² Air Stores Parks' O.R.B.s.

<i>Unit</i>	<i>Location</i>	<i>Command</i>
No. 31 A.S.P.	Marino/Marcianise	D.A.F.
No. 36 A.S.P.	Capua/Cassino Road	D.A.F.
No. 37 A.S.P.	Cerignola	No. 205 Group
No. 40 A.S.P.	Petacciato	D.A.F.
No. 136 A.S.P.	Foggia	No. 242 Group

Repair and Salvage Units¹

Repair and salvage units landed at Salerno, Brindisi and Taranto during October 1943. They were soon established on airfields in these localities and commenced work almost immediately.

No. 113 R. and S.U. was situated at Capodichino airfield, near Naples, where the hangar facilities and workshops enabled them to increase the scope of repairs to damaged aircraft and made them independent of the weather. The arrival of the advance parties of the base organisation (No. 113 M.U.), with their overriding claims for covered accommodation, resulted in the loss of these facilities. With the approach of the Italian winter in mind it was suggested that a portable type of hangar and workshop should be provided for all R. and S.U.s.

When the base organisation had been set up the original R. and S.U.s were switched on to the liberation of southern France. Their commitments were either taken over by replacement units or by newly created repair and salvage sections which were attached to the maintenance units of No. 214 Group.

The R. and S.U. system had proved most satisfactory in providing workshop backing for squadrons in the forward areas and as a means of salvage and transportation of crashed aircraft back to the base maintenance units.

The Mechanical Transport Light Repair Units (M.T.L.R.U.s)

No movement date had been specified in the administrative plans for the M.T.L.R.U.s. However, No. 3 M.T.L.R.U. crossed the Messina Strait into the Toe of Italy on 20 September 1943, and by 6 October had found its way up into the Naples area. The repair arisings of this unit are typical and show the measure of support which these units rendered during the critical early stages of the campaign.² The vehicles received for repair were fed in due course into a serviceable pool from which issues were made. Those vehicles with repairs beyond unit capacity were returned to base. In addition hundreds of miscellaneous repairs were carried out by mobile detachments as well as by the main party. M.T. engines and battery-charging sets were repaired and overhauled for the various formations to whom also issues were made from an equipment section. Components, when salvaged, were repaired whenever possible and used to swell the equipment stocks. -

¹ O.R.B.s. of Nos. 108, 109 and 113 R. and S.U.s. A.H.B./II J1/91.

² Month	Received for Repair	Rendered Serviceable	Serviceable Pool	Vehicles Issued	Returned to Base
Sept. 1943	171	158	—	—	9
Oct. " " " " ..	206	176	189	159	—
Nov. " " " " ..	292	216	169	166	33
Dec. " " " " ..	400	234	176	254	45
Jan. 1944 " " " " ..	283	204	20	61	250
Feb. " " " " " " ..	105	181	9	23	6

M.T. Companies and Supply and Transport Columns

Several mobile supply and transport columns were operating in Italy serving the fighter and light bomber wings under M.A.T.A.F. They supplied explosives and aviation P.O.L. from the air ammunition parks to advanced dumps and airstrips. They assisted in the move of squadrons and in the event of a withdrawal they were responsible for the clearance from the airstrip of fuel and explosives.

The mechanical transport companies were static base heavy-duty units. One of these was assigned to No. 216 Group for work in Italy.

Build-up of the Base Maintenance Organisation in Italy

After the consolidation of the Naples area arrangements were made to move *en bloc* the maintenance units of No. 214 Group from Tripoli, and, although they had to be transported piecemeal in L.S.T.s and an Italian cruiser, the move was successfully accomplished by the end of November 1943. Aircraft repair units were established at Brindisi, Gioia and Capodichino, whilst a large maintenance unit was formed at Castellammare, near Naples. An equipment depot (No. 114 M.U.) moved into the San Rocco caves, and the main dump of explosives was formed in the Taranto area. Subsequently it became necessary to hand Gioia over to the U.S.A.A.F. for use by operational squadrons, but the personnel and equipment of the repair unit (No. 159 M.U.) were transferred to Brindisi and later to Naples, where they continued to maintain a high output. An aircraft repair section of No. 113 Maintenance Unit which was at Brindisi was absorbed into No. 110 Maintenance Unit on its formation there in December 1943. The aircraft storage units at Oujda and Sétif were amalgamated and re-formed at Blida as soon as the necessity for dispersal against possible air attack had disappeared. However, another aircraft storage unit was necessary nearer to the front line and No. 117 Maintenance Unit, which had moved progressively from Port Sudan up to near Tripoli, was therefore shipped partly to Catania in Sicily and partly to Bari. This unit at Bari then formed the final link in the chain for reinforcing aircraft.

If all had gone according to plan the base organisation should have moved into Italy and thoroughly established itself before being called upon to undertake any technical work. However, in the event there was some delay due to demolitions at Naples and the uncertainty of the military situation. Consequently, units whose eventual location was the Naples area were forced to seek accommodation at Brindisi and elsewhere. In many cases they had to start functioning as units before they could complete the reconditioning of buildings, plant and services, thereby causing a dilution of effort. All this was again repeated when they moved to their final destinations. The delay also meant that the mobile forward units such as air stores parks, etc., continued to find themselves burdened with work which under more favourable circumstances would have been undertaken by the base organisation.

Despite the early delays and difficulties the spring of 1944 found the principal units of No. 214 Group fairly well established in Italy and making strenuous efforts to satisfy current requirements and catch up with the arrears of work.¹

¹ Unit O.R.B.s and A.H.B. Narrative, *The Italian Campaign*.

The eventual success of the maintenance organisation may be measured by the degree of air support which the Allied air forces were able to maintain throughout the campaign.¹

The formation of the Mediterranean Allied Air Force (M.A.A.F.), on 1 January 1944, resulted in some reorganisation in the repair organisation for engines, airframes and propellers, both for M.A.A.F. and the Middle East in April 1944.²

Base Supply³

Both the North West African and Italian campaigns were unique in that they were the first two occasions in the history of the R.A.F. when large striking forces were supported from main supply bases sited in occupied or captured territory, bases formed simultaneously with the opening of operations.

The base equipment units were called upon to supply to the striking forces all equipment and materials other than rations, petrol and oil fuel, explosives, ammunition and complete aircraft.

No. 351 Maintenance Unit at Algiers was intended to supply the needs of the R.A.F. in North West Africa from within a few days of the initial landings. No. 114 Maintenance Unit was transferred from Tripoli to Naples as soon as the Naples docks were functioning so as to supply the R.A.F. in the Italian campaign.

On 1 December 1943 No. 114 M.U. moved into the San Rocco caves at Naples. All available domestic accommodation had already been taken and consequently they had to make do with one of the daylight caves and tents. Alfa-Romeo had been using the caves as a temporary engine workshop but their elaborate air conditioning plant, lighting and other machinery had been blown up by the Germans. The maintenance unit, with some 200 airmen, was faced with the task of establishing an equipment unit which would be capable of supplying a force developing from 50,000 to 70,000 personnel. The caves were wrecked, the physical conditions were bad and the equipment for Italy was pouring in from the docks. As works services were practically unobtainable a unit section had to be formed and work commenced on providing amenities and clearing the covered storage, for which there was a minimum requirement of 500,000 square feet.* The area eventually cleared totalled only 250,000 square feet, the balance was made up by moving three-quarters of the stock holdings onto new sites which were inconveniently dispersed and difficult to administer. This task had to be done at the same time as the receipt, recording and issuing of supplies for a hotly engaged striking force. The deficiency in man-power was partly made up by employing some 300 civilians, and subsequent increases brought the total number of personnel to 600 airmen and 1,600 civilians.

¹ Appendix 42 shows the principal repair and supply units controlled by the Director of Maintenance and Supply, Mediterranean Air Command, in November 1943.

² The statistical details during this period of the repair arisings and the number of personnel required to satisfy them will be found in the Combined Maintenance Appreciation for the R.A.F. in the Central and Western Mediterranean and Middle East. A.H.B./II J1/215/1. See Appendix 44 for location of units of No. 214 Group on 9 June 1944.

³ No. 114 M.U., O.R.B.s and Report by Wg. Cdr. Scorgie, O.C., 114 M.U. A.H.B./II J1/91.

⁴ The original estimate had been for 150,000 square feet of covered storage and 300,000 square feet of open-air storage.

The unit struggled from December 1943 to give the air stores parks and other units the supplies they needed, but it was not until the autumn of 1944 that this was being done with any degree of smoothness. The operations were maintained largely by a system of priority demanding through which urgently needed items were flown in from Algiers, Middle East or the United Kingdom. As the priority could not be used until the need was already urgent or the aircraft already grounded the scheme resulted in lost flying hours. Owing to shortages of shipping and various other delays it was not until late in the campaign that an initial build-up was achieved in Italy. The extent of the build-up required may be seen by the fact that in order to meet immediately on demand 60 to 75 per cent of the items demanded by a force of between 60,000 and 70,000, the unit's holding was in the region of 20,000 dead weight tons of equipment with a monthly flow in and out of between 6,000 and 8,000 dead weight tons.

In war-time it is imperative that ships and docksides are emptied at once. With supplies arriving in convoys from overseas there was no even flow of receipts and the result was that on many occasions three or four separate quays, with a loading strength of over 500 men and 100 vehicles, were pumping stores into the maintenance unit which had an off-loading strength of less than 100 men. The unpacking and checking rate was very much slower than the rate of receipt. The result was the backstacking of colossal piles of cases containing equipment urgently needed by the units, and for which the maintenance units' provisioning section was at the same time sending 'immediate' signals to Air Ministry. The restrictions of space added considerably to the difficulties of 'turn-round' and the unit was constantly assailed with complaints at the delay in clearing vehicles back to the docks. The maintenance unit was handicapped from the start by the shortage of handling machinery which ranged from 5-ton cranes to nail pullers, from fork lift trucks to gravity rollers.

Aircraft Repair, Modification and Erection

In October 1943 the aircraft repair section (A.R.S.) of No. 113 Maintenance Unit had started to move into Italy and was located at Brindisi. By December the whole of A.R.S. had moved to Brindisi, with the exception of a small rear party which was doing clearing-up work at Castel Benito, Tripolitania.

On 29 December the aircraft repair section of No. 113 Maintenance Unit *in toto* was renamed No. 110 Maintenance Unit. The function of the new unit was the repair, erection and rebuilding of all types of aircraft, and the repair and servicing of accessories and ancillaries up to the standard necessary for major inspections of aircraft.

Facilities had already been taken over by the now absorbed A.R.S. and consisted of a seaplane base and a share in an airfield. Work was put in hand immediately to bring all the buildings up to the required standard and a road suitable for towing aircraft was constructed from the airfield to the seaplane base. Aircraft flown in to the airfield could then be towed along the road to the base, and when completed returned to the airfield for test and despatch. Spares began to arrive in January 1944 and the unit was able to commence production.

The unit was made responsible for the supervision of the work of the Italian S.A.C.A. factory in Brindisi which was operating with civilian labour. This

factory was subsequently fully requisitioned in June 1944 and put under the control of an officer appointed by No. 214 Group on behalf of the Royal Navy and R.A.F. Any work to be done there for the Italian Navy or Air Force was then referred to the R.N. and R.A.F. for permission and priority.

During the period January to July 1944 the unit's heaviest commitment was Spitfire aircraft. The consolidated figures for all types of aircraft during these months were as follows :—

<i>Month</i>		<i>Aircraft Input</i>	<i>Aircraft Output</i>
January 1944..	..	69	34
February „ ..	..	86	38
March „ ..	..	163	55
April „ ..	..	110	83
May „ ..	..	120	102
June „ ..	..	188	96
July „ ..	..	184	101

No. 159 Maintenance Unit

A small advance party of No. 159 Maintenance Unit had arrived at Brindisi as early as the end of October and had made fairly extensive preparations for the siting of the unit, but on 10 November they were ordered to move to a new location at Gioia. The technical accommodation at Gioia consisted of three large hangars, two large workshops, together with domestic buildings, but as these were almost entirely occupied by the Italian Air Force and No. 2 Repair and Salvage Unit they had to be accommodated at Brindisi. Four days later a small dispersed camp was taken over and the whole of the advance party then moved to Gioia.

Both 'fly-in' and 'haul-in' aircraft began to arrive at the Gioia location and by the end of the month 23 aircraft were held. Eleven major airframe repairs, five minor repairs and engine changes were carried out during November.

A hangar and a machine shop were occupied during the first week of December, and shortly afterwards tools and equipment began to arrive. The main party arrived on 8 December and a large school in the town capable of housing 500 men was taken over. This released further airfield buildings for use as workshops, but the dispersed nature of these made things difficult, especially as there was a shortage of unit transport. These difficulties were being overcome when the unit received instructions to move on again to Brindisi to make room for the U.S.A.A.F. at Gioia. This meant dismantling, repacking and crating all workshop equipment and stores.

As most of the buildings at Brindisi were occupied by units already located there the accommodation of No. 159 Maintenance Unit was restricted to one civil seaplane shed, two hangars on the waterfront and one on the airfield. The wide dispersal of workshops, hangars and living sites again entailed many disadvantages. An advance party moved in to prepare the buildings and to receive aircraft on 21 December.

The move of the unit to Brindisi was commenced at the end of the month and was completed by 10 January 1944. The clearance of Italians from hangars and workshops enabled repairs and improvements to be put in hand. A start was also made in laying out the various sections of the unit.

The change over to the new policy of repairing twin-engined American aircraft began in January and by the end of the month a total of 9 Bostons, 4 Baltimores and one Marauder was held. A new twin-engined flight was formed and work commenced.

All the Bostons were very long term repair jobs and, in view of the probable move of the unit to the Naples area in March, work on this type was restricted to servicing the equipment removed from the aircraft so as to provide a nucleus of spares for aircraft which might be flown in for repair. A start was also made on a commitment of modifying 150 Kittyhawk IV aircraft, a new section was formed and four aircraft were completed by the end of January.

Personnel deficiencies in establishment were made good by the recruitment of civilian labour. The policy aimed at was to man the stripping and workshop sections with civilian labour, thereby releasing Service personnel for duty on the airfield and in the new twin-engined flight. Some civilians proved to be excellent skilled workmen. The local Italian transport services were inadequate and great difficulty was experienced in getting these civilians to the unit from outlying towns and villages.

During February the unit started to settle down in its new location and production began to increase. The output for March was 44 aircraft repaired or modified. The month of April was largely spent in preparing for the move of the unit to Naples (Capodichino), this being completed by 7 May. At the new site all available personnel were concentrated on clearing debris from the hangars, workshops and offices and preparing them for occupation. Materials for this had to be obtained locally and carefully hoarded for several weeks. The technical layout was considered to be very good and a vast improvement on anything the unit had previously occupied. Production for April, despite the unit move, was some 56 aircraft.

Early in May all the workshop sections were reorganised under a central control, a start was made on the organisation of a safety equipment section, whilst the stripping section was enlarged and renamed the salvage section in order to cover the new unit commitment for salvage in areas lacking repair and salvage facilities. The latter section was also made responsible for the receipt, storage and despatch of all salvage arisings.

Following the opening of the offensive by the Fifth and Eighth Armies towards the end of May an appeal was received for maximum output, working hours were increased and the tempo stepped up to meet the demand. The unit was beginning to play its full part in the work of the base organisation.

Aero-Engines, Instruments and Mechanical Transport Repair¹

In Naples, and at Castellammare, close by, there were considerable workshop facilities which had been found comparatively undamaged. These were

¹ No. 113 M.U., O.R.B.

occupied at the end of October 1943 by No. 113 Maintenance Unit who rapidly commenced to put them into working order. Buildings were repaired, services restored and improved and additional machinery obtained and installed. By the end of January 1944 the first few overhauled engines were being bench tested—the unit was beginning to function. Progress after this was rapid: a summary of the unit's work for August 1944 reads as follows:—

Engine Test and Despatch. A total of 172 engines was tested during the month and work had been commenced on the conversion of the last Cyclone test bench for use with Merlin engines. With the additional personnel recently posted in it was hoped that this section would now be able to handle the increased output of engines.

Hercules Engine Repair. In spite of a hold up at the start of the month due to lack of carborundum for grinding purposes, a total of 50 engines passed bench tests. This was nearly double the previous month's best output, and the number of failures under test was only eight. The shop lighting was improved to enable additional night shifts to be worked in the erection bay.

Merlin Engine Repair. The experimental fitting of Packard cylinder blocks to Merlin 45 engines gave rise to many difficulties which were only overcome after considerable time had been wasted. In view of this a record output of 81 engines was very creditable, especially as work was still being hampered by lack of spares. The position improved slightly towards the end of the month.

Equipment Section. Large stocks of metals and other materials were obtained from various local sources and it was expected that even larger stocks would soon be available. A new spares hastening procedure was introduced causing a great improvement in the flow of supplies, aero-engine spares being flown direct to the unit.

Electrical and Instruments. The dilution of labour in this section was further increased by the employment of more civilian women and boys from whom good results were obtained. Most of the equipment was now available for the overhaul of Mk. 14 and T.I bombsights. The overhaul of Sperry instruments was now well under way and the output of gyro instruments had greatly increased.

Armoury. Work was proceeding well on the packing of surplus repairable and serviceable equipment for despatch to the U.K. A new perspex moulding section was now well established and had produced a quantity of useful work.

General Engineering Shop. Several important jobs had been held up during the month due to lack of materials but the position eased towards the end of the month. The number of orders placed was higher than ever before but the shops were able to keep pace with them. An increase in personnel strength in most trades enabled a large amount of sorting out to be done between shops with the result that shortages diminished.

Mechanical Transport Repair. A major alteration in this section was made during the month with the introduction of a 'Line Production' system. This meant that for a short period there was no output but the first vehicles were

approaching the inspection stage and it was expected that the scheme would very soon show a great improvement both in quality and quantity. The vehicle erection section was moved to a new site and the construction of additional lifting tackle put in hand. The buildings vacated by the section were taken over by the various bays of the major overhaul section.

Camp Maintenance. A new maintenance section was by now fully established and was catching up very well with a backlog of work.

By the following month supplies of most spares and materials had reached an excellent level and most sections achieved a record output.

Aircraft Storage and Issue¹

The need for an aircraft storage unit closer to the scene of operations was met by moving into Italy No. 117 Maintenance Unit, with a detachment at Catania, Sicily. On 14 November 1943, the entire personnel of the unit, together with their equipment and mechanical transport, were embarked at Tripoli. They reached Taranto on 18 November and were temporarily accommodated at Brindisi. By the end of the month they were established at Bari in tents.

The first aircraft received for servicing arrived on 10 December and by the end of the month some 126 Spitfires, Kittyhawks and Hurricanes of various Marks had been received, there had been 81 aircraft despatched whilst 45 were held in stock. Many of these aircraft were, however, in poor condition and had to be returned to Nos. 159 and 113 Maintenance Units for rectification. The receipt of aircraft during January was spasmodic and the number held in the pool was much below the establishment. Aircraft therefore had to be sent forward to the squadrons after only a thorough inspection and clean, although every effort was made to incorporate outstanding modifications despite the lack of facilities. The pool had risen at the end of the month to 77 aircraft with 224 received and 194 despatched.

Nos. 3201, 3204 and 3232 Servicing Commando Units were assigned to the control of No. 117 Maintenance Unit on 23 December. All but No. 3201 S.C.U. were disbanded in January and the majority of their personnel sent to the transit camp at Taranto.

During February the demand for certain types of aircraft exceeded the receipts and a rapid turn-round of such aircraft had to be maintained, whilst overstocking in the pool of other types caused extra work in constant servicing. Gales and heavy storms on several days prevented any normal work at all, all personnel being fully employed attending to the safety of the aircraft. A certain amount of reorganisation occurred when it was decided that the detachment at Catania should be absorbed by No. 118 Maintenance Unit. The aircraft pool holdings at Bari and Catania being fixed at 60 and 88 aircraft respectively. The bad weather continued throughout March and caused many delays and much extra work, but the output for April was 235 aircraft despatched despite the continuation of many of the earlier difficulties.

The formation of an aircraft storage unit under the Desert Air Force was approved in June 1944 and No. 117 Maintenance Unit was disbanded and half

¹ No. 117 M.U., O.R.B.s.

the personnel posted to the new unit which was subsequently transferred to No. 218 Group, Sardinia, for the liberation of southern France during June and July 1944.

Explosives, Petrol, Oil and Lubricants¹

No. 141 Maintenance Unit was responsible for petrol, oil and lubricants (P.O.L.) and explosives. It moved into Italy via Taranto at the beginning of November 1943 and by the end of the month had established a unit headquarters at Caserta, 17 miles north of Naples. There were three explosives parks, one at Caserta, one at Montiasi, 10 miles from Taranto, and one situated at San Nicandio, 10 miles west of Bari. Their capacities were 5,000, 6,000 and 10,000 tons respectively.

The receipt and issue of explosives from the parks commenced almost immediately. No difficulties appear to have been recorded apart from the bad condition of the ground for open-air storage.

The unloading of R.A.F. explosives at Taranto was discontinued in January and the park at Montiasi was closed.

¹ No. 214 Group and No. 141 M.U., O.R.B.s.

Part VII
THE LIBERATION OF
NORTH WEST EUROPE

CHAPTER 19

THE R.A.F. MAINTENANCE PLAN FOR OPERATION OVERLORD

Main Features of the A.E.A.F. (R.A.F.) Administrative Plan and the Joint Maintenance Project¹

The distinctive feature of Operation Overlord, as far as administrative planning was concerned, was that the main base for the operation was to be in the United Kingdom. This fact was one of the chief formative influences in the shaping of the administrative organisation. The other very significant factor was the extreme mobility that it was expected would characterise the early stages of the operation. It was, moreover, inevitable that during these early stages the amount of shipping space available for supplies, and for non-operational personnel, would be severely limited. This circumstance precluded the possibility of establishing the Base Group on the Continent during the assault phase, and made it necessary to devise a system of supply and maintenance which would enable units in the field to carry on satisfactorily until such time as the permanent base administrative organisation arrived. Accordingly, to tide over this vital period, special arrangements had to be made, and a number of units were formed whose functions would cease when the base administrative units took over. The way in which this temporary system worked will be outlined in due course, but a characteristic example that may be noted in passing is that of the beach squadrons and sections. The need for these units was occasioned by the fact that the maintenance of the British forces in Overlord would probably continue over the beaches until after D plus 30. The anticipated opening of the first major port by D plus 17 would make little difference to the position, as the bulk of its capacity was to be allocated to the Americans. It was therefore important that arrangements be made to ensure the proper handling, unloading, storage, entraining, etc., of R.A.F. equipment and supplies which arrived via the beaches, and a beach organisation was accordingly formed to carry out this work until the opening of the British 'Mulberry' or artificial port, and the capture of other existing ports, diverted the bulk of the traffic to more normal channels. Other units with a purely temporary function were formed to carry out 'running repairs' to aircraft and M.T., until the permanent replacement and repair system could come into operation. In fact the conditions prevailing during the period from the launching of the assault until a firm foothold had been secured on the Continent were such as to require quite different systems of supply and maintenance from those which were to be employed in the later phases of the operation.

The immediate and overriding task of the R.A.F. administrative organisation in the days following the initial assault on the beaches was, to put it simply, to maintain in fighting condition as many aircraft as the operational plan required, and to ensure that no hitch occurred through a breakdown in the chain of supply and maintenance. The actual construction of airfields was mainly an Army responsibility, since the Royal Engineers were better equipped

¹ Review of Admin. Problems, Pt. III.

than anyone else to do the job, but the Royal Air Force had to undertake practically all other services necessary to administer the finished product, in addition to the assistance in construction rendered by the airfield construction wings, of which more will be said later. The rate at which advanced landing grounds, refuelling and rearming strips and complete airfields could be completed naturally determined the rate at which supplies of aviation P.O.L., ammunition, aircraft spares, etc., would have to be phased in. It was accordingly necessary to estimate as closely as possible the rate of construction which could reasonably be assumed. In view of the pre-eminent need for air superiority at an early date, it was, moreover, desirable to plan administratively for a higher rate of construction than could be foreseen before the assault took place, so that any unexpected advantages would not be wasted. The R.A.F. Administrative Plan envisaged a development up to D plus 40 as indicated below.

<i>Date</i>	<i>British Sector</i>
'D' Day	1 Emergency Landing Strip.
D plus 3-4	2 Refuelling and Rearming Strips.
D plus 8	5 Advanced Landing Grounds.
D plus 14	10 Airfields.
D plus 24	15 Airfields.
D plus 40	25 Airfields.

The Functions of the Base Group

In the initial stages of the assault all responsibility for R.A.F. administration was to be vested in A.O.C., 2nd T.A.F., until such time as T.A.F. units vacated the base area (i.e. by D plus 30-40) and units of No. 85 (Base) Group moved in to take over the administration of the rear. 2nd T.A.F. was built up of two Composite Groups (Nos. 83 and 84), No. 2 Light Bomber Group and No. 34 Recce Wing. Attached to the composite groups were various mobile aircraft and M.T. and signals maintenance units, which were to become a part of the R.A.F. forward maintenance organisation. These units, whose functions and scope will be described later, carried the full weight of maintenance and servicing during the difficult 'emergency' period before the long-term organisation could become operative. The gradual build-up on the Continent of the base group units was the task of A.O.C., 2nd T.A.F., who was further responsible for controlling such of these units as landed very early in the assault phase. The first part of No. 85 Group to go across was not the administrative element, but the Static Fighter Defence organisation for the protection of the base area. This group was gradually expanded as the administrative units went over during the build-up phase until it was eventually administering the whole base. No. 85 Group thus had two roles, an operational one and an administrative one, but its primary functions were of an administrative nature. Its essential purpose was in fact to serve as the permanent administrative base for the operations of the R.A.F. Component of A.E.A.F. As, therefore, its importance in the administrative history of the air forces in Overlord is very great, a brief account of its main tasks is apposite. In addition to his responsibility for the Command and administration of all units assigned to the Group, A.O.C., No. 85 Group, had also to carry out the local administration of other R.A.F. units operating in or passing through the base area, together with his responsibility for the administration and care of all R.A.F. detachments and personnel temporarily in the base and L. of C. area which were not under the

control of another H.Q. Regarding stocks of equipment, he was responsible for ensuring that these were kept at the levels laid down by H.Q., A.E.A.F. And in conjunction with the appropriate Army authorities, H.Q., A.E.A.F. and H.Q., 2nd T.A.F., he was to work out the plans for the move of the base group to the Continent. Finally, he had to represent the broad interests of the Royal Air Force and to co-ordinate with the commanders in the base and L. of C. the work of handling R.A.F. personnel and material from beach or port and along the L. of C. to delivery points.

The general control and development of the rear maintenance area was the responsibility of H.Q., 21st Army Group, in co-operation with Second Army and 2nd T.A.F. Store and supply depots in the base areas were to be controlled by the Army commanders and A.O.C., 2nd T.A.F., and R.A.F. requirements of stores were to be included in Second Army Bids.

There was to be only one R.A.F. base maintenance organisation, and it was to be capable of moving in echelons, in case the capture of further ports should make possible the shortening of the L. of C. as a whole. Where there was no R.A.F. base organisation near to a port, R.A.F. stores were to be handled by R.A.F. embarkation staff. Two R.A.F. embarkation units were authorised to form on 1 January 1944.¹ These were to be allotted to the first two British-operated ports to be opened. A third embarkation unit was to be formed to deal with R.A.F. stores passing through the British 'Mulberry,' and at one time it was proposed to have a similar unit operating at the American 'Mulberry.' It was later decided, however, that owing to a reduction in capacity of the American artificial port, there was no need for an R.A.F. embarkation unit there : this unit was accordingly cancelled on 29 June 1944.

Formation of No. 85 Group

The formation of a base maintenance group had been under consideration for many months before definite proposals for the creation of No. 85 Group were submitted to the Air Ministry. In December 1943, however, H.Q., A.E.A.F. put forward a scheme for the setting up of one base air defence wing, certain signals units, and a nucleus of the Air Staff for the Group H.Q.² On 8 January 1944 the H.Q. of No. 85 Group was authorised to form in full, and from that time on the various units which were to constitute the base group were gradually transferred to the new headquarters. Many of the base administrative units had already been formed, or were in process of formation, by January, but a vast amount of training lay ahead, and further units were still to be created. The principal types of administrative unit in No. 85 (Base) Group were the following :—³

- Forward Equipment Unit (F.E.U.)
- Forward Repair Unit (F.R.U.)
- Base Signals Unit (B.S.U.)
- Mobile Signals Servicing Unit (M.S.S.U.)
- Base Signals Centre (B.S.C.)
- Supply and Transport Column (S. & T. Column)
- Personnel Transit Centre (P.T.C.)
- Embarkation Unit

¹ File AEAFF/S.10065.

² File AEAFF/S.17030, Part I.

³ AEAFF Admin. Plan. Appendix 'D.'

Administration and Maintenance in the United Kingdom

Responsibility for the administration of all units of the R.A.F. Component, while based in the United Kingdom, rested with the respective commanders. All units of No. 85 Group which were to operate under 2nd T.A.F. in the early stages on the Continent were, however, to be transferred to the command of 2nd T.A.F. before leaving their tactical dispositions in the United Kingdom. The object of this decision was to facilitate administration generally, and in particular to avoid any duplication of orders relating to embarkation. It was hoped that all units of the air forces would have arrived at their tactical locations by 1 February 1944. There were, however, the following exceptions: first, those required to fulfil the Cover Plan, secondly, certain American units reaching the United Kingdom after that date, and lastly, units which would be operating towards 'D' Day from A.L.G.s, and would have to be accommodated on permanent aerodromes while the winter lasted. It was accordingly essential that the supply system from main depots to air stores parks and repair and salvage units should remain as flexible as possible.

Results of the Concentration of Tactical Air Forces in S. England

The concentration of the British and American tactical air forces in southern England was bound to have a marked effect on the existing organisation of Maintenance Command and U.S. Air Service Command in that area. One urgent requirement was the immediate formation of the R. and S.U.s and A.S.P.s wanted to complete Nos. 83 and 84 Composite Groups. Another important task was the selection of specific repair and equipment depots to serve each of the two T.A.F.s; this action involved the possibility of adjustments of stocks and equipment at the depots concerned, as they would have to continue to serve the units permanently in the United Kingdom which they had served hitherto, while giving priority to the maintenance of the A.E.A.F. units. Such depots would, moreover, have to be organised in a way that would permit them to throw off an advanced element for use on the Continent at a fairly early stage in the operation. Approval for the setting up of a nucleus of these advanced depots for the Royal Air Force had already been given before the end of 1943, but a great deal remained to be done. The problem of creating a supply system which would be fully efficient, and yet not impair the mobility of airfield H.Q.s, A.S.P.s, and R. and S.U.s, was one which required very special attention. Accordingly, a constant review was made of all the items consumed and held by units, in order that reasonably reliable establishment figures could be laid down for each type of maintenance unit. The information obtained in this way was used in determining the composition of the maintenance 'pack' for the A.S.P.s and for the advanced equipment depot.

Pre-Stocking of Airfields

Since many of the airfields to be used for Overlord were in what were to be the Army concentration and assembly areas, where roads would inevitably be congested from about D minus 15 until the end of the first stage of the transition to the Continent, it was necessary to arrange for these airfields to hold special stocks of equipment and supplies. This measure was known as the pre-stocking of airfields. Its aim was to ensure the efficient operation of units during the period of intensive air operations based in the United Kingdom,

and to make it possible at the conclusion of that period for units to cross to the Continent with their correct establishment of stores. By the method of pre-stocking these ends could be achieved without unwelcome demands on road space at a time when transport had to be cut to the minimum if dislocation was to be avoided.

Maintenance Problems during Squadron Moves¹

A rather more formidable problem for the maintenance organisation in the United Kingdom was that of providing service for squadrons after the airfield H.Q.s and supporting ancillary units had left for their Continental locations. It was estimated that about seven days would elapse between the packing up of the H.Q.s and the date when their squadrons would have arrived and be ready to operate from the new airfields overseas; and this at a time when the squadrons concerned were required to operate from the United Kingdom at a particularly intensive rate of effort. It was proposed to meet this situation by the setting up of a duplicate airfield and maintenance organisation, to function during the period of the move and while the airfields on the Continent were being prepared for the reception of the squadrons. The plan was to locate the squadrons temporarily at static stations, which would receive an adequate stock of maintenance requirements for the seven days or so that the transition involved. A number of vital personnel from each Airfield H.Q. would be retained, and the necessary balance drawn from the Static Station H.Q.s and from other sources. With regard to salvage, supplies, and repair and replacement of equipment, the assistance of Maintenance Command would be available.

Emergency Replacement Pools

Another problem of administration in the United Kingdom prior to and during the early phases of the assault, was to arrange for the provision of swift replacements for personnel, vehicle and equipment wastage occurring before the normal procedure for replacement could be fully operative—i.e. during the move to the marshalling areas, the actual embarkation and crossing, and the preliminary period of establishment on the Continent. To cope with this demand H.Q., A.E.A.F. was to arrange for the setting up of special reserve pools in southern England. One pool, containing personnel and vehicles, was to be established near the concentration area, and was to provide replacements for casualties arising during the move of units from their tactical locations to the marshalling areas. In addition, an emergency pool of vital personnel vehicles and equipment was to be set up in the vicinity of the R.A.F. marshalling areas to afford swift replacement of wastage occurring during embarkation, crossing, and the early build-up period.

The responsibility for carrying out the salvage and repair of aircraft and M.T. in the area to be vacated by 2nd T.A.F. and No. 85 Group was to be assigned to No. 43 Group, which would gradually take over control as the R. and S.U.s (Repair and Salvage Units) and M.T.L.R.U.s (M.T. Light Repair Units) belonging to 2nd T.A.F. began to move to their Continental locations.

¹ Review of Admin. Problems, Part I, Section 6, para. 28. AEAf Admin. Plan, Part III, paras. 62 and 63.

The Organisation and Control of Movement¹

One of the most complex aspects of the administration of the air forces in Overlord prior to the actual assault was the organisation and control of movement. As has been mentioned already, the effect of amassing in southern England the enormous forces required for the assault was likely to mean serious confusion on the roads leading to the embarkation points, unless a very rigid and detailed control of the movement of units was exercised. During the mounting of the operation the supreme authority for R.A.F. movement lay with the Director of Movements, Air Ministry, working with the D.Q.M.G., War Office, and the Chief of Transportation, ETOUSA. This central control was to be effective until units had embarked. During the development of the operation the procedure for movement was based on the provisions of a pamphlet prepared under the direction of the Q.M.G. and A.M.S.O. for issue to all units. The title of the paper was 'Overseas Movement—Instructions for Commanding Officers (Combined Operations—Short Sea Voyage).' In most cases the movement of R.A.F. units was arranged by R.A.F. Movement Control, but where no representatives of the latter were available, unit commanders took their orders from the Army movement authority.

The overall control of movement to the Continent during the initial build-up of the expeditionary forces, when a day-to-day supervision of the phasing in of units was essential, was vested in the Build-Up Control Organisation (BUCO). This body was composed of representatives of the Commanders-in-Chief of the Allied Naval Expeditionary Force, 21st Army Group, and A.E.A.F., and was located at Combined H.Q., Portsmouth. Its function was to control the build-up and to make bulk allocations of ships and craft to the various users, basing its decisions on the information supplied by Turn-Round Control Organisation (TURCO), the Naval body concerned with the turn-round of ships and craft. Once the build-up priorities had been decided by the representatives of the Force Commanders in BUCO, the task of preparing the actual movement programme embodying these policy decisions fell to Movement Control Organisation (MOVCO), a subordinate branch of the Build-Up Control Organisation, which then forwarded the programme to Movement Control, Southern Command. The latter were responsible for issuing the appropriate Movement Instructions to units regarding transfer to concentration areas and then to marshalling areas. Such instructions carried the authority of Force Commanders and could not be amended by C.O.s of units.

As BUCO was in control of the ground movement of all R.A.F. and U.S.A.A.F. units its machinery had considerable ramifications and utilised a large number of bodies, including a concentration area camp staffed by A.D.G.B., a replacement pool administered by H.Q., A.E.A.F., and a static movements staff responsible to the Air Ministry. One of the main tasks of the A.E.A.F. representative on BUCO was, of course, to secure adequate sea lift for the air forces. And from the Air Force point of view the BUCO procedure worked very well; as compared with the normal methods of controlling movement overseas—i.e. through the Admiralty and War Office—the BUCO organisation was capable of a much swifter response to the unpredictable requirements which air warfare is liable to involve.

¹ AEAFF Admin. Plan, Part IV, para. 91.

Accordingly, when it was suggested in July and August 1944 that BUCO might be closed down, a protest came from Main H.Q., 2nd T.A.F., asking that no such action be taken until No. 2 Group and the outstanding units of No. 85 Group had been phased in, which it was expected would have happened by the middle of October. The views of 21st Army Group on this matter concurred with those of T.A.F., and in a memo dated 9 October the former stated that BUCO would continue to function for an indefinite period.

Movement Prior to Embarkation¹

It is now apposite to consider briefly the actual stages of movement in the United Kingdom up to the time of embarkation, in so far as administrative problems are involved. In chronological sequence, the three big unit movements were :—

- (a) from tactical locations to the concentration area ;
- (b) from the concentration area to the marshalling area ; and
- (c) from the marshalling area to the embarkation area.

In the normal sense of the word, units were concentrated on reaching their tactical dispositions, but in order to carry out efficiently the first stage of waterproofing, in readiness for the sea crossing, it was desirable that all R.A.F. units should pass through one point on their journey to the embarkation areas. The point selected for this purpose was the R.A.F. station at Old Sarum, which was therefore the concentration area as far as the Royal Air Force were concerned. The job of waterproofing was an enormous and complicated one, for until ports became available, and vehicles could be unloaded directly on to dry land, all had to be waterproofed for wading to a depth of 3 ft. 9 in. It was anticipated that this would apply to all vehicles disembarked up to D plus 42. Responsibility for carrying out or supervising waterproofing was vested in the Air Ministry, which provided special personnel for the task. Arrangements for waterproofing the contents of vehicles were to be made by H.Q., 2nd T.A.F. and H.Q., 85 Group. There were three stages in the process ; Stage 'A' was to be performed in the concentration area, Stage 'B' in the marshalling areas, and Stage 'C' in the embarkation areas. Completion of each stage was to be indicated on the vehicle by a coloured paint mark, and no vehicle was allowed to embark unless it bore all three marks.

Units to be landed on 'D' Day and D plus 1 might not pass through Old Sarum but through a military concentration area. Their target date for arrival there was about eight days prior to the assault. Units to be landed after D plus 1 were to move into the concentration area about five days before they were due to land on the other side.

Control of movement in the concentration area was to be held by R.A.F. Movement Control, Southern Command, working closely with the representatives of Director of Movements, Air Ministry, at Combined H.Q.

Units would not normally spend more than 48 hours in the concentration area, and during this time administration would be carried out under arrangements made by the Air Ministry, all domestic services being provided.

¹ AEAF Admin. Plan, Appendix 'G'

In the marshalling areas, the principal activity was the breaking down of units into unit parties, and the formation of these into craft or shiploads in readiness for embarkation. Road movement into the marshalling areas was normally by day, and vehicle parties were grouped in convoys of a convenient size. The commander of each convoy sent ahead an officer, accompanied by unit representatives, to report full details of the convoy at the marshalling area regulating post, one hour before the convoy was due to arrive. Once in the marshalling areas, the composition of the parties commenced, and an officer or N.C.O. put in charge of each. In addition, an O.C. Troops was appointed in the marshalling areas for each craft or ship, and he remained in command until arriving on the Continent. Units were normally in the marshalling areas from 18–36 hours. During this time their administration was carried out under War Office arrangements, with R.A.F. Movement Control Officers to assist in last-minute preparations. A permanent Admin. Staff provided all domestic services.

Embarkation was to take place at hards or ports, and craftloads, whether of vehicles or personnel, were to be called forward from the marshalling area to the embarkation points by movement control. In order to minimise the losses which might occur during the crossing as a result of enemy action, the principle of 'balanced loads' for ships and craft was adopted. This meant that each shipload was composed in such a way that on arrival on the other side all its equipment and personnel could go into action without being dependent for their efficiency on the safe arrival of any other shipload. For instance, guns would not be shipped in one craft, and their ammunition in another, thus eliminating the possibility of having large quantities of the one item arriving and none of the other. The value of this system was enormous, for as the tonnage of equipment which could be shipped in the early days of the assault was severely restricted, it was vital that no items should be 'frozen' while awaiting the arrival of other items necessary to their use.

The Assault, Beach Organisation¹

It was anticipated that the first major port to be captured on the Continent would not be working to full capacity until D plus 17 at the earliest, and it was therefore necessary to arrange for the entire maintenance of the assault and follow-up forces to be carried out over the beaches. Moreover, as it had been decided that the American forces should have chief claim on the first major port, supplies for the British forces would continue to be unloaded on the beaches as late, probably, as D plus 30. This circumstance involved the setting up of an elaborate organisation to administer the beach areas concerned, and special units were formed in A.E.A.F. to deal with the requirements of the Royal Air Force. The functions of this beach organisation would, of course, cease whenever sufficient ports were available, and the permanent base organisation could be established in their vicinity.

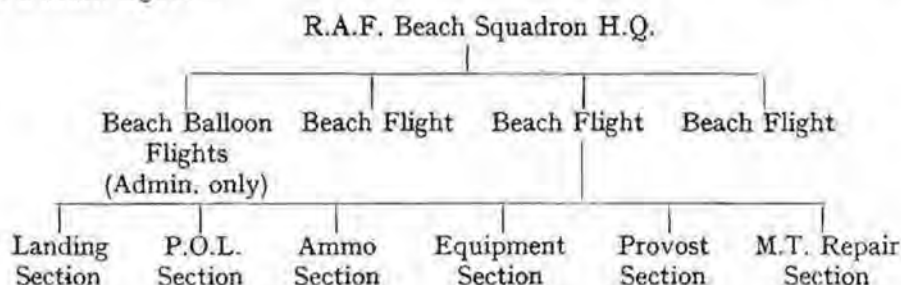
Responsibility for the development of the British beach maintenance areas, or the L. of C. terminal, was vested in Second Army. Attached to the Army beach groups and beach sub-areas were R.A.F. beach squadrons and beach

¹ Review of Admin. Problems, Part II, Section 3. AEAF Admin. Plan, Appendix 'H,' and Part V, para. 147 and Maintenance Project.

flights. Each R.A.F. beach squadron had the control of up to three R.A.F. beach flights. The commander of a beach squadron (normally a wing commander) was responsible for liaison with the Army sub-area commanders, and for the implementation of orders issued by R.A.F. H.Q. ashore concerning the disembarking of personnel and supplies. In addition he was responsible for the administration of beach balloon flights, about which a word or two is relevant here.

The beach balloon barrage was required to operate as soon as possible after the beach organisation had landed. There were, however, difficulties; first, if, in order to save shipping space, the balloons were brought over inflated on L.C.T.s there was a danger of interference with radar, even if the balloons were on short haul. On the other hand, the amount of space which would be used in shipping hydrogen cylinders, etc., would possibly make it preferable to phase back the establishment of the beach barrage for a while. Responsibility for maintaining the barrage in full strength once it had been set up was to be shared by H.Q., Balloon Command and H.Q., 2nd T.A.F. When shipping lift became less restricted it was intended to bring over some packed balloons, with the requisite hydrogen cylinders.

As far as possible, R.A.F. beach squadron commanders were briefed before leaving the United Kingdom with the daily landing programme of R.A.F. units and stores. This information was supplemented at later stages by R.A.F. H.Q. ashore. The R.A.F. beach flights were divided into sections, each dealing with the R.A.F. aspect of the work that the beach organisation was designed to perform. The following diagram illustrates the composition of a beach flight :—



As was stated earlier, the beach maintenance areas were organised on a purely *ad hoc* basis, and as soon as the rear maintenance area was opened, and brought under the control of H.Q., 21st Army Group, the beach areas were to shut down, except in so far as they continued to be used as stores transit areas. Similarly, once the R.A.F. base group was established, all R.A.F. units in the base sub-area would be transferred from the control of 2nd T.A.F. to that of A.O.C., No. 85 (Base) Group. The date at which this would take place would depend, of course, on the tactical situation, but when the boundary of Second Army was forward of the rear maintenance area, H.Q., 21st Army Group was to take over the rear, and the four beach sub-areas and the one base sub-area would come under its command.

Broadly speaking, the main responsibility for the development and control of the beach area and base and L. of C. facilities was an Army one, and the part

of the Royal Air Force was to provide essential elements in the Army organisation. In the base and L. of C. the Royal Air Force, of course, controlled their own units, and where there was economic justification provided their own facilities.

Clearance of the beaches was the task of the beach groups. The Royal Air Force were not normally required to provide transport for their requirements between the beaches and the forward areas, except where special R.A.F. vehicles were involved. During the period 'D' Day to D plus 41, Second Army were to be responsible for phasing in daily maintenance requirements and initial stocks required for reserves, and R.A.F. requirements were to be covered by the Second Army programme. After D plus 15, H.Q., 21st Army Group was to phase in all stores requirements, and the R.A.F. were to submit demands direct to this H.Q. The scale of R.A.F. reserves to be landed was laid down by H.Q., A.E.A.F., and conformed generally with the Army scale. In the initial stages of the operation it was considered unlikely that air lift would be available for the transportation of stores, except in cases of emergency, but every effort was to be made to provide this additional form of transport later on.

With regard to aviation P.O.L., explosives and oxygen, requirements were calculated by H.Q., 2nd T.A.F., and the supply arranged by the Air Ministry through Maintenance Command channels. The movement of initial stocks from the beaches to the R.R.S.s and A.L.G.s was an Army responsibility, although at a later stage it was considered possible that the Royal Air Force would be able to assist in providing transport for pre-stocking purposes. During the early days all aviation P.O.L. was to be supplied in containers, and a minimum of 14 days' reserve at sustained rates was to be established by D plus 41. Bulk supply was to be introduced as soon as possible in order to reduce the tonnage coming over the beaches. This could not be done, however, until adequate storage capacity was available. Bulk storage was to be established at Port-en-Bassin, and the petrol transported to airfields in special lorries. R.A.F. explosives and ammunition were to be held in R.A.F. air ammunition parks within base ammunition depots, and all labour and transport needed at these parks were to be provided by the Army.

In the period before R.A.F. repair units could be brought to the Continent the provision of adequate repair and recovery services was a major problem of the administration of the beaches.

The Army was responsible in these early days for the salvaging and repair of R.A.F. M.T., spares being provided by the Royal Air Force. The Royal Air Force, however, had to deal with R.A.F. mechanical equipment other than M.T., and had to supply experienced personnel for the purpose. A certain amount of cannibalisation was unavoidable at first, but such drastic action was not to be permitted except as an emergency measure.

The procedure concerning captured enemy air equipment, including radar equipment, was that it should be reported to the air intelligence sections of T.A.F., who would dispose of it. Enemy aircraft in serviceable condition would be guarded until taken over by these sections, and airborne and para-troop equipment would be dealt with by the Army.

The R.A.F. Forward Maintenance Organisation before the Establishment of the Base Group¹

The operational plan for the initial stages of Overlord aimed at the establishment of a firm bridgehead on the Continent, and the capture of a port or ports, followed by a rapid advance towards the German frontier. It was an integral part of the plan that air formations should be as mobile as possible, and a highly flexible maintenance organisation was accordingly necessary. The whole success of the great venture was dependent on our ability to sustain a regular flow of supplies and equipment for the forces which went over during the assault and follow-up phase, but this had to be accomplished with strictly limited shipping capacity. It was therefore impossible to consider the establishment overseas of a permanent and complete base maintenance organisation until some months after 'D' Day, and it was accordingly necessary to evolve a system of supply and replacement to tide over the period before No. 85 (Base) Group left the United Kingdom.

During this time the main burden of R.A.F. maintenance fell on 2nd T.A.F. The two composite groups, comprising day fighters and Army support and reconnaissance squadrons, were the first to operate on the Continent: the night fighters and the light bomber group were due to arrive later, and in the meantime continued to operate from the United Kingdom. As early as possible the base defence units of No. 85 Group were to be transferred to the Continent, but not the administrative units, and until these could be phased in 2nd T.A.F. was entirely responsible for all R.A.F. administration on the far side.

The first aircraft servicing units to be put ashore were the servicing commandos. These units were attached to the composite groups, and their function was to cater for squadrons operating from A.L.G.s. They were small and very mobile units, trained in amphibious operations, and composed chiefly of technical personnel. Their duties comprised the servicing of a variety of aircraft up to daily inspection standard, and for this purpose they carried a stock of 14 days' requirements of essential spares. They were also capable of executing light repair work. After the arrival of the airfield H.Q. the primary task of the servicing commandos was finished, and they could then be moved on to a new A.L.G. in the forward area or used to strengthen repair and salvage units or airfield H.Q.s. Replenishment of the stocks held by servicing commandos was to be obtained in the form of packs direct from the United Kingdom, without demand, for even when the air stores parks had been landed the stocks held by them were not considered adequate to meet such a comprehensive requirement.

Airfield H.Q.s

An airfield H.Q. was a large unit established on an airfield for the servicing and maintenance of squadrons. Units of this type were attached to 2nd T.A.F. and to No. 85 (Base) Group. They held 7 days' stock of spares and were equipped to carry out servicing up to, but excluding, major inspection standard. They were not intended to carry out aircraft repairs requiring more than 48 hours to complete, or M.T. repairs requiring more than 24 hours to complete. The first airfield H.Q.s to go across were to be fully mobile, but those phased

¹ Review of Admin. Problems, AEAF Administrative Plan and Maintenance Project.

in later required the assistance of a supply and transport column if they had to move *en bloc*. Replenishments of spares and equipment were demanded from air stores parks.

Air Stores Parks (A.S.P.s)¹

Responsibility for the administration, both technical and operational, of A.S.P.s lay with 2nd T.A.F., although Maintenance Command acted in an advisory capacity in dealing with certain special tasks. The A.S.P.s were to be landed at the same time as airfield H.Q.s and were designed to meet the requirements of two airfield H.Q.s and one repair and salvage unit. They were mobile units and held a month's stock of spares, equipment and technical and domestic stores. In addition they held the bulk of the spares required by M.T. light repair units, and mobile signals servicing units, except for certain special radio items needed by the latter, which were obtained from the base signals unit. Replenishment for A.S.P.s was demanded direct from the forward equipment unit, and despatch of stores was to be arranged by sea or air, according to the degree of priority and the air lift available.

Repair and Salvage Units (R. and S.U.s)

During the period when there were only the servicing commandos on the Continent, very little repair and salvage could be undertaken, but it was planned to put ashore advance salvage sections of R. and S.U.s as early as possible, so that landing strips could be kept free of damaged aircraft. The complete R. and S.U.s were to come over with, or immediately after, the airfield H.Q.s, and from then on more comprehensive repairs were practicable. Control of R. and S.U.s was exercised by 2nd T.A.F. They had two principal functions:—

- (a) Close technical support of the airfields for which they were responsible.
- (b) Collection and disposal of salvage within specified areas.

They were established on a scale of one per six squadrons and were located as near as possible to the airfields which they served. Repairs requiring longer than 7 days to complete were not within the scope of the R. and S.U.s, and aircraft in this category were, if possible, to be returned to the United Kingdom until such time as the forward repair unit was brought over and could deal with them on the Continent. During this interim period cannibalisation might be necessary, but was not to be allowed except as an emergency measure, since the stripping of usable parts from a damaged aircraft meant that its eventual repair, if practicable at all, would be a far longer job than if it had been left untouched.

M.T. Light Repair Units (M.T.L.R.U.s)

Two M.T.L.R.U.s were attached to each of the composite groups in T.A.F. They performed services for M.T. similar to those performed by the R. and S.U.s for aircraft. Their function was to hold a small pool of replacement vehicles, and to carry out repair and salvage and major inspection of all M.T. They held a stock of 7 days' requirements of 'quick turnover' items, and obtained replenishments from A.S.P.s. Complete overhauls, and repairs taking longer than three days, were outside their province and were to be undertaken by the forward repair unit.

¹ File FC/S.35726.

Mobile Signals Servicing Units (M.S.S.U.s)

These units were established on the basis of one for each composite group and one for No. 85 Group. Their functions were to repair ground wireless and radar equipment 'on site,' and to hold an operational reserve of complete signals units to replace casualties. They were to hold in addition 7 days' stock of 'quick turnover' items, replacements for which were to be demanded on A.S.P.s (specialist radio items excepted). Repairs beyond the capacity of an M.S.S.U. were to be returned to the base signals unit.

Supply and Transport Columns (S. and T. Columns)

Each composite group had an S. and T. column, divided into six sections, each consisting of 48 vehicles. The function of the column was to provide a central pool of load-carrying vehicles for the purpose of transporting aviation P.O.L., S.A.A., and bombs from the air ammunition parks to airfields, and for assisting in the movement of non-mobile units. The delivery of all R.A.F. requirements of packed P.O.L., ammunition, stores and supplies to agreed points within a distance of 40 miles from R.A.F. units was an Army responsibility. Bulk P.O.L. was to be delivered direct to airfields by the Army. The R.A.F., however, were responsible for distribution from the agreed points to units. Further, R.A.F. representation was provided at all levels in the Army supply organisation.

R.A.F. Base Maintenance Organisation

In planning the maintenance organisation for the R.A.F. for the build-up phase and subsequent stages of Overlord it was decided that only one base would be necessary. It was, however, desirable that the units of the R.A.F. base group should be organised in a way that enabled them to move in echelons, thus facilitating any change in the location of the base area resulting from the capture of further ports. In the early days of the assault the base area had to be accessible, by road or rail, from the beaches and from the first captured port, but if and when further ports became available, it was conceivable that the L. of C. as a whole might be shortened if the base area were transferred to the vicinity of these ports. Accordingly, the initial base maintenance organisation was to be set up on a purely temporary footing, and in matters such as accommodation only a minimum protection was to be provided.

The policy control of the R.A.F. base maintenance units was exercised by H.Q., A.E.A.F., but the base group H.Q. was responsible for the local administration of the maintenance units in the base area, and also for the control, both operational and administrative, of the static fighter defence organisation.

The staff of A.E.A.F. were to take an active part in planning the layout of the base area, and were responsible for representing R.A.F. requirements to the Army who dealt with the requisitioning and hiring of land and buildings.¹ The negotiations were to be carried out by Group Captain (Quartering) under the supervision of Air Commodore (Admin. Plans). Among the units to be established in the base area were the Forward Equipment Unit,² the Forward

¹ File AEAF/S.21000.

² Originally named the Base Maintenance Unit, or Base Equipment Unit.

Repair Unit, the Base Hospital, Base Signals Centre, Personnel Transit Centres, Mobile Signals Servicing Units, Supply and Transport Column, Aircraft Reception Unit, and Embarkation Units.

The Forward Equipment Unit (F.E.U.)

Since it was essential that the air stores parks attached to the composite groups should be fully mobile, the amount of stock that they could carry was strictly limited, and although they were to start with a month's reserve of requirements it was very probable that this stock level would be depleted more quickly than it could be replenished. If it had been practicable to provide a regular air supply service from the United Kingdom during the early days, the A.S.P.s would have been able to fulfil their functions without recourse to any intermediary supplier, but as this was impossible, and as transport by sea was altogether too slow for the purpose, the problem had to be solved in another way. Accordingly it was decided that a large unit should be set up as part of the permanent base organisation with a stock of one month's requirements for all R.A.F. units in the theatre. Its range was to include all R.A.F. stores equipment and spares, including items common to both the Army and Royal Air Force, but not P.O.L., ammunition and bombs. All demands from A.S.P.s were to be submitted to the F.E.U., and the latter was to obtain its replenishments from a specially allocated maintenance wing in the United Kingdom. At a later stage, 'common user' items were to be demanded from Army depots in the base area, and not direct from the United Kingdom. The F.E.U. was also to be responsible for the collection and delivery of R.A.F. stores from/to port or railhead.¹ It was to be a transportable, but not a mobile, unit and to consist of an Admin. H.Q. and six stores groups, a case-making section and provision office. Responsibility for the formation and build-up of the F.E.U. rested with Fighter Command, the technical control being exercised by Maintenance Command, who also gave advice on specific matters. The nucleus for the F.E.U. was approved as early as 16 September 1943.

The Forward Repair Unit (F.R.U.)

The F.R.U. was the technical link between the repair and salvage units and M.T. light repair units, and the aircraft repair organisation in the United Kingdom. It was not intended to undertake work which could without difficulty be returned to the United Kingdom, and it was to be provided with full depot facilities. The F.R.U. was to be a transportable unit, and so organised as to be capable of movement by stages. In addition to its services to the air forces established on the Continent, the F.R.U. was to be responsible for the salvage and repair on site of Transport Command aircraft, and of aircraft of No. 38 Group. It was further intended to carry out a certain amount of salvage and repair work on Bomber Command aircraft.

The Base Signals Unit (B.S.U.)

The Base Signals Unit was the main ground wireless and radar equipment repair organisation in the theatre. Its functions included the execution of repairs beyond the capacity of the mobile signals servicing units, the holding of a reserve of complete signals units and vehicles, and the installation of fixed wireless and radar stations in the base area and along the lines of communication.

¹ File FC/S.35726.

An illustration of the way in which the chain of R.A.F. technical maintenance units operated in Overlord may be given in connection with the demand for the No. 40 Group range of equipment in stock for T.A.F. In the period before the Forward Equipment Unit moved to the Continent the procedure was that units in the field demanded on the A.S.P.s, the A.S.P.s then demanded on the F.E.U. located in the United Kingdom and the F.E.U. drew supplies from the various units of the United Kingdom Maintenance Organisation. Once the F.E.U. was located on the Continent the chain of demand was as before, except that the F.E.U. itself obtained its replenishments from No. 3 Maintenance Unit, which acted as a collection point for demands in the way that the F.E.U. had served hitherto.

M.T. Replacement

A reserve of M.T. vehicles was held in the M.T.L.R.U.s attached to 2nd T.A.F., and this reserve was maintained at the agreed level by demands on the F.E.U. Before, however, the M.T.L.R.U.s could be established on the Continent units made direct demands, by the most expeditious method, on the R.A.F. station at Old Sarum. The M.T. reserve for No. 85 (Base) Group was held at the Forward Repair Unit.

Aircraft Replacement

A rather bigger problem was that of arranging for swift replacement for aircraft casualties. Each wing held a small pool of replacement aircraft at the aircraft reception flight in the repair and salvage unit. New and repaired replacement aircraft from the United Kingdom were flown to the aircraft reception flight where they were brought up to operational standard. The rate at which aircraft wastage on the Continent could be made good was dependent not only on output of new machines, but on the efficiency of the United Kingdom repair organisation.¹ As it was highly probable that in the normal course of transfer from the Continent to the United Kingdom a damaged aircraft would sustain additional injury—for instance, in the loading on to and removal from a salvage vehicle—a special L.C.T. shuttle service was instituted which enabled salvage trailers, 'Queen Marys,' to be transported complete with their freight from the collection point on the Continent to the repair depot in the United Kingdom. Salvage trailers withdrawn in this way from the Continent were replaced by incoming trailers bearing loads of equipment. A unit known as the Base Salvage Centre was set up to control this traffic movement. Responsibility for the loading of vehicles on to L.C.T.s lay with the appropriate beach unit, and the beach squadron commander had the task of calling forward the vehicles from the beach salvage centre.

Division of Responsibility between the Army and the Royal Air Force

It has always been an accepted principle that services of common usage in the Army and the Royal Air Force should be provided by one Service for the benefit of both. The factor determining which Service was to have responsibility in a particular case was economy, and the Service which was more able, by reason of resources of man-power, equipment, organisation and experience to perform a service efficiently, was assigned responsibility for it.

¹File AEA/S.19326.

This principle was adhered to in the main in the planning for Overlord, but it was inevitable that certain modifications should be necessary to meet the conditions of specific theatres and types of operation. In the detailed application of the principle it was found that two important requirements would have to be met :—

- (a) The provision of R.A.F. elements in certain Army units which were to provide services for common usage.
- (b) The provision by the Army, in certain circumstances, of services for the Royal Air Force in areas where these services are not required by the Army.

In the majority of cases it is more economical for the Army to provide services of common usage, partly because Army requirements were on a far bigger scale than those of the R.A.F., and partly because the Army is often better equipped for the purpose.

The prime consideration in administrative planning for Overlord was, however, to cut the transport commitment in the early stages to the bare minimum, and it was therefore necessary to aim at the utmost pooling of resources by the Royal Air Force and the Army, even at the cost of administrative convenience.

It was on this basis that the detailed policy for the division of administrative responsibility between the two Services was worked out. One of the most important matters covered by this policy was responsibility for movement control. In principle, movement control is a joint service, but the Army, as main user, had the main responsibility. The general policy and organisation was formulated by the Army in conjunction with the R.A.F. Movements Service, and R.A.F. Movements officers were established wherever necessary. Group Captain (Movements) was responsible both to the Deputy Quartermaster-General, who controlled movement and transport in the whole of the British theatre, and to the A.O.C. regarding the movement of R.A.F. personnel and material. At ports handling R.A.F. requirements, R.A.F. embarkation units were provided, who received their instructions from the port commandant. Apart from this provision of specialist personnel, the R.A.F. had no responsibility for the transport organisation at ports and docks, the only exception being the provision of M.T. for conveying certain large aircraft parts.

With regard to road transport, the Army had the task of delivering all R.A.F. stores, supplies, ammunition and bombs to agreed points within 40 miles of R.A.F. units. The R.A.F. was responsible for collection of goods from these points, and for subsequent distribution to units. The carriage of loads necessitating special R.A.F. vehicles, such as 'Queen Marys,' was an additional R.A.F. responsibility. It was at all times essential for the R.A.F. to give adequate notice to the Army authorities of their road transport requirements, for otherwise the greater speed at which the air forces could concentrate might have involved a time lag in the provision of the requisite supplies.

In the matter of providing labour, the Royal Air Force was responsible for meeting the requirements of all R.A.F. units, except for the supply of unskilled military labour and the enrolment of labour in occupied territory. All engineer works services were, however, provided by the Army, the only Royal Air

Force responsibility being the notification of requirements and the provision of portable hangars, and items made to special R.A.F. specifications, such as fittings for airfield lighting.

The acquisition and allotment of accommodation for both Services was an Army task, and the Army was further responsible for all the administrative arrangements connected with the hiring and purchase of land and buildings. Payment of billets for R.A.F. personnel was, however, the responsibility of the Royal Air Force.

The reception and disposal of salvage was also arranged by the Army, R.A.F. advice being sought with regard to aircraft and other air technical matters. The Royal Air Force was in charge of the delivery of salvage to the appropriate Army depots or dumps, except in the case of aircraft damaged beyond repair, which were collected by the Army after all serviceable spares had been removed by R.A.F. personnel.

The division of duties with regard to aviation P.O.L. was rather more complex. In the case of bulk P.O.L. the Royal Air Force was responsible for provision at the source of origin, and for allocation between the various theatres of war. They also controlled the quality of bulk P.O.L. and provided all facilities for handling it at airfields, apart from airfield tankage, which was erected and maintained by the Army. The Army was also responsible for control of storage in the base and L. of C., and for bulk delivery to airfields. R.A.F. personnel, acting in an advisory capacity, made recommendations to the Army as to R.A.F. reserves, and supervised the inward and outward movement of stocks. The arrangements for packed aviation P.O.L. were broadly the same as for bulk, except that the Army did not deliver it from 'door to door,' but only to agreed points within 40 miles of the R.A.F. consumer unit, where it was collected by the Royal Air Force. Empty containers were returned by the Royal Air Force to dumps, where they were picked up by the Army.

The provision of M.T. P.O.L. from the source of origin was an Army responsibility, and the latter was also responsible for delivery to agreed points within the usual 40-mile radius, and for control of qualities and grades. The Royal Air Force provided transport for subsequent collections, and were under the obligation of notifying the appropriate military H.Q. as to impending changes in R.A.F. dispositions which might affect R.A.F. requirements.

The Royal Air Force was the agreed provider of all stores and equipment peculiar to the R.A.F. (excluding M.T.), and of the appropriate types and quantities of R.A.F. explosives, bombs, S.A.A. and pyrotechnics. The Army took charge of storage for the latter in the base and L. of C., provided the necessary labour for handling, and transport up to agreed points. Provision of supplies such as hospital comforts, fuel and disinfectants was entirely an Army job, the one exception being emergency flying rations.

All repairs to R.A.F. M.T., and the provision of spares for this purpose, were tasks generally undertaken by the Royal Air Force. During, however, the interim period between the establishment of an airfield and the arrival of the M.T.L.R.U., 1st and 2nd echelon repairs to R.A.F. M.T. were undertaken by the Army, spares being obtained from the Royal Air Force.

Under the arrangements made for the care of casualties, the Army had full responsibility back from, and the Royal Air Force for areas forward of, Army casualty clearing stations. The Royal Air Force was also responsible for the supply of medical stores peculiar to the R.A.F., and for the provision, where necessary, of R.A.F. hospitals in established theatres. The procedure for the evacuation of casualties by air was that the Army undertook transport to the special R.A.F. mobile field hospitals which were located near airfields used for air evacuation, whereas the R.A.F. was concerned with the treatment of casualties from the time at which they were admitted to the R.A.F. hospital until their despatch from the airfield on arrival in the United Kingdom. The Army was responsible also for the transport of casualties after disembarking from airfields to Army medical units.

CHAPTER 20

THE WORK OF THE R.A.F. MAINTENANCE ORGANISATION DURING THE INITIAL STAGES OF OVERLORD

Brief Outline of the Operation¹

Operation Overlord was launched on 6 June 1944. The immediate command of the air forces participating was vested in the Air Commander-in-Chief, Air Chief Marshal Sir Trafford Leigh-Mallory, who was directly responsible for the overall control of the Allied Expeditionary Air Forces.

The original plan of operations was to put a force ashore over five main beach areas, three of which were British and two American. It involved the consolidation, at the earliest opportunity, of a firm bridgehead running some five miles inland from the coast from Utah beach on the east coast of the Contentin Peninsula in the east to the town of Caen and the River Orne in the west.²

The plan for the use of air power in direct support of the assault called for the fulfilment of the following principal air tasks :—

- (a) To protect the cross-channel movement of the assault forces against enemy attack, and to assist the Allied naval forces to protect the assault craft and shipping from enemy naval forces.
- (b) To prepare the way for the assault by neutralising the coast and beach defences.
- (c) To protect the landing beaches and the shipping concentrations from enemy air attack.
- (d) To dislocate enemy communications and control during the assault.

It was anticipated that the enemy would launch a counter-attack at the earliest opportunity to divide our forces by means of a thrust northwards towards Bayeux and thus isolate the British assault forces north of Caen and the American assault forces to the west of the river Vire. This attack was made but was successfully held.³

Directly the enemy's initial counter blow had lost its momentum, it was planned that the Americans would take the port of Cherbourg as soon as possible, expand their western flank of the bridgehead as far as Avranches, forming a secure base for any future advance into the Brest Peninsula or down the river Loire, while the emphasis of the build-up, particularly in armoured mobile formations, would be made in the Caen sector. The final breakout from the bridgehead would occur once the forces ashore had been regrouped and the original assault brigades, which were not mobile owing to the light scales of equipment which their amphibious operations had forced them to carry, had been withdrawn. It was found that the C-in-C's plan, in spite of gallant attempts by the Army, supported by heavy concentrations of both Strategic and Tactical

¹ A full account of the operation is given in A.H.B. Narrative *The Liberation of North West Europe, Volume III*.

² Despatch by A.C.M. Leigh-Mallory.

³ Report by A.M. Coningham. A.M. File C.28691/45.

Air Forces, could not be accomplished. The concentration of the enemy's best divisions in the Caen sector, and their fighting strength, prevented a breakthrough and the air forces could not obtain the airfields which were so urgently required. It therefore became necessary to increase the number of airfields above those which had been planned for the area Ouistreham-Caen-Bayeux-Arromanches. The Americans likewise increased the density of their airfields beyond that planned on the Contentin Peninsula.

The Build-up of Air Forces in the Bridgehead

The main problem of the air forces at this stage was to ensure the maximum possible build-up of squadrons based in Normandy as the continued location of short-range aircraft in England involved much wasted flying. Unless the short-range squadrons were moved to the Continent within seven weeks, the rate of effort which could be maintained would be insufficient to maintain air superiority, to harass enemy communications and delay the build-up of enemy ground forces which could otherwise concentrate in superior numbers against the bridgehead.

The high degree of air superiority which was achieved over the bridgehead soon after the commencement of operations plus the very high standard of rapid airfield construction enabled more aircraft to be concentrated on each airfield than was originally planned.

In accordance with the maintenance plan, the first R.A.F. personnel to be landed on the Continent were the three Beach units which formed part of the Army beach groups which controlled the landings in the British sector. By the evening of 'D-Day' the advance party of Headquarters No. 83 Group was also put ashore successfully. Thereafter the build-up of units went ahead, controlled by an inter-Service organisation located at Portsmouth. On the arrival of elements of Headquarters No. 83 Group in France, all R.A.F. units in Normandy were placed under the local command of that group until such time as 2nd T.A.F. Headquarters moved into Normandy. This ensured that all units in the bridgehead had one controlling formation to whom they could state their problems, and who could represent the requirements of the Royal Air Force to the Army in the case of common user supplies, and to H.Q. 2nd T.A.F. for supplies peculiar to the Royal Air Force. Associated to this system of command, the A.O.C. No. 83 Group was made responsible for calling into the bridgehead all R.A.F. units that were required to be moved over. This ensured that the build-up of the R.A.F. formations was controlled smoothly, and that no units not essential to the operations in hand were moved to the bridgehead to add to the congestion that was experienced.

On 7 June, the first two servicing commando units arrived over the beaches. A day later the first emergency landing strip was levelled at Asnelles to enable a Spitfire to make the first aircraft landing at 1300 hours. On 9 June four more airstrips were available for aircraft at Bazenville, St. Crois, Camilly and Coulombs respectively. By 10 June, three more airstrips had been established by the Americans at St. Laurent, Pouppeville and Beuzeville. By the afternoon of 9 June, 3,537 men and 815 vehicles had been landed for the Royal Air Force in the beach-head. Landings of R.A.F. personnel and vehicles from 'D' Day up to D plus 3 were :—

' D' Day	..	..	456 vehicles	..	..	1,818 men
7 June	..	..	594	..	..	2,615 "
8 "	..	..	750	..	..	3,232 "
9 "	..	..	815	..	..	3,537 "

By 20 June, 13,000 men and 3,200 vehicles had been disembarked.

The move of the squadrons of 2nd T.A.F. commenced on D plus 4 and the transfer of the fighter wings from their advanced landing grounds in southern England to Normandy worked smoothly and efficiently. During the move the squadrons were able to operate throughout the daylight hours. The wings were organised into three parties, i.e., main, airlift and rear parties. The main party moved by sea prior to the move of the aircraft and was installed on the strip in Normandy before the wing moved ; a small rear party followed by sea after the airlift party had flown over.

During the period that the main party were moving from the strip in southern England to the strip in Normandy, normally a period of 10 to 12 days, which included packing up, concentration, marshalling, shipborne time, landing, etc., the wings and squadrons with their airlift party moved to one of three main backer-up stations. Squadrons operated continuously from the backer-up stations, serviced and fed by the station personnel, assisted by the specialised team from the wing and squadrons which formed the airlift party. When the main parties of wings and squadrons signalled that they were ready to receive the aircraft in Normandy, the squadrons flew over accompanied by their airlift parties in Dakota aircraft. The aircraft were then able to operate the same day from Normandy. The airlift party for the normal operational wing of four squadrons consisted of some 10 to 12 Dakota aircraft loads.

One of the disadvantages, unexpected in a western theatre of war, which the squadrons experienced on landing in Normandy, was the fact that the soil on which the airfields had to be constructed contained a very high proportion of abrasive silica dust which lessened the life of the engines, particularly those which were not fitted with air-cleaning devices. After an intensive effort made by the Ministry of Aircraft Production with the adoption of various impromptu expediences, such as pumping oil or sea water on to the landing and taxiing surfaces, and the reduction of warming-up time to a minimum, the crisis was passed successfully.

Owing to the failure of our forces to break through immediately after the landing, the airstrips were under shell fire and were being bombed intermittently at night during the early days of the build-up.¹ On 13 June, there were, however, sufficient stocks of petrol, ammunition and rocket projectiles to permit of 3 days' maximum effort of 200 sorties per day, but so far the best day's effort from France had been 140 sorties. By 20 June, the 2nd T.A.F. had six landing grounds in use, but owing to the rapid transfer of squadrons—one wing every five days, there was, as Air Marshal Coningham put it, 'only standing room on the Continent for the moment.'² At this period the force was somewhat short of bombs, as it was anticipated that no bombs would be required until D plus 18, but because there was little air fighting the A.O.C. No. 83 Group used every

¹ L.M./7977/D.G.O., 14 June 1944.

² L.M./8116/D.G.O., 21 June 1944.

available fighter to carry bombs. To make up the shortage five special ships each carrying 350 tons of bombs were sent to the beachhead and when the shortage was still felt, 30 Dakota aircraft loads, each carrying $2\frac{1}{2}$ tons of 500 lb. bombs were despatched from the United Kingdom. Three thousand tons of petrol were now in dumps in Normandy, some of which was on the landing grounds. In addition, 2,500 gallons of oil, $\frac{1}{2}$ million rounds of ammunition and 1,000 cylinders of oxygen and hydrogen were available. The daily emergency lift by sea was working well. Instead of the 20 tons per day which had been planned, 2nd T.A.F. were getting 30 tons every second day which suited them better. The one repair and salvage unit which had been transferred to Normandy was working well and two air stores parks were also in operation.

On 29 June, No. 83 Group, complete with its nine wings and ancillary units, was complete on the Continent. Ten airfields were in use by the R.A.F. and six by the U.S.A.A.F. Supplies of hessian strips to overcome the dust problem were arriving and it was arranged in future that every fourth airfield would be a hessian airfield. All the Typhoon aircraft had been returned to England and fitted with dust deflectors, a measure which appeared to overcome 80 per cent of the troubles experienced but no less than 66 engines removed from aircraft as the result of damage caused by dust were found to be beyond the repair of R.A.F. facilities. A shortage of mainplanes was being experienced owing to unforeseen damage by 'flak.'

The cross-channel low loader service commenced on 29 June with two L.C.T.s crossing the water with low loaders every second day. The vehicles were used to convey the needed mainplanes and heavy equipment for the air stores parks.

Throughout July the relatively static and inactive conditions on the Caen front, resulting from the continued failure to break through the enemy lines, retarded the progress of increasing the strength of the Royal Air Force in Normandy.¹ At the beginning of the month a small administrative staff of seven officers from No. 85 (Maintenance) Group was attached to Headquarters No. 83 Group to deal with the detachments and base details of No. 85 Group as they were phased in to the Continent. By 14 July, the Aviation and Ammunition Park was completed and fully stocked and some sections of the Forward Repair Unit were established and working well. The low loader shuttle service was organised to return to the United Kingdom twelve crashed aircraft every other day. Owing to lack of work the number of repair and salvage units was cut down to one per two wings.

On 10 August 1944 No. 85 (Maintenance) Group was transferred from A.E.A.F. to the control of 2nd T.A.F. and the servicing echelon system for the maintenance of squadrons was introduced.

The Work of the Servicing Commandos²

The six servicing commando units formed in April 1943 were all employed in connection with the Normandy landings, either in direct support of advanced squadrons or at bases in the south of England.

¹ L.M./8298/D.G.O., 14 July 1944.

² O.R.B.s of Servicing Commando Units and A.M. File S.83764.

The four which operated from advanced landing grounds in France were grouped in pairs, each pair operating from one airfield and having attached to it a repair and salvage unit element with two salvage cranes and airfield salvage equipment, a propeller fitting party complete with twelve fully assembled propellers, and a wing flying control section with fire tender and ambulance. The chief technical officer of the wing which was to take over the advanced landing ground was attached to the servicing commando party to act as chief technical officer of the airfield. Owing to the nature of the operation none of the servicing commandos was employed as extensively as had been planned, but it was demonstrated that one commando could meet a peak load of 100 fighter sorties per day.

No. 3210 S.C.U. landed on 7 June 1944 near St. Croix-sur-Mer, where it serviced the aircraft of the first squadron to land in Normandy on 9 June. No. 3205 S.C.U. landed at Ver-sur-Mer also on 7 June and co-operated with No. 3210 S.C.U. in the servicing of aircraft at the adjacent landing strip. The units were employed in this neighbourhood for the remainder of the month, working as servicing units. On 30 June No. 3205 S.C.U. was attached to No. 403 Repair and Salvage unit and engaged in the collection of damaged aircraft; No. 3210 S.C.U. joined No. 405 R.S.U. at Martragny. At the end of July both these units were withdrawn to England, No. 3205 being attached to No 83 Group Support Unit at Bognor Regis and No. 3210 to No. 84 Group Support Unit at Thruxton. At these stations the servicing commando units were employed principally on the modification and inspection of new aircraft.

Nos. 3206 and 3208 S.C.U.s landed in Normandy, near Coulombs, on 15 and 16 June, though part of No. 3206 S.C.U. remained at Thorney Island until the withdrawal of No. 3205 at the end of July when it took over the duties of the latter unit. Following the collapse of the German front in Normandy No. 3208 S.C.U. moved forward to Lille on 9 September and to Melsbroeck in Belgium on 28 September. No. 3206 reached the Brussels area on 11 September, Eindhoven on 16 October and Dieste on 29 October. The units remained in these localities, employed on salvage and repair work and a certain amount of servicing, until the end of March 1945 when they were disbanded.

As on all previous occasions when they had been used, the commando units had to undertake up to 60 per cent of the pre-stocking of the landing grounds owing to the inability of the army to meet its full commitments in this respect.

No difficulties were experienced in refuelling and rearming aircraft, all refuelling being done with jerricans and a filter funnel. The hand refuelling gear was never used and it was the recommendation of the chief technical officer, 2nd T.A.F., to dispense with it.

The technical qualifications of the Group I tradesmen proved invaluable and the high proportion included in the establishment was considered absolutely essential during the early stages of an assault operation, when the Group I tradesmen of wings and repair and salvage units would not be available. A large number of aircraft were made serviceable at the beachhead landing grounds by the exchange of propellers, carburettors, constant speed units, flaps, rudders and many other such components, thus enabling aircraft to fly back to base and assisting to maintain the high rate of serviceability which existed during the

assault period. Once the Tactical Air Force was established in the bridgehead the Sicily experience was repeated; there was little further need for the servicing commando units, only two of which remained on the Continent. These two were replaced, in December 1944, by refuelling and rearming parties. The scales of equipment provided formed a satisfactory basis for the requirements of the operation but it was decided in the planning stage that the spares and equipment carried must be entirely dependent on the detailed planning of the operation for which the servicing commandos were used. The scales were adjusted accordingly, prior to the operation. Spares carried covered types of aircraft to be operated but not other types which might in emergency use the advanced landing grounds. Fourteen day packs of spares for each type were provided at the base so that the servicing commandos could be restocked by fast sea craft or by air, also to cover the possibility of alterations to the basic plan necessitating the servicing of types of aircraft other than those originally intended.

The criticism made in Sicily, concerning the over-accentuation of the assault aspect in the training of the commando personnel, was repeated by the A.O.C.-in-C., 2nd T.A.F. He submitted that, before the servicing commando unit could take over, it was essential that the site should have been firmly secured by the army and the airfield constructed or repaired by the airfield construction parties. Accordingly, though subject to sniping and shell fire, the commando personnel had little need for skill in boatwork, cliff-scaling and the use of arms.

Several proposals were made for increases in establishment but it was realised that in the majority of instances these arose out of needs peculiar to the nature of the operation and could be covered by the attachment to the unit of such specialist personnel as might be required. Certain recommendations were, however, made, which affected the basic establishment of the servicing commando unit. The most important was that the rank of the commanding officer should be raised to squadron leader to enable him more effectively to conduct the necessary inter-service discussions and arrangements arising in the initial stages of a combined services assault. His position as a junior officer seriously restricted his disciplinary powers and was detrimental to the efficiency of the unit. It was felt that an additional engineer officer should be carried on the establishment. It had been necessary on previous operations frequently to split up the unit into two, or more, detached groups operating on different airfields. An additional flying officer, engineer, had been attached to each commando unit for the Overlord operation and as this move had, in the event, proved its value it was recommended that the post be permanently established. Provision for M.T. maintenance had been provided by the inclusion in the establishment of two fitters (M.T.)—one a corporal—and an M.T. mechanic. The importance of transport serviceability was considered such as to warrant a sergeant in charge in lieu of the corporal.

The chief technical officer, summing up in his report, concluded that servicing commandos were essential for the assault phase of a waterborne invasion but that it was unnecessary to retain them once the wing personnel had landed and taken over the maintenance of their own aircraft. The A.O.C.-in-C. 2nd T.A.F. in his covering letter suggested that three such units would have met the needs of the Tactical Air Force and that the provision of six was extravagant. He

considered that such tactical groups as Nos. 83 and 84 Groups should be provided with a refuelling and rearming party. Such a party would support the commandos in the assault phase. He pointed out, further, that the majority of the ground personnel of four complete wings was immobilised in marshalling or concentration areas during the first ten days of the operation, while their squadrons were being operated by 'backer-up' stations in the United Kingdom or by servicing commandos in the bridgehead. He felt that it would have been possible and preferable to have made up advance parties from these wings, who in addition to three servicing commandos could have carried out all necessary servicing in the bridgehead area during the first fortnight of the operation. He did not underrate the value of the commandos which, by providing small, well-trained units with a high proportion of skilled personnel, had enabled the entry of complete wing ground parties to be postponed, thereby allowing the armies to have a greater proportion of their personnel and vehicles in the assault phase convoys.

On 28 July 1944, Headquarters, Allied Expeditionary Air Force, passed to the Air Ministry the information received from the Air Marshal Commanding 2nd T.A.F. that the servicing commando units under his command had served their purpose. Authority was requested to disband Nos. 3205 and 3207 Commandos in No. 83 Group and Nos. 3209 and 3210 in No. 84 Group. It was desired to retain one commando unit in each group until future commitments were known. Nos. 3207 and 3209 S.C.U.s had not moved to France as units, though detachments had been across and personnel had been posted to other servicing commando units to replace wastage. Their chief work had been the servicing of aircraft operating from airfields in England. They performed a variety of tasks at various stations which were temporarily in need of assistance during the stress of the early period of the landings. Although only Nos. 3206 and 3208 S.C.U.s were retained in France, the remaining four units were not disbanded but were re-equipped and embarked for the Far East at the end of 1944.

CHAPTER 21

THE MAINTENANCE ORGANISATION AFTER THE BREAK-OUT FROM THE BRIDGEHEAD IN NORMANDY¹

Phases of the Operations²

The air campaign in the liberation of Europe may be divided into four phases :—

- (a) The initial landings.
- (b) The period from the break-out and the advance through France and Belgium up to, but not including, the airborne operation which resulted in the first capture of Arnhem.
- (c) The period from the airborne operation at Arnhem up to and including the defeat of the enemy spoiling offensive in the Ardennes.
- (d) The period from the crossing of the Meuse to the crossing of the Rhine and the final disruption and pursuit.

The breakout commenced during the first week in August with an American thrust to the south. Immediately before this period the Rear Headquarters of 2nd T.A.F. was moved to Normandy and an advance party of Headquarters No. 85 Group was brought in to assist in running the rear maintenance area when 2nd T.A.F. Headquarters moved forward.

Supply Services up to the end of Phase II

Throughout the entire campaign, the United Kingdom was the main base supporting all Continental operations, and from there supplies were fed into advanced bases in the theatre. Initially, the advanced base for Overlord was the rear maintenance area which was supplied through the artificial port of Arromanches, and the three beach-heads in the British sector. In the Rear Maintenance Area (R.M.A.) were located all the Army and R.A.F. base supply depots which fed forward to meet the requirements stated by the armies and R.A.F. groups.

When the break-through occurred, the rapidly advancing forces were initially maintained by road and rail from the R.M.A., but the length of the L. of C. soon made it necessary to consider the opening of supplementary ports for the maintenance of the forces. The continued resistance of the enemy in the Channel ports made this project increasingly difficult, and it was not until the port of Antwerp had been captured and opened that a suitable advanced base could be prepared for the maintenance of the forces in their new dispositions. At this time, owing to the length of the lines of communication, the continued advance of the ground forces seemed likely to be hampered by the lack of supplies, and the maximum possible use of air transport was ordered into the forward airfields in Belgium to bring in the supplies to enable the armies to continue their

¹ Air Marshal Coningham's Despatch.

² Full details of the operations during the respective phases are contained in A.H.B. Narrative *The Liberation of North West Europe, Volume IV*.

advance. The request for air transport assistance was met by the allotment of approximately 50 per cent of the Supreme Commander's resources of transport aircraft for lift into the British sector and this, together with the allotment of a group of Halifax aircraft of Bomber Command and a wing of Liberator aircraft of the VIIIth U.S.A.A.F., enabled the Royal Air Force to import an average of 800 tons of supplies a day over the vital period when the L. of C. was being adjusted and the port of Antwerp opened. The commodities that were lifted into the theatre by air during this period included aviation and M.T. P.O.L., army ammunition, rations and ordnance stores.

Supplies during the Third Phase

Towards the end of the Second Phase, Nos. 83 and 84 Groups were deployed in Holland and northern Belgium, and it was arranged for No. 2 Group to move from the United Kingdom to bases in northern France and eastern Belgium. No. 85 Group were to move from the United Kingdom to the advanced base which was developing around the port of Antwerp.

The first administrative repercussion of the decision to move No. 2 Group light bomber wings to the Continent was the very heavy tonnage of supplies, particularly P.O.L. and explosives, required to maintain them. Their maintenance on the Continent was made possible, however, by the opening of the port of Antwerp, and their continued supply, after the initial pre-stocking, presented no undue problems.

Maintenance Considerations up to the Crossing of the Rhine

The principal administrative considerations during the first two months of 1945 were concerned with the build-up of reserve to enable the maximum effort to be put forward by the force in the forthcoming spring campaign. The target date was 1 March 1945, by when it would require the force to be at its maximum strength in aircraft, trained aircrew and supplies with adequate reserves behind it. This target was achieved, and by the commencement of the spring offensive all 2nd T.A.F. squadrons were up to strength and reserves were adequate for the ensuing campaign.

The operations to move up to the line of the Rhine did not have an immediate effect on the administrative staff beyond an intensification of their efforts, as it was possible to cover these operations from existing bases, and there was no question of lengthening the lines of communication or of moving forces.

The Crossing of the Rhine and the subsequent Advance to the Elbe

The first administrative consideration for the crossing of the Rhine and the subsequent advance was the ability to supply the advancing forces from a distance through an area where railways were almost bound to be non-existent.

The main base was still located in the Antwerp area, and it would not be possible to open supplementary ports for the maintenance of the forces until, perhaps, Bremen. 21st Army Group, in their maintenance project, announced their intention of concentrating on the Hamburg area as the next location of the Advanced Base.

The Royal Air Force accordingly decided to concentrate sufficient stocks in the forward area, as close to the Rhine as possible, and on the main L. of C.

to support the whole operation. By the time the crossing of the Rhine was started, the Royal Air Force had managed to concentrate in the Goch area sufficient supplies to maintain any advance that Nos. 83 and 84 Groups might undertake. In the operations that followed the crossing of the Rhine, the rate of advance of land and air forces once again continued to exceed the rate at which they could be maintained even from the forward base just west of the Rhine. This was due partly to the completely wrecked rail system in Germany and to the bridge limitations over the river Rhine itself. Very heavy tonnages were required to support the armies in their advance, particular requirements being M.T. petrol and bridging materials. There was also an urgent need for airfield construction materials.

As with the previous advance from Normandy, so on this occasion transport aircraft were used to supplement the capacity of the 'pipe line,' and to some degree assisted in keeping up the momentum of the advancing forces. On this occasion, however, air transport resources were somewhat limited owing to the pressing requirements of 12th Army Group on the right flank. A further limiting factor was the non-availability of airfields in north-western Germany, as the majority of those uncovered were required for operational purposes or were otherwise unsuitable for transport aircraft. Such aircraft as were made available, however, brought in valuable supplies of M.T. and aviation P.O.L. and were used on their return flights for the evacuation of casualties and liberated prisoners of war.

In order to retain the closest possible control of its forces operating to the east of the Rhine, 2nd T.A.F. Headquarters were moved to Suchteln in Germany with the intention of moving it farther to the east as soon as possible. But events moved too quickly, and it was at Suchteln when the German collapse and surrender occurred, and the Headquarters did not complete its move to Bad Eilsen, its final location in Germany, until after the war in Europe had ended.

Air Transport

The fact that 21st Army Group and 2nd Tactical Air Force had no air transport aircraft at their own immediate call was a very definite handicap throughout the campaign.

Air transport was from time to time available, but to obtain transport aircraft demands had to be placed with the combined air transport operations room working under the direct control of SHAEF. This organisation, though extremely willing and co-operative, could not guarantee that aircraft would be supplied a day or a week ahead. The fact that no guarantee could be given made the planning of supply by air or the movement of air forces by air a most uncertain quantity.

The lack of foreknowledge of air transport availability made the handling of the air lift arrangements of the wings and squadrons of 2nd Tactical Air Force from Sussex and Hampshire to Normandy very difficult. Likewise, the moves from Normandy into Belgium, and again in the advance from the Rhine to the Elbe, were complicated by the fact that the availability of transport aircraft could not be relied upon.

In this respect two cases are worthy of record. The first was when the 2nd Tactical Air Force/21st Army Group Reconnaissance Wing was at Amiens during the advance from Normandy into Belgium. On this occasion, it was found necessary to use the Wellington aircraft of the night flying reconnaissance squadron to carry aviation petrol from bases in Normandy to Amiens to keep the Reconnaissance Wing operational. No other means of transport by air or ground was, at that time, available. Again, in the advance of No. 83 Group from positions just east of the Rhine to the Luneburg, Fassburg, Celle, Wunstorf area, a planned lift of aviation fuel was arranged. This lift worked on some days but not on others, and No. 83 Group eventually asked that their aviation fuel should be carried by the Army's road transport as they could not rely on air lift.

It is worth mentioning that the Ninth U.S. Air Force, operating on the right flank with the American 12th Army Group, were much better off as regards transport aircraft. This Force had 75 Dakotas frozen for their own needs, and these aircraft were under their own local control and were not removed when airborne operations were in view.

Movement Organisation

As far as is known, this campaign was the first occasion on which a R.A.F. Headquarters in the field had a complete movements staff to co-ordinate movement by air, rail, road and sea. This staff, co-ordinating all movement, functioned most successfully. Working closely with the senior equipment staff officer, and in the closest liaison with the 'Q' Maintenance and 'Q' Movements Staff of Headquarters, 21st Army Group, they were able to ensure the movement of all personnel and equipment from the United Kingdom to the Continent, and within the Continent by the most suitable method. Placing the air movement organisation under the senior movements staff officer was a new feature, and ensured a close tie-up between the four methods of movement. The organisation of the booking of passages in all Transport Command aircraft and Communication aircraft of the Headquarters Wing was found to be sound. The designation of all freight to be carried in Transport Command aircraft, whether for the Army or the Air Force on the Continent, was correctly vested in the hands of the movements staff. The movements staff, besides being responsible for the loading of all transport and communication aircraft, was likewise responsible for informing the operation agency of the time of take-off and destination of the sortie concerned. All the requests for the carriage of Army passengers or freight were passed by 'Q' Movements, 21st Army Group to the movements staff of Headquarters, 2nd Tactical Air Force.

Aviation Fuel and Ammunition

The organisation of the 2nd Tactical Air Force which, in the Overlord plan, allowed for an aviation fuel and ammunition park, under the command of each of the tactical groups and the light bomber group, to hold 10 days' stocks for the squadrons of the group concerned at the normal operational rate of effort, proved sound. Likewise, the establishment of a base aviation fuel and ammunition park under the Base Group (No. 85 Group), the latter unit holding a month's reserve stocks for the whole forces, proved essential to the efficient distribution of supplies.

There was a great deal of discussion in the Overlord planning stage as to whether the base aviation and ammunition park should be formed, as the planned intention had been to hold reserve stocks of fuel and explosives in army base depots. This intention had been officially recognised by the War Office and the Air Ministry, and was published in an official pamphlet entitled 'The Division of Responsibility between the Army and the R.A.F. for certain Administrative Services in the Field,' wherein it was stated that the holding of stocks of aviation fuel and R.A.F. explosives in the base and on the L. of C. should be entirely in the hands of the Army.

In agreement with Headquarters, 21st Army Group, and as a result of experience in North Africa, Italy and Sicily, the base aviation fuel and ammunition park was formed to hold the R.A.F. reserve stocks of fuel and explosives. This unity, which was most successful, was placed under the administrative control of No. 85 Group and under the functional control of the senior equipment staff officer of Headquarters, 2nd Tactical Air Force. This organisation proved an unqualified success and was supported strongly by the staff of 21st Army Group.

The lesson learned was that it was vital for the Royal Air Force to hold its own stocks of aviation fuel and explosives in the base, on the lines of communication and in the forward areas. The holding of the stocks must include the responsibility for calling them forward from the main base and control of the distribution of stocks within the theatre. The physical movement of stocks, both by sea into the theatre and by road and rail along the lines of communication within the theatre, must be the responsibility of the main user of the shipping and the lines of communication, i.e. the Army.

In practice, at weekly meetings held by the 'Q' Branch of 21st Army Group, the equipment staff of 2nd Tactical Air Force would bid along with services of 21st Army Group for their tonnage requirements for shipping into the theatre and for movement on the L. of C. within the theatre, and there was never an occasion during the campaign when an amicable agreement was not reached.

The question of the holding and supply forward of bulk aviation fuel was raised during the campaign. It was the responsibility of the Army in the field to build and operate bulk installations and pipe lines for the supply of aviation fuel. It was also their responsibility to distribute bulk aviation fuel direct to airfields by road tankers, either direct from the bulk installations or from pipeline head. The campaign appeared to show that it would have been better if the Royal Air Force in the Field had been supplied with a fleet of bulk road tankers and had been responsible for the distribution of aviation fuel from bulk installations in the base or from pipeline heads to airfields. In the case of aviation fuel supplied in drums and jerricans, the Royal Air Force was in complete control of distribution of stocks which were held in the Base A.F.A.P. or in Group A.F.A.P.s., and the distribution of which was entirely controlled by the senior equipment officer at Headquarters, 2nd Tactical Air Force or at Group Headquarters. Precisely the same organisation should be adopted for the distribution of bulk aviation fuel.

Calling Forward of Supplies from the Main Base

A firm lesson learned during the campaign was that it is essential that all supplies should be called forward into the theatre as and when required by the

consumer in the field, and not that the maintenance organisation in the main base should send supplies into the theatre at their own will. Such a state of affairs did occur in other campaigns, entailing unnecessary build-up and confusion in advanced base areas and unnecessary locking up of shipping, thereby preventing the vital requirements of the local tactical situation from coming through.

Efficiency of the Supply Organisation

The organisation for the supply of the Royal Air Force with reserve aircraft, aviation petrol, bombs, ammunition, technical stores, etc., functioned well. The high state of serviceability of aircraft and M.T. maintained throughout the campaign was in no small way due to able provisioning. At no time in the campaign were operational units prevented from carrying out sorties due to lack of the necessary supplies, except on occasions in the rapid forward moves of Normandy to Belgium and Holland, and again after the crossing of the Rhine. For short periods the lines of communication could not support more than two or three operational wings in the very forward areas.

The planning in Overlord allowed for the two tactical groups, Nos. 83 and 84, to be fully mobile, i.e. all the operational wings, the Group Headquarters and all its ancillary units could move forwards or backwards under their own transport arrangements. Likewise, each group had its own supply and transport column of some 300 \times 3-ton load-carrying vehicles which enabled forward airfields to be pre-stocked at the same time as the operational units were moving in to occupy them.

This arrangement proved its value throughout the campaign, and more especially in the rapid advance from Normandy into Belgium and Holland and again from the Rhine to the Elbe.

The Main Headquarters of 2nd Tactical Air Force, No. 2 (Light Bomber) Group and No. 85 Base Maintenance and Night Defence Group were established on a 'transportable' basis. This organisation was a great economy in load-carrying vehicles and proved sound. The transportable units did not have to move at great speed, and could be 'shuttled' forward unit by unit in slow time.

The value of the supply and transport column of 400 vehicles, produced rapidly and at very short notice by the Director of Movements, Air Ministry, during the move from Normandy to Belgium, and controlled throughout the campaign by the senior movements staff officer at Headquarters, 2nd Tactical Air Force, was proved again and again. At any time when a heavy requirement arose for pre-stocking airfields or moving dumps of aviation fuel and explosives from the advanced base to the forward areas, this extra column under the direct control of Headquarters, 2nd Tactical Air Force, was of vital assistance.

Base Units

The decision to hold the 2nd Tactical Air Force Base Aircraft Repair Unit, Base Equipment Holding Unit (at that time named 'The Forward Equipment Unit') and Base Hospital back in the United Kingdom until such time as a firm base area was established on the Continent alongside a base port, proved correct. Had these units been put across into Normandy in August 1944, they would

have taken up a large amount of shipping which was vitally required to carry the tactical battle needs, and they would have been left stranded far behind in Normandy for some months after the advance into the Low Countries.

With the United Kingdom base within 200 miles of the operational area, it was always possible to keep the air stores parks filled by daily Dakota services, to evacuate casualties by air to the United Kingdom, and to fly back to the maintenance depots in England such repairable aircraft as were capable of making the passage. Other aircraft were either repaired on site by the repair and salvage units of the force, or else shipped back to the maintenance depots at home in empty low loaders and 'Queen Marys.'

Once a firm base area was established in the Low Countries with powers of entry to Calais, Boulogne, Ostend and Antwerp, large base units were brought into the Continent and were enabled to settle down without a further move during the campaign. In such a static situation they proved of unlimited value.

Group Support Units

The Group Support Unit (G.S.U.) was an entirely new Air Force formation built up from Mediterranean experience, and proved its value in the campaign 100 per cent. The policy behind these units was that they should hold three pilots and three aircraft per squadron of the group they served. Likewise, a small training flight was included in the G.S.U.s to give the pilots their final operational polish under group direction, in order that they might join their squadrons capable of taking their place in the line the day they arrived. Reserve aircraft in the G.S.U.s were prepared in a similar way under group arrangements, having their guns harmonised, radios calibrated, etc., and were thus enabled to take their place in an operational formation on the day they arrived at a front line airfield. For each of the two tactical groups, the G.S.U.s held some 100 reserve aircraft and 100 pilots. It also had a ferry flight which enabled reserve pilots with their kits to be flown direct to the forward airfields.

The policy for the Group support unit was that it should be located outside enemy fighter range in order that the reserve aircraft could not be shot up, nor the final training of the pilots interrupted. This policy proved sound and, in fact, it never became necessary to bring these units on to the Continent.

Repair and Salvage Units

The policy whereby repair and salvage units were established in every two operational wings was proved right. These units were located at a wing airfield in the forward area with sections detached to the other wing they served. The units were able to remove immediately from the operational squadrons any smashed, shot up, or otherwise unserviceable aircraft that was likely to take more than 48 hours to put back into the line, an immediate replacement to the squadron being provided from the repair and salvage unit. This combined organisation enabled squadrons to maintain a daily serviceable strength throughout the campaign of at least 12 operational aircraft.

Aircraft Serviceability¹

The maintenance of operational aircraft strength throughout the campaign

¹ Despatch by A.C.M. Leigh-Mallory.

was the result of a carefully prepared plan of replacement. In this connection it is interesting to note that the forecasting of wastage and casualties by the planning staff of Overlord was sound and, since the losses were below those estimated, there were no serious difficulties of supply. The replacement pool and recovery organisation worked extremely well. The average strength and serviceability of the 2nd Tactical Air Force was as follows :—

	Fighters			Bombers		
	Average Strength	Average Serviceability	Percentage	Average Strength	Average Serviceability	Percentage
June ..	1,156	954	82.5	272	231	85.0
July	1,058	956	89.5	265	232	87.5
August ..	1,077	930	86.4	277	240	86.7
September ..	1,250	1,093	87.5	253	214	84.6

Part VIII
THE WAR IN THE FAR EAST

CHAPTER 22

MAINTENANCE IN THE FAR EAST PRIOR TO THE FALL OF SINGAPORE

The Establishment of a Base at Singapore

The decision to establish a Naval and Air Base at Singapore was made after the 1914-18 War, and by 1921 a committee had selected sites at Seletar. Progress after this, however, was slow and spasmodic due to fluctuations in the political and economic situation. By 1929 a floating dock was in position, the gun defences were proceeding and Nos. 205 and 36 Squadrons were stationed there. The completion of the defences was postponed for five years by the Disarmament Conference, but in 1933 the potential threat of Japanese aggression and the obvious weakness of Singapore resulted in the work being resumed. The first stage was accelerated and provision was made for additional air forces, together with the second airfield. As an immediate measure No. 100 Torpedo-Bomber Squadron arrived in Singapore early in 1934. The enemy forces at this time were expected to be carrier-borne, and attack from land-based aircraft or an over land invasion was discounted and emphasis was, therefore, placed upon the need for an ample air reconnaissance force, backed by suitable aircraft for attacks against shipping. In order to permit the rapid movement of air forces to the Far East the reinforcement route was to be developed by the establishment of a further three airfields.

Development of the Far East Maintenance Organisation

The policy governing the future development of the air base at Seletar in October 1934 was based on the establishment of two torpedo-bomber squadrons and two flying boat squadrons. The Base Repair and Stores Organisation was to be sufficient to deal with the peace-time requirements of the Royal Air Force and Fleet Air Arm in the Far East Command, as there were to be no squadron workshops at Seletar, this also included all the major squadron repair work.¹

The technical and domestic buildings of the existing base repair organisation were sited on the east of the airfield and comprised, in part, the already existing buildings on this site. The revised scheme called for additional accommodation and authority was therefore granted for contracts to be placed. Considerable delay, however, was caused by various changes in policy in respect of land acquisitions, the technical design of buildings and the efforts to economise financially.

By March 1937 the workshop and equipment sections at Seletar had expanded to such an extent that the work in the individual sections could no longer be adequately controlled by the normal station organisation. The A.O.C. Far East, therefore, recommended that these sections should be grouped into units under a Depot Headquarters, which in turn could be directly administered by Headquarters, Far East. Ultimately this policy was accepted and on 3 January 1938 certain domestic and technical accommodation, including two

¹ A.M. File S.32742.

hangars, was taken over to form the Aircraft Depot, Far East. In the initial stages the depot functioned as a large station workshop and undertook all the work which was beyond the capacity of the four squadrons then based at Seletar. These facilities were later extended to cover major repairs to the Fleet Air Arm aircraft and this work represented a permanent holding of at least six Walrus and/or Swordfish aircraft, and at times constituted 50 per cent of the work of the depot.¹

The building programme for the technical accommodation at Seletar was approximately two years behind schedule in the spring of 1939. This affected the expansion of the unit and caused such vital sections as engine repair to be temporarily accommodated in unsuitable buildings.

The expansion scheme 'M' for the Royal Air Force was produced in November 1938 and exceeded and incorporated all previous schemes. One of its provisions was an increase in the number of squadrons overseas to 49 and, as this would call for increased maintenance backing, the A.O.C. Far East carried out an investigation into the depot's ability to meet this commitment. In a letter to the Air Ministry in August 1939 he stated that the present capacity of the temporary engine repair sections at Seletar was only six engines per month, but that this could be raised to nine per month in an emergency. A new engine repair section was being built and was scheduled to be completed in twelve months' time. The capacity would then be twelve engines per month, but this could be raised to 15 provided the personnel were available. This would have been totally inadequate as the minimum requirement under scheme 'M' would be at least 62 overhauled engines per month. The existing congestion at Seletar without further expansion was already undesirable and the A.O.C. therefore recommended that further engine repair accommodation should be located elsewhere. He suggested that the vulnerability of the Command would be reduced if this was sited near Kuala Lumpur where technical trade schools already existed, and the supply of skilled labour would not present so serious a problem as on Singapore Island. This proposal was approved on 12 September 1939.²

The design and internal lay-out of the new depot was made the responsibility of Far East Command, but in the main the systems that were adopted were those that had already proved successful at St. Athan and Sealand. Originally it was the intention that all major repairs to components should be undertaken in the general engineering section at Seletar where certain of the necessary tools were already installed, but this policy was changed and it was decided to transfer the necessary equipment from Seletar and establish a general engineering section at Kuala Lumpur. Eventually a plan for the depot was produced and the Treasury Interservice Committee proposed that the sum of £275,000 should be allocated for this purpose. The estimated time for completion was 12 to 18 months, but every endeavour was to be made to reduce both the period of construction and the cost of the project. Efforts to find suitable temporary accommodation were not successful. At this point the Admiralty stated that they did not desire to be included in the scheme and this enabled the planned output of engines to be scaled down from 100 to 50 engines per

¹ A.M. File S.40760. A.M.O. N.1007/37.

² A.M. File S.55833.

month and reduced the depot to five Bellman hangars and the necessary barrack accommodation. It was expected that these buildings would be ready in June 1941 and that the cost would now be £120,000.

During 1940 modern aircraft started to arrive in the Command and this soon revealed the necessity for an efficient and well-equipped maintenance organisation at Seletar. In the United Kingdom the operational commands could turn to Maintenance Command and the aircraft industry for the necessary backing; Singapore 8,000 miles away could not do this. Consequently the depot was called upon to produce equipment which under normal circumstances would have been demanded from the United Kingdom. The general engineering section at Seletar had expanded from a 'four squadron station workshop' and this task proved that it was quite inadequate for its new role. Throughout there was an acute shortage of space and equipment and some sections had at times so much work in hand that they were unable to accept any further orders for a period of six months. Several additional workshops were required, but this was not pursued because the time taken for a decision and the ultimate completion of another building was anticipated to be anything from several months to three years.¹

At the outbreak of hostilities in Europe the strength of the Aircraft Depot, Far East, included 206 Asiatic tradesmen consisting of Chinese, Malays, Indians and Eurasians. All these tradesmen proved themselves to be quite efficient when properly supervised by British other ranks. As the output of the depot in May 1940 was 70 per cent more than the previous year some degree of their usefulness can be appreciated when it is realised that the strength of the British other ranks had remained unaltered, whilst that of the Asiatics had increased to 391.

To ensure adequate supervision and to meet the operational needs of the depot it was decided with effect from 12 August 1940 to mobilise the Asiatic tradesmen and to form a Special Technical Corps. The first enlistment was effected on that day and by the end of the month there were 112 personnel on the strength of the Corps. Some of these were local volunteers whilst 44 came direct from the Government trade schools in Malaya. The organisation necessary for discipline, billeting and training operated quite smoothly in the initial stages, but later it was found that a separate administrative staff should have been established. Certain of the special training corps were therefore given N.C.O. rank. By September 1940 the number of personnel had risen to 297, but many of these required further training before they could be usefully employed. The applications for enlistment were numerous, but only 20 per cent of these succeeded in passing the requisite trade tests. There was no accepted establishment for the Special Technical Corps and personnel were enlisted as required by the Air Headquarters, Far East.

There was a considerable number of civilian engineering firms in Singapore which were staffed by Asiatics. If these firms had been properly organised they could have been extensively used for the manufacture and overhaul of Air Force equipment, thereby relieving the pressure of the sorely taxed base maintenance organisation. No attempt, however, was made to initiate a

¹ No. 151 M.U., O.R.B., September 1940.

comprehensive civilian repair organisation and such work as was given to local firms followed the pre-war procedure known as local purchase. Certain engineering officers of No. 151 Maintenance Unit were appointed as inspectors to certify that this work was up to standard. Barrack furniture, required to equip the newly-opened station, represented the majority of the work undertaken, although towards the end of 1941 an increasing number of technical items were included in the programme. As these mainly consisted of items which had been previously developed and manufactured by the Service, their production by local tradesmen was considerably simplified.¹

In March 1941 Air Headquarters, Far East, established No. 221 Group in Burma, No. 224 Group (Cadre) for air operations in Singapore and No. 222 Group (Cadre) to control flying boat operations from Ceylon. Even so the Headquarters suffered increasingly from the lack of decentralization. A chief Maintenance Officer (C.M.O.) was not appointed, nor was there established a purely maintenance group and the highly complex problem of maintenance and supply remained in the hands of two separate staff officers at Air Headquarters.

The aircraft depot at Seletar was re-named No. 151 Maintenance Unit in June 1941. A party was sent to Kuala Lumpur to open up the by now completed Universal Equipment Depot and Engine Repair Section (No. 153 Maintenance Unit). The development of airfields in Burma needed to be covered by an equipment unit in that area and consequently No. 154 M.U. commenced to operate in July, on a temporary basis, at Mingaladong. Another universal equipment depot was needed on Singapore Island in order to relieve the acute congestion of stocks at Seletar, and a site was found in May at Bukit Panjang. Stocks were moved in July and No. 152 Maintenance Unit was officially opened in August 1941. No. 81 Repair and Salvage Unit arrived by sea at Singapore in August and was based at Kluang, Johore Straits. Later in the year two air ammunition parks were formed, one at Seletar and one at Batak Quarry.²

No. 151 Maintenance Unit, Seletar

This unit consisted primarily of the universal equipment depot, engine repair section, general engineering section, mechanical transport maintenance unit and a marine craft overhaul section. A group captain was in command with wing commanders holding the posts of chief technical officers and chief equipment officers. There was a permanent shortage of personnel who had experience of 'modern' Royal Air Force methods, whilst several of the newly-created engineer officer establishment had to be met by the commissioning and promotion of personnel within the unit. Early in 1941 the approximate strength of the unit was 900 British, 600 enlisted Asiatics, and 200 native artisans.

During 1940 it had been found necessary to work two shifts a day, but by 1941 the pressure of work necessitated continuous shifts throughout the 24 hours. Opposing this effort there was a considerable loss in man-hours as the result of technical personnel being called upon to perform station duties, and the climate in Singapore was particularly oppressive.

¹ Interview—Wg. Cdr. Saw.

² For the operational aspect of the campaign the reader should refer to the A.H.B. Narrative, *The Campaigns in the Far East, Vol. II, Malaya, Netherlands East Indies and Burma*.

About this time the Commander-in-Chief visited the unit and issued instructions that a certain degree of dispersal was to be undertaken in respect of fuel, aircraft, and engine spares. All buildings were to be traversed with 10-ft. high sandbag walls. The latter instruction was carried out, but it was not until well after the Japanese invasion of Malaya that any real effort was made to disperse the unit, when the engine repair section took over a section of the Ford motor works in Singapore. In every department of the unit there was a shortage of space, spares and equipment. Such items as ring and bead sights for ground machine guns, bomb fusing spanners, belt positioning tools for .303 and .5 ammunition, parallel brass rules for navigators, complete course and distance indicators for aircrew, torpedo carrying trolleys, exhaust rings for Bristol engines, are typical examples of the work undertaken in the general engineering section. The stock and variety of materials required for the fabrication and repair of components was never adequate despite the early provisioning action that had been taken, and this resulted in an excessive number of man-hours being expended on crude improvisations.¹

A batch of Blenheim IV's arrived in May and were erected by the usual production line methods, although a distinct lack of spares again resulted in several improvisations. In the same month it was decided that two new fighter squadrons should be formed in the Far East Command and equipped with the first consignments out of a total of 170 Brewster Buffalo aircraft which were being shipped direct to Singapore from America. Each squadron was to be established at 14 I.E. and 2 I.R. aircraft and organised on a two-flight basis. To ensure maximum flexibility in the Command and to allow for the consequent formation of additional squadrons, five sets of ground equipment were demanded. The aircraft commenced to arrive at Singapore on 17 February 1941 and deliveries continued over several weeks. Records that accompanied the aircraft indicated that they had been stored effectively, all the engines had been inhibited and one aircraft in 20 had been test flown. Erection was organised on a double production line under two parallel gantries, and work proceeded 24 hours a day. The aircraft were moved forward as the various stages were completed until they were finally passed to flight test and despatch sections which operated from an adjoining hangar. The erection of the first few aircraft was carried out without any guidance or data and it soon became apparent that a detailed inspection would be required on each one in order to clear up several minor faults. To save weight and improve the performance, the .5 guns were removed and replaced by .303 calibre, the necessary ammunition carriers and spent cartridge chutes being manufactured locally. Two of the aircraft were prepared for photographic reconnaissance duties by stripping all unnecessary equipment and fitting 20-inch lens cameras and long range fuel tanks. The total number of modifications on each aircraft was 33 and this slowed down the rate at which they could be prepared. Five squadrons were eventually formed and their ground technical personnel detached in parties to No. 151 Maintenance Unit to gain experience in servicing the new type.

In July 1941 the overhaul of five Singapore flying boats, which had previously been regarded as beyond repair, was commenced. These aircraft were the only ones that could be obtained for safeguarding thousands of miles of shipping so that every effort was made to overhaul each boat on time. About 300 men worked

¹ M.R.S. 2155.

directly and indirectly on the commitment, and the time taken to complete each boat was approximately five weeks. The hulls and wiring were in a very bad condition, and fabric had to be renewed and numerous components such as ribs and brackets required replacing, the main spars throughout the hull were so corroded that in several places sleeves had to be fitted. The engine repair section overhauled the Kestrel engines. When brought to operational standards the aircraft were flown to the Fiji Islands by crews of the Royal New Zealand Air Force.

A quantity of Hudson aircraft arrived by sea and were off loaded on to barges and taken to Seletar. Erection was commenced the same night despite the lack of tools and technical publications, and by the time the American Hudson test team arrived the erection of the whole consignment was well advanced. The aircraft had not been provided with any machine-gun mountings so an appropriate modification was produced and embodied. The Wirraway aircraft, which arrived from Australia, were extremely simple to assemble and required only one modification, that of fitting sirens to frighten the Japanese.

Shortly before the commencement of hostilities in the Far East, a 'factory' was organised on the unit to produce dummy aircraft. These aircraft were mobile and exact in every detail. Jigs were used so that unskilled tradesmen and such personnel as were in transit could be employed in their manufacture. Approximately 50 aircraft were completed. Air Vice-Marshal Pulford and the commanding officer of the unit devised an operation whereby dummy aircraft in crates, painted on the outside to indicate genuine Hurricanes, were conveyed through the town. Several hold-ups were conveniently arranged before they were returned to Seletar. The hoax appears to have been a complete success, in fact, so near to the original were the aircraft that the Army requested the manufacture of dummy artillery and machine guns.¹

On 7 December 1941 the Japanese struck at Pearl Harbour, and on the following day a high-level bombing attack was made on Seletar by two formations of enemy aircraft, two airmen were killed and a certain amount of damage was done to the technical accommodation. Within a few days a considerable number of aircraft that had been in combat with the enemy were flown into No. 151 Maintenance Unit for repair. A special section was established at the unit with a working limit of four days on any one aircraft. Additional sections were organised to handle crashed aircraft on Singapore Island as the main element of No. 81 Repair and Salvage unit had, by this time, proceeded north to assist the operational squadrons. Throughout December work continued at high pressure both by day and by night, several hundreds of aircraft were resurrected and numerous aircraft modifications designed and embodied. On 25 December half of the aero-engine repair section was dispersed to the Ford Motor Works in Singapore whilst arrangements had already been made with the Works and Building Department to dismantle three hangars at Seletar and re-erect them at selected sites a mile or so outside the aerodrome perimeter. These hangars were to serve as aircraft component, repair and assembly shops; unfortunately this work was not completed before the evacuation. During December only a few desultory night raids were made on Seletar, but in January the attacks began in earnest and five or six concentrated raids

¹ Interview—Grp. Capt. Walkington, March 1947.

were made during daylight. By the end of January the unit's technical buildings were so badly damaged as to render them unusable, unit headquarters had received a direct hit and the annexe housing the equipment records was destroyed. On 2 February 1942, after a particularly heavy raid, it was decided to accommodate all personnel of the unit in tents pitched amongst the rubber trees along the Seletar road.

Meanwhile in January 1942, owing to a delay in the establishment of an erection unit in Java it was decided that a number of cased Hurricanes, due to arrive as reinforcements by sea, would have to be erected at Singapore. The unit therefore selected two erection sites, one about $\frac{1}{4}$ mile from Tengah airfield and the other just outside the perimeter fence at Seletar. Every preparation was made for the reception of the much needed aircraft, tracks were prepared to the site and gantries erected to facilitate the unloading. The morale of all personnel in the unit rose as it became generally known that Hurricanes were due to arrive and as a result all worked harder than ever. On 14 January 1942 when the ships docked at the naval base it began to rain and it continued almost without a break for more than 24 hours. By the time the first cases were unloaded at the dispersal sites the ground was a quagmire and all vehicles including tractors became 'bogged.' The decision was then made to erect as many as possible in the large hangars at Seletar and a smaller number at the two dispersed sites. The storage site which had been selected for the cased aircraft awaiting erection proved to be quite unusable. In less than 36 hours after the first crate arrived at the hangar, the first Hurricane had been flight tested, and in three days the commanding officer of the newly-formed No. 232 Fighter Squadron, led five aircraft into battle against enemy aircraft that were attacking Singapore. Unfortunately, in full view of the unit, three of the five Hurricanes including that flown by the commanding officer were shot down. However, within seven days the whole 51 aircraft had been erected and were serviceable and ready to fly. All the aircraft were found to be in perfect condition for speedy erection.¹

The Equipment Organisation at Seletar

In the early period when the Far East Command was very largely static, the equipment section of the depot proved itself to be quite adequate. When the expansion of the Command commenced it soon became apparent that the whole aspect of the equipment organisation had been under-estimated.

The quantity of packing cases that were permanently waiting to be opened continued to grow, and it was conservatively estimated that there were several thousands of such cases by the end of 1941. This was due partly to the acute shortage of equipment assistants and unskilled labour in the receipt and despatch sections of the unit, and also to the fact that the packing cases were inadequately marked to indicate their contents. The Royal Air Force cases were usually stamped with the stores vocabulary reference only, whereas the packing cases from American sources had a convenient external compartment in which could be found a complete list of all the contents. The R.A.F. procedure meant in effect that the equipment personnel often had to open several cases in order to locate one particular stores item and this resulted in vital delays in the final stages of the campaign.²

¹ M.R.S. 2155.

² Interview—Grp. Capt. Walkington, March 1947.

There was an extreme shortage of all kinds of equipment necessary for the maintenance of aircraft and for the continued expansion of the Command, promises of equipment from Australia, and to a lesser extent India, were not always implemented. Furthermore the whole problem of provisioning for equipment was complicated by an Air Ministry instruction of August 1940 to the effect that only equipment not available from the Commonwealth countries was to be demanded from the United Kingdom. The policy of a central provision office was not energetically pursued and it was not until November 1941 that a master provision officer reached Singapore. By that time an office had been established and a copy of the M.P.O. scheme had been studied by the personnel concerned. The essential forms were designed and sent to the printers whilst the equipment units at Seletar, Bukit Panjang and Kuala Lumpur were visited to explain the need for, and the principle of, the scheme. The office building was ready for occupation at the beginning of December 1941 and authority was received to engage 26 female clerks. After hostilities had commenced and it was decided to transfer No. 153 Maintenance Unit from Kuala Lumpur to Java an amended master provisioning scheme was evolved. Time was short, however, and it became necessary to cancel the master provisioning projects and to use the personnel to establish a unit at the 'Great World' Armament Park for the sorting and storage of equipment salvaged from the airfields from the mainland which were at this time being occupied by the enemy. The absence of a master provisioning office had the effect of multiplying the work of Nos. 152 and 153 Maintenance Units and overburdening No. 151 Maintenance Unit at Seletar.¹

The congestion of the equipment stocks at Seletar resulted in a universal equipment depot (No. 152 Maintenance Unit) being opened on Singapore Island at Bukit Panjang in August 1941, the barrack equipment being supplied in large quantities from Australia, India and local contractors was handled almost exclusively by this unit. Later, approximately one third of the Command holdings of aircraft spares were taken over from No. 151 Maintenance Unit. The resulting procedure was slow and in consequence it became necessary for Air Headquarters to amend the system on the outbreak of hostilities by allowing both units to receive copies of demands simultaneously, the parent unit took accounting action whilst No. 152 Maintenance Unit made an immediate issue. When the Japanese landed on Singapore Island a complete denial policy was carried out, and the unit embarked for Java on 10 February.

No. 153 Maintenance Unit, Kuala Lumpur

On 1 June 1941 an advance party proceeded from Singapore to open the engine repair depot at Kuala Lumpur. At the end of the month its title was changed to No. 153 Maintenance Unit and a universal equipment section was added to the establishment. By October 1941 the unit was still in the process of 'building up' with the engine repair section and general engineering sections working considerably below their planned capacity. An airframe repair section was under construction at the civil airport, and the universal equipment section was in the process of accumulating stores from No. 151 Maintenance Unit.

The total output of the engine repair section by 29 November 1941 was only 12 engines owing to the proportion of inexperienced fitters, and to the acute

¹ M.R.S. 2155.

shortage of hand tools. The outbreak of war with Japan found No. 151 Maintenance unit in the process of despatching one third of its equipment to No. 153 Maintenance Unit. Between 8 December and 20 December quantities of barrack equipment were also received for issue to new R.A.F. stations north of Kuala Lumpur.

Aircraft Repair and Salvage

The limited resources of the Command in aircraft and equipment, and the irregularity of the receipt of normal aircraft replacement stores, accentuated the necessity for salvaging and repairing everything possible from crashed aircraft. The fullest possible use was therefore made of No. 81 Repair and Salvage Unit, which arrived in the Far East by sea in August 1941. The formation of the unit did not occur until 19 September 1941 and in the interim period the personnel were utilised for technical work at No. 151 Maintenance Unit, Seletar. When formed the unit was divided into four mobile salvage sections controlled by the normal repair and headquarters sections.

The unit was based at Kluang, Johore Straits, and carried out all the salvage work in southern Malaya. Two of the sections were detached to Singapore Island to recover aircraft salvaged in that area. The salvage of aircraft was invariably difficult on land due to the nature of the country which was mainly either rubber plantations, jungle or swamp. Railway facilities were limited and the roads (apart from the main roads) were little more than cart tracks which became practically impassable in the heavy daily rain. Very often the salvage parties had considerable trouble in locating the crash due to language difficulties, the unreliable information given by natives and the limited range of vision in the jungle. This meant that a systematic combing of the reported location of a crashed aircraft was generally necessary, and on many occasions parties were not allowed to proceed beyond a certain point owing to the uncertain military situation. Repair on site was hardly ever possible except on airfields and landing grounds. Salvage from the sea was rarely possible but there were one or two occasions when assistance was obtained from the Navy. The inevitable delay, however, in completing the arrangements resulted in the deterioration of many parts by corrosion.

After the outbreak of hostilities the unit, with the exception of a small party left behind to maintain the operational training aircraft, proceeded north to R.A.F. Station, Teiping.¹ By this time the Japanese had landed and were advancing on the northernmost airfields and it became necessary for all R.A.F. personnel to withdraw.

The Evacuation of Malaya and Singapore

Approximately a week after the outbreak of hostilities No. 153 Maintenance Unit at Kuala Lumpur was warned that evacuation of the station was probable and on 28 December 1941 the first party left for Singapore where they were accommodated in a transit camp. During the following twelve days they were joined by the remainder of the unit. Instructions had been issued to move all the essential equipment for servicing aircraft and consequently large quantities of stores arrived at Kuala Lumpur from the R.A.F. stations farther north.

¹ M.R.S. 2155, Encl. 16A.

This threatened to create a bottleneck which was only overcome by diverting every available vehicle to the task of evacuation and by reducing the time taken for the journey to Singapore from two days to twelve hours.¹

During the withdrawal down Malaya to Singapore the sections of No. 81 Repair and Salvage Unit operated independently and assisted in the evacuation of each R.A.F. station in turn. Large quantities of technical stores were salvaged and sent southwards either by road or rail. Aircraft were repaired and flown off but where this was not possible vital equipment was removed and the aircraft destroyed. Dummy aircraft were erected on imitation landing strips. One lengthy retirement brought the bulk of the up-country sections together at Kluang, but enemy air attacks forced them to move into a tented camp about three miles away. Here, under the cover of the rubber trees, the transport vehicles were parked and overhauled, whilst work at the airfield was continued during the hours of darkness. By the end of January 1942, most of the sections had reached Singapore where they proceeded to give maintenance assistance to the Australian and Netherland squadrons based at Sembawang.

When the enemy crossed the border of Northern Johore on 14 January it was soon realised that the Royal Air Force would be confined to the four airfields on Singapore Island. Not only would these stations become easy targets for the Japanese Air Force, but the likelihood of incoming reinforcements would still further increase the dangers of congestion. Dispersal beyond the dangerous limits of the island was imperative and plans which had been made for evacuation were commenced. No. 151 Maintenance Unit resurrected four Swordfish and made them operational. Apart from these and the fighter force, all other serviceable aircraft had left for the Netherlands East Indies by 31 January. Any unserviceable aircraft which remained, unless repairable within seven days, were struck off charge.

No effective defences had been prepared to resist an invasion of Singapore from the north and the eventual evacuation of the base was therefore inevitable. The Commander-in-Chief issued instructions that arrangements should be made to evacuate stores from the island.² Preliminary arrangements to move men and materials to Sumatra had been made as far back as 5 January but even by the 18th they were still awaiting shipping in Singapore. It was estimated by the chief equipment officers, A.H.Q., that 30,000 shipping tons space would be needed for the proposed moves from Singapore. Already there was an accumulation of 1,000 tons awaiting transfer, and no shipping was available.

Orders were given on 21 January for two-thirds of Nos. 151 and 152 Maintenance Units to be sent to the region of Batavia, the remainder were to be formed into a repair and salvage unit and an air stores park to cover the requirements of the fighter force. Most of the undamaged equipment at the depot had by this time been moved to a camouflaged dispersal site. A packing section was now organised and as the equipment was crated it was sent down to the docks. Everything had to be moved by sea and towards the end of the month work at the docks continued day and night. No. 153 Maintenance Unit was got away and loading was now concentrated on technical equipment, heavy machinery, vehicles, airfield construction equipment and explosives.

¹ M.R.S. 2155, Encl. 5A.

² A.H.B./II J50/2 and A.H.B./II J53/5.

The docks were being bombed and dock labour began to disappear and had to be replaced by service personnel. Some ships had to be loaded by lighters in the roads whilst others, despite the bombing, came right into the berths. Many vessels were sunk and damaged in the harbour and crews deserted. Embarkation plans became disorganised and units became scattered and separated from their equipment. Even when the ships had put to sea the danger was not past for the Japanese air attacks inflicted heavy losses, and large quantities of equipment, including M.T., never reached its destination.

A party consisting of 11 officers, 296 airmen and 145 Asiatics of the Special Technical Corps, left Singapore by sea on 6 February but the ship was forced to return to port twice due to crew shortages and finally got away on the 8th by making good the deficiencies from airmen volunteers.

By that time the Japanese had started to shell the tented camp and light bombardment continued from thence onwards. Conditions were rapidly deteriorating and orders were received to destroy all secret documents and to spike all oil drums. Very soon Seletar was under fire from Japanese mortars across the Straits of Johore and any movement in daylight drew instant fire. Salvage work however was continued under the cover of darkness but with no adequate lighting.

The air defence of Singapore came to an end on 9 February when, after a day of battles against overwhelming odds, the A.O.C., realising the hopelessness of the situation, gave orders for the few remaining aircraft to leave next morning for Sumatra. At first light the last eight Hurricanes took off from Kallang, and led by two Hudsons set course for Palembang. These men of No. 488 Squadron had no prior experience of the Hurricane, yet despite this and the lack of tools and spare parts they had somehow managed to maintain 100 per cent serviceability. Of the eight Hurricanes which made the sea crossing to Sumatra only one failed to reach base—it burst into flames a few miles from the airfield but the pilot managed to escape by parachute.

General Wavell visited Singapore for the last time on 10 February. Rapid progress had been made by the enemy and although a counter-attack was to be mounted he had little confidence in any prolonged resistance. He therefore ordered the immediate evacuation of all the remaining R.A.F. personnel and at the same time ordered the Deputy A.O.C. to take charge as soon as possible. Some of the senior staff officers, including the senior engineer and armament officers, were now evacuated by air, but the A.O.C. remained.¹

The events of the last few days in Singapore are recorded from the memories of a handful of officers who remained almost until the end. Airfields were ploughed up; Seletar, the oldest station, was the first to be destroyed. All the equipment which had been removed from the depot was eventually crated but the shortage of transport and the absence of coolie labour at the docks meant that considerable quantities had to be left behind. The shipping state went from bad to worse and it became obvious that there was no hope of loading the equipment which had been so arduously packed. Instructions were therefore issued to damage as much of it as possible and some 57 aero-engines alone were

¹ A.M. File C.28801/45 Encl. 27A, para. 27.

smashed to pieces with sledge hammers. Although much vital equipment was destroyed, large quantities which had been salvaged from the up-country stations had been temporarily housed within the city itself and in consequence destruction by fire was impossible.

The final draft of No. 151 Maintenance Unit left Singapore with a cruiser escort on 12 February. Both ships were heavily attacked en route and sustained casualties. They arrived at Batavia four days later.

The remaining garrison were given permission to surrender at their own discretion and on 15 February a deputation was sent to the Japanese lines. An unconditional surrender was agreed to, hostilities ceased at 2030 hours—Singapore had fallen.¹

Strenuous efforts were made to set up a working maintenance organisation in the Netherlands East Indies. Two repair and salvage units were formed with dispersal areas and improvised workshops, one at Palembang and one at Batavia. On the morning of 11 February the erection commenced of Hurricanes, ex H.M.S. *Athene*, and by the 14th seventeen of these had been completed and flown to Palembang. Ships carrying equipment and spares had been sunk, whilst the stores arriving in ships which had been diverted from Singapore could not quickly be identified as cargo manifests were often not to hand. The deficiencies had to be made good wherever possible by purchase or loan from the Dutch Air Force. Events were, however, moving too fast and evacuation from Java to Ceylon was commenced on 27 February 1942.

¹ Percival Despatch paras. 580, 581, 582. Details of the operational aspects of the defence of Singapore and the final evacuation will be found in the A.H.B. Narrative, *The Campaigns in the Far East, Vol. II, Malaya*.

CHAPTER 23

THE DEVELOPMENT OF A BASE MAINTENANCE ORGANISATION IN INDIA TO SUPPORT THE EXPANSION OF THE AIR FORCES

The Early Attempts to Develop the R.A.F. in India¹

A scheme was commenced in July 1939 to provide India with sufficient Blenheim I aircraft to re-equip their four bomber squadrons. Nos. 11 and 39 Squadrons were the first to re-equip, but no sooner had they received their first Blenheims than they were transferred to the Far East Command. In August 1939 No. 60 (Bomber) Squadron began to re-equip with Blenheim Mark I aircraft. The role of the Air Force in India in 1939 was not one which demanded or could expect a high standard of modern equipment and aircraft and, at the outbreak of war with Germany, No. 60 Squadron was the only unit in India which possessed a number of comparatively modern aircraft. That these forces were only suited to the limited role of tribal operations within India's borders describes not only their function but their capabilities. To fulfil this role, that of watch and ward, coupled with proscription bombing that was more deterrent than damaging, there were available² :—

- No. 5 Squadron, R.A.F. (Wapiti).
- No. 20 Squadron, R.A.F. (Audax).
- No. 27 Squadron, R.A.F. (Wapiti).
- No. 28 Squadron, R.A.F. (Audax).
- No. 31 Squadron, R.A.F. (Valentia).
- No. 60 Squadron, R.A.F. (Blenheim I).
- No. 1 Squadron, I.A.F. (Audax).

Not one of these aircraft was considered to be operationally first line by the Metropolitan Air Force at that time. Nos. 5, 20, 28 and 1 (I.A.F.) Squadrons were Army Co-operation Units, Nos. 27 and 60 Squadrons were bomber formations and No. 31 Squadron was classed as a Bomber/Transport Unit.

Of these squadrons, No. 27 Squadron was employed as a flying training school and No. 60 Squadron had small detachments of from two to four aircraft at Karachi, Bombay, Madras and Calcutta for coastal defence duties. The remainder of the squadrons were limited to the north-west frontier. The units comprising this small force were, according to peace-time standards, well equipped for the duties they had to fulfil.

The requisite bases, without which a modern air force could not operate, were, however, entirely without the best equipped and laid out airfields. Of those at Lahore, Peshawar, Miranshah and Ambala, not one possessed a runway of more than 1,100 yards. Although this was not essential, considering the take-off run of the aircraft involved, they would have been unsuitable as bases for aircraft fit to wage offensive or defensive war against a major power.

¹ The full details of this aspect are given in the A.H.B. Narrative, *The Campaigns in the Far East, Vol. III, India Command*.

² A.H.B./II J50/47/21, Modernisation of the Air Forces.

Moreover, all these bases were situated in the north-west, remote from what was to become the area of operations. During 1940 the pre-occupation with the war in Europe resulted in India being left low on the list of priorities. As development went on apace in England without the corresponding advance in India, the gap between the efficiency of the air striking power of units in the two areas increased.¹

Nos. 11 and 39 Squadrons returned to India from the Far East in April 1940, but were immediately lost to the Command on being transferred to Aden to meet pressing operational needs in the Middle East. The only progress made in 1940 was the formation of a flying training school to relieve No. 27 Squadron and the formation of five coastal defence flights to release No. 50 Squadron for service on the north-west frontier as a Blenheim bomber squadron. To increase the air striking force, No. 5 Squadron was converted from an army co-operation role to that of bomber, but the only bomber aircraft available were obsolete Harts.

Some attempts were made in 1940 to obtain modern aircraft for the squadrons in India. Negotiations commenced in June 1940 for the erection of an aircraft factory in India wherein it was hoped that machines for the R.A.F. and I.A.F. squadrons might be built. But trouble was experienced in obtaining the necessary materials since these would have to come from Britain. In December 1940 a contract was signed by the Hindustan Aircraft Company. Under this contract the company, whose factory was being built near Bangalore, undertook to construct 24 Vultee bombers and 30 Harlow trainers. Materials for the trainers were to be obtained direct from the United States whilst the bomber material was to come out of the allocation to the Chinese Government by the United States. It was expected that the Hindustan factory would commence production of Harlows in May 1941 and of bombers in the following December. On completion of this contract it was hoped to construct enough Mohawk fighters to equip two squadrons.² By the beginning of 1942 no aircraft had been erected mainly owing to the difficulty of obtaining skilled labour. The factory was subsequently relegated to the task of overhaul and repair of flying boats.

Events in 1941 followed a similar course to those of the previous year. Promises which had been received for the delivery of Vengeance and Mohawk aircraft were not fulfilled. The lack of response to India's appeals was due to two factors. Firstly, the overriding priority of the Far East demands consequent upon the growing Japanese threat and, secondly, the unforeseen delays in American production. The greatest disappointment for India in 1941, however, was the loss of her only two comparatively modern squadrons which moved to Singapore and Burma in February. Moreover, India's solitary bomber transport squadron, which received its first DC2 aircraft in May 1941, spent most of the year operating in other commands.³

India's greatest need was for modern fighter aircraft to defend the vital industrial areas of Bengal and Assam. No. 5 Squadron was, therefore, converted from bomber to fighter role with an equipment of Audax aircraft. After a period in West India the squadron moved to Calcutta in December 1941 for the defence of that city. No. 146 Squadron was formed in October with Audax fighters and in November moved to Assam.

¹ A.H.B./II J50/47/19, Expansion of the Air Force.

² A.H.B./II J51/15/6, Quarterly Reports by the A.O.C.

³ A.H.B./II J50/47/19, Expansion, September 1939 to December 1943,

The expansion of the Indian Air Force progressed a little in 1941. No. 2 Squadron was formed on 1 April and was equipped with Wapiti aircraft and No. 3 Squadron came into being on 1 October equipped with Audax. Both squadrons were classed as army co-operation units. The year did not, however, see the hoped for modernisation of the squadrons and they were forced to watch their machines and equipment becoming increasingly obsolescent and their efficiency as an air striking force grow progressively less.

Thus at the outbreak of war with Japan in December 1941, the Air Force in India, bereft of its two most modern squadrons, was already an ineffective force. In January 1942, No. 1 Squadron I.A.F. and No. 28 Squadron R.A.F. were both moved to Burma. No. 31 (Transport) Squadron with 12 serviceable aircraft in India was also sent to the Burma front to assist in the evacuation of British forces and civilian refugees.

Prior to March 1942, the Royal Air Force in Ceylon was controlled by the Far East Command, but after the fall of Malaya and the Netherlands East Indies, the responsibility for R.A.F. units in the Island was taken over by Air Headquarters, India. At the time of the transfer of the Command No. 222 Group at Colombo had under its control¹ :—

R.A.F. Station, Koggala

No. 205 Squadron Det.	2 Catalinas.
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China Bay (Trincomalee)

No. 273 Squadron	4 Vildebeests.
Station Flight	4 Seal aircraft.

Ratmalana (Colombo)

No. 273 Squadron Det.	..	..	..	..	1 Vildebeest.
					1 Seal.

Advanced Flying Boat Bases

Male, Maldiv Islands, Diego Garcia, Chagos Archipelago, Port Victoria, Seychelles, Port Louis, Mauritius ; Mombasa, East Africa ; Lindi, East Africa ; Dar-es-Salaam, East Africa.

R.A.F. Depot Ships

<i>Shen King</i>	}	when on East
<i>Tung Song</i>		Indies Station.

Reorganisation

The build-up of the India Command was largely conditioned by the war situation in other theatres and it was, therefore, not until March 1942 that the Chiefs of Staff agreed that the time had come to expand and develop the air forces in this area. This expansion of the air forces necessitated some subdivision between operations, training and maintenance and led in due course to a general reorganisation of the Command.

¹ No. 222 Group O.R.B., September 1941.

In March 1942 there were but two group headquarters in India, No. 1 (Indian) Group at Peshawar controlling air operations on the North-West frontier, No. 222 Group at Colombo responsible for the control of the R.A.F. units in Ceylon and at the island bases in the Indian Ocean. In addition, there existed a nucleus of No. 2 (Indian) Group at Lahore which had been formed with the intention of undertaking the training of air force personnel in India, a scheme which did not reach maturity.¹

During the second quarter of 1942 the group organisation was expanded to the scale of seven headquarters. On 12 March remnants of the original No. 221 Group of Rangoon re-formed the Headquarters at Calcutta and on 1 April No. 224 Group came into being. No. 221 Group was made responsible for all bomber and general reconnaissance operations on the Burma front and over the Bay of Bengal, and No. 224 Group for all fighter operations in Bengal and Assam.

In Ceylon, No. 222 Group retained its former function. In the north-west, No. 1 (Indian) Group became No. 223 Group on 1 May and continued to fulfil the same role. No. 2 (Indian) Group was disbanded and in its place there arose No. 227 (Training) Group with Headquarters at Lahore. In the south, No. 225 Group formed at Bangalore on 22 April as a composite headquarters vested with the charge of air force units in the enormous land area ranging from Cape Comorin in the south to Sind and Orissa in the north-west and north-east respectively. To complete the group organisation, No. 226 (Maintenance) Group formed on 9 May at Karachi, the principal port and air terminal through which reinforcement aircraft for the India Command were to flow.

Early in the expansion period it became evident that the control from New Delhi of operational groups in north-east India was impossible as it was over 850 miles from Calcutta. In order to overcome this problem it was decided that a new command within the Command, as it were, would have to be formed. The justification for this unusual arrangement was once again the tremendous distances and poor communications in India. The direct control of the two operational groups in Bengal was, therefore, taken over by the new headquarters called Bengal Command, located at Barrackpore, a suburb of Calcutta, and acted as the A.O.C.-in-C.'s Advanced Headquarters in the field.

Before 1942 had run its course, further reorganisation had been effected. In making No. 221 Group and No. 224 Group responsible for bomber and fighter operations respectively, the area in which their units were dispersed was so large that adequate control and maintenance was virtually impossible. Moreover, the offensive operations due to take place in Arakan in December 1942 made it necessary for a group headquarters to be located farther afield alongside the army division which was to engage the enemy. Nos. 221 and 224 Groups, therefore, became composite formations, the former at Calcutta controlling bomber, coastal and fighter operations of units based in western Bengal, and the latter moving to Chittagong whence they controlled all offensive and defensive fighter and light bomber squadrons along the entire Burma front from north-east Assam to the Mayu Peninsula.²

Simultaneously with the reorganisation of the operational groups in Bengal, it was decided to adopt the Middle East system of mobile wings operating under

¹ A.H.B./II J50/47/20. A.M. File S.101057.

² A.H.Q. Bengal O.R.B. Appendix 'D,' August 1943.

the operational group headquarters, each wing having its own air stores park and repair and salvage unit. This organisation was brought into being in October 1942 in the Bengal area and was later extended to other operational groups in India. Ceylon, however, was not included since the area of the Island was so comparatively small that mobility was not of any great importance.

Expansion of the Squadrons¹

In March 1942 the Chiefs of Staff agreed that the squadron target for the India Command should be 64 plus one transport squadron and a photographic reconnaissance unit. Towards the end of the year this target was increased to a total of 83 squadrons, as a long term policy, a number judged to be necessary if India and Ceylon were to be defended adequately and if sufficient air support was to be provided during the re-conquest of Burma.²

April 1942, therefore, saw the inception of an all-embracing programme of development of a force which had remained static during a period of rapid advance in other theatres. The immediate reinforcement of Ceylon against the possibility of a Japanese invasion had already taken place in February when the Island's defences were increased to a total of 50 serviceable Hurricanes, 40 Blenheims, 6 Catalinas and a few Fulmar aircraft. In the north-east of India, efforts were made, subject to the greater priority of Ceylon's demands, to build up a force with which to maintain air superiority in that area.

The small air force in Burma was virtually annihilated during the retreat and only a few aircraft were flown back to India. The majority of R.A.F. personnel were, however, successfully evacuated and these served to re-form squadrons for the defence of India. The aircraft for these squadrons were arriving in increasing numbers from the Middle East and the United Kingdom together with fresh R.A.F. personnel.

Between March and June 1942 the air forces in the India Command expanded from 5 to 26 squadrons. In March 1942 the Indian Air Force consisted of four squadrons and the I.A.F.V.R. manned six coastal defence flights. It was decided to disband the flights and to concentrate on a programme of ten Indian Air Force squadrons made up of five fighter reconnaissance squadrons, one bomber reconnaissance squadron and four light bomber squadrons. During the remainder of 1942 modern aircraft continued to arrive in the Command to reinforce what was still a collection of second-line aircraft.

R.A.F. heavy bombers (Liberators) operated for the first time over Burma on 17 November 1942, but not for some months were they used in any quantity owing to the lack of spares and ground equipment required for their proper maintenance. The heavy bomber needed a well-developed industrial backing more than any other type of aircraft and their use in India served to drive home the vital need for local manufacture, a need that had already made itself apparent during the employment of lighter types of aircraft. Initially the Liberators were a wasting asset since a policy of cannibalisation was forced upon the R.A.F. maintenance organisation. It was not until a complex supply

¹ The full details of this aspect are given in the A.H.B. Narrative, *The Campaigns in the Far East, Vol. III, India Command*.

² A.H.B./II J50/47/20. A.M. File S.101057.

system had been established, together with second and third line servicing echelons, that the employment of heavy bomber aircraft on the Burma front became a practicable proposition.

The general situation at the end of 1942 was that 32 squadrons were fully operational on modern types of aircraft with a further 16 non-operational squadrons in various stages of equipment and training. In addition there were two flights of transport aircraft and a photographic reconnaissance unit. Aircraft comprising this force were Mohawk and Hurricane fighters, Blenheim and Vengeance light bombers, Army co-operation Lysanders, Wellington and Liberator bombers, general reconnaissance Hudson and Catalinas, Dakota and Hudson transport, Mitchell, Spitfire and Hurricane photographic reconnaissance aircraft. The total in all amounted to some 1,443 aircraft.

By June 1943 the number of squadrons in the Command had grown to 53. Of these 38 were fully operational, comprising 17 fighter, 7 bomber, 9 general reconnaissance, 1 photographic reconnaissance, 1 transport squadron engaged on supply dropping and 3 Indian Air Force squadrons employed on watch and ward duties on the north-west frontier. During the monsoon period when the fair-weather strips in the forward area had to be evacuated, no fewer than 17 squadrons were re-equipped with various types of aircraft. Seven of these squadrons changed their operational roles on re-equipment whilst two changed their role without being re-equipped, two new squadrons began forming in the Command, three squadrons arrived complete with aircraft from the Mediterranean Command and one from the United Kingdom.

The two most notable features regarding the re-equipment of squadrons during the monsoon of 1943 were, firstly, the conversion of light bomber squadrons because of the shortage of Blenheim aircraft and the availability of a considerable reserve of Hurricanes and, secondly, the re-equipment of certain Hurricane squadrons as the flow of Spitfire aircraft increased. Nos. 11, 34, 42, 60 and 113 Blenheim squadrons were re-equipped with Hurricane aircraft, thereby creating a more suitable and flexible weapon for army support. The Hurricanes soon illustrated their versatility both for ground attack and as fighter bombers. Nos. 136, 607 and 615 squadrons changed over from Hurricane II's to Spitfire VC's in October 1943 and this was perhaps the greatest single step in the modernisation of the air forces in India. The Spitfire soon established a superiority in the air which was never again seriously challenged.

The need for offensive bombing aircraft in other theatres limited the reinforcement of the India Command and the only heavy bomber squadron to form in 1943 was No. 355.¹ This squadron based at Salbani and equipped with Liberators had not, however, seen operational service by November 1943.

By the middle of November 1943 there were 49 squadrons trained and equipped up to the standard of modern operational requirements. In addition there were 12 squadrons at various stages of training and equipment but not yet operational, and one transport squadron operating on internal air routes in India.

During this period air supply had its modest beginning, when in May 1942 the maintenance of small isolated parties in difficult hilly country had presented

¹ A.H.B./II J50/47/3.

a major problem. Much valuable experience was gained in these early days. The poor lines of communication and the vast distances involved soon led the air forces vigorously to develop the potentialities of air transport, and a pitch was soon reached when the power and mobility of both the Army and the Air Forces was increased and offensive operations were undertaken with aircraft as the only source of supply. Of all the factors which contributed towards making India a base for offensive operations, the development of an organisation capable of handling large numbers of transport aircraft, and the building up of the squadrons themselves, is one that is outstanding from the Air Force view point.

Development of Airfields¹

The extent and rapidity of the air forces' expansion in India depended upon a number of factors not the least important of which was the number of available airfields. To meet possible commitments in eastern and southern India, a total of some 215 airfields was judged necessary and steps were taken to construct them. This immense programme was given number one priority in India in March 1942, and, although much work was done, progress was much slower than had been anticipated.

In many cases the sites chosen were unsuitable, and road communications to sites were extremely bad and in some cases non-existent. The lack of telephone and telegraphic services prevented the reports of sites being sent rapidly. Moreover, strategic and geological aspects were not always considered jointly. The vast amount of material required for the construction of the new airfields, the nature of the country over which these materials had to be transported, the initial shortages of mechanical transport combined with the great demands on the railway systems, all created delays and difficulties. Machinery for airfield construction was scarce and, most important of all, there was a serious shortage of skilled engineers with the experience and drive necessary for this type of constructional work. No R.A.F. Works Directorate existed in India and all construction, both of airfields and domestic accommodation, had therefore to be left to civilian contractors and the Army.

Of the 215 airfields envisaged in the expansion programme, some were to be operational and built to the full scale of two runways and accommodation for two squadrons, others were planned as rear airfields with reduced accommodation.² By the end of 1942 five operational airfields were complete in all respects and 88 had one all-weather runway of over 1,600 yards ready. In addition 60 fair-weather air strips had been completed.

Mobility was important as units stationed in Bengal might have been forced to move to southern India or Ceylon at short notice, but their re-deployment would have been impossible without the necessary chain of airfields. This need was anticipated and by November 1942 potential mobility had been achieved.

The increasing scale of offensive operations throughout 1943 necessitated far more airfield construction in the east than had been envisaged under the original plan. For operational purposes during the dry weather season a

¹ A.H.B./II J50/47/19.

² A.H.B./II J50/47/3.

number of fair-weather airfields were prepared in the forward areas with shelter type accommodation and tentage. The decision to conduct operations throughout the monsoon period led to the development of some of these as all-weather airfields with increased accommodation and ancillaries.

A number of airfields constructed either under the original plan or at the request of the United States Army Air Force were completed in north-east Assam to handle the aircraft engaged in carrying supplies to China. In the same area certain airfields were developed so that the Americans could operate heavy bombers or defensive fighters. The maintenance and reinforcement of American squadrons in Assam involved further construction in the southern, western and central areas. By the time the South-East Asia Command was formed a total of 34 all-weather and 11 fair-weather air strips had been handed over to the U.S.A.A.F. and facilities were also given to them at some R.A.F. airfields.

In March 1942 there were only 16 airfields possessing all-weather runways of which only four were operational by modern standards. There were also 20 fair-weather air strips. By November 1943, however, 285 airfields were complete with 15 others under construction. Of this number 140 were complete in all respects, 64 had one all-weather runway ready and a further 71 had fair-weather strips. The air forces in India now possessed sufficient airfields from which to operate their target force in dry weather.

Supply and Maintenance¹

Faced with an expansion programme of from five to 60 squadrons within a few months, with an incredibly long line of communication stretching for thousands of miles either from America or the United Kingdom, the Maintenance Organisation, in March 1942, was in no condition to tackle this enormous task. India was not a highly industrialised nation and her immense natural resources were only on the fringe of development. Unskilled civilian labour was almost unlimited, but there were few semi-skilled and practically no skilled industrial technicians. The utilisation of the available civilian manpower was thus limited and a very heavy load was thrust upon Service personnel.

Geographical factors also complicated the building up of an efficient repair and supply system. The allocation of the limited industrial facilities largely dictated the allocation of the best repair units, both civilian and service, and inevitably great distances separated such units from the squadrons they served. Road, rail and water transport throughout India was overloaded and whereas in a country with good lines of communication a repair might average a month or six weeks, quite frequently this period elapsed in India before a damaged aircraft arrived at its base repair unit. Climatic conditions affected both men and material, the former by exhaustion and the latter by corrosion. During the hot weather and the period of the monsoon the daily man-hours depreciated some 25 per cent. The actual work of the repair units was frequently held up due to the lack of spares and tools and the sinking of one or two supply ships could, and did, upset the even flow of repaired aircraft. The shortage of spares inevitably led to wasteful cannibalisation.

Before the outbreak of war with Japan, India possessed but one R.A.F. depot located at Karachi and, of its kind, it was comparatively well organised.

¹ A.H.B./II J50/47/20. A.M. File S.101057.

But the inevitable financial difficulties had prevented it from being conceived on a scale that would allow for expansion, although the Air Ministry had pressed for the development of base facilities in India as early as 1940. This R.A.F. depot had served the peace-time squadrons in the capacity of aircraft erection and storage, airframe, engine and ancillary repair, and as an equipment main supply section incorporating the provision office for the whole Command. This worked tolerably well while the air forces were concentrated in the north-west, but the enormous distances in India made it impossible for an aircraft depot at Karachi to serve, with any degree of efficiency, a rapidly expanding air force at the other side of the sub-continent. The functions of the aircraft depot had, therefore, to be decentralised to meet the needs of modern aircraft on operational service.

The first step was the expansion at Allahabad of a main supply unit in April 1942, a unit which eventually became No. 320 Maintenance Unit. This enabled main stocks to be brought nearer to the area of consumption which had been shifted from the north-west to the north-east. The expansion of base repair facilities was undertaken concurrently and the first units drawn into the scheme were the existing workshops at Lahore and Ambala. Local resources were then harnessed and the railway workshops at Kanchrapara, near Calcutta, were taken over and incorporated into a civilian repair organisation. Gradually other firms in the Calcutta area were drawn into the network and later the railway workshops at Trichinopoly and the United Provinces workshops at Cawnpore were also absorbed. At Bangalore the Hindustan Aircraft Company had failed to fulfil its contract, scheduled for completion in March 1942, and no aircraft had been produced by that date. The resources of the company were, therefore, utilised to undertake the repair of flying-boats.

The harnessing of all available industrial resources that occurred in India was born of necessity, but the lesson had been learned and gradually more and more local industry was mobilised to maintain a striking force whose efficiency depended upon the supply of technical equipment. The fact that if India was to maintain an air force comparable to those in other theatres, a backing of a network of factories and communications, equal to the speed and complexity of modern air warfare, had impressed itself upon those responsible for maintenance in India before the end of 1942.

With the successful completion of the Allied landings in North Africa, the shipping situation improved and this, coupled with the intensive mobilisation of India's industrial resources, was responsible in 1943, for some advance in the employment and maintenance of air force weapons and equipment. The difficulties encountered necessitated an organisation of repair and maintenance in depth for which the base units comprised the R.A.F. maintenance units at Karachi, Ambala, Lahore and Cawnpore, and the civilian maintenance units at Kanchrapara, Trichinopoly, Cawnpore; Barrackpore, Calcutta, Dum Dum and Poona. The civilian units were organised under the aeronautical division of the Development of Supply which came into being early in 1943 and developed in October 1943 into the Directorate General of Aircraft. Under this Directorate the country was divided into five geographical areas and all available civilian manufacture and repair capacity was co-ordinated under regional directors. It was necessary, however, to establish R.A.F. personnel on the civilian maintenance units for the purpose of supervision and guidance.

The R.A.F. base repair units carried out third line repairs of a major nature while field repair and maintenance was carried out by the maintenance wings which controlled forward repair depots and the repair and salvage units. The first unit was No. 186 (Maintenance) Wing which formed at Calcutta in January 1943, followed in September by two other wings in north-west and southern India. In Ceylon the field maintenance facilities were centralised under No. 222 Group.

The developments already outlined enabled the Base Repair Organisation to serve at the end of 1943 some 60 squadrons and 500 non-operational aircraft. The peak period for repair in 1943 was in June when a total of 314 airframes and 210 engines were repaired. This peak was the result of a swift expansion of repair capacity and the culmination of a strenuous campaign for spares. It proved impossible to sustain this level of repair when the spares position once more deteriorated owing to shipping problems. In October 1943 the figures fell to 130 airframes and 210 engines. Nevertheless, the outlook was hopeful since the three civilian maintenance units at Barrackpore, Dum Dum and Poona, and the R.A.F. depot at Cawnpore had barely commenced production. Throughout the year 1943 the process of irregular expansion did, of necessity, force on the Command a repair programme which was not only above capacity, but which also fluctuated considerably.

The work of erecting aircraft brought to the Command by sea steadily increased. During 1943 over 1,700 aircraft were erected, 1,120 of them during the period June to November. The import of crated aircraft was irregular owing to shipping difficulties and when the change over from the Cape route to the Mediterranean route was effected there was initial dislocation since two consignments, despatched at different times, arrived simultaneously.

The aircraft storage programme fluctuated considerably. At the beginning of 1943 reserves were scarce and the flow through erection units rapid. During the monsoon of 1943, however, the aircraft storage units began to build up larger holdings. The output for the seven months from December 1942 to June 1943 amounted to 650 aircraft, while during the five months, July to November 1943, the output was 810 aircraft. This total did not merely represent normal routine servicing of the aircraft held, as a large number of modifications had continually to be carried out. Many aircraft had to be parked in the open, exposed to such extremes of heat and humidity, that the work involved in some cases was practically doubled. A typical example of the maintenance difficulties was the long procession of trials and modifications necessary to bring the Vengeance aircraft up to operational standards. This type of aircraft was delivered in large quantities from America, but was found unsuitable for tropical use. The fuel system was re-designed and over 100 modifications incorporated in the aircraft. By the end of 1943 it had become the standard light bomber in the Command and could claim the highest serviceability rate of any aircraft in operational use in India.

The percentage of aircraft serviceable increased with the improvement of the supply of tools, spares and facilities for squadron maintenance. In June 1942 it had been difficult to keep six aircraft out of 16 on a squadron serviceable, but by the end of 1943, when No. 186 Wing was expanded into No. 230

(Maintenance) Group, the average serviceability rate had risen to nearly 80 per cent.¹

During this period the receding perimeter of military operations had resulted in the India Command becoming less preoccupied with the defence of India and more concerned with its development as a supply base for offensive operations.

The Maintenance Organisation in India at the beginning of 1943

*Aircraft Reinforcement.*² Reinforcement aircraft could arrive either by air or by sea. All arrivals by air were flown to Mauripur Road, Karachi, where they were received by ferry control who then handed them over to the servicing maintenance unit. After inspection and servicing they were returned to ferry control for onward despatch to an air storage unit or squadron. Those that arrived by sea were unloaded at either Karachi or Bombay where they were fed into an aircraft assembly unit. After being assembled and tested they were handed over to ferry control for routing and despatch. Aircraft sent to the air storage units were maintained in varying states of readiness as a second line reserve from which to replenish the reserve aircraft pools. These pools formed a first line reserve of operationally serviceable aircraft, available for immediate issue. However, in an emergency, operationally serviceable aircraft of the second line reserve could be flown direct from the air storage units to the squadrons. In addition to these incoming reinforcements there was a steady flow of serviceable aircraft within the Command from the repair organisation to the air storage units, and here again the air storage units could be by-passed in an emergency.

There were three possible theatres of operations in India, southern India and Ceylon, north-east and north-west India. The storage and ferry organisation was, therefore, designed to permit reinforcement to any one or more of these theatres, although it was improbable that all three would be involved simultaneously. Early in 1943 the chief theatre of operations was in north-east India and the main flow of aircraft was, therefore, in that direction, with an additional but smaller flow to the south.

The control of the ferry organisation was exercised by a ferry wing under No. 226 Maintenance Group, with a headquarters at Karachi. This wing was responsible for ferry controls at Mauripur Road, air storage units and reserve aircraft pools. It was also responsible for re-fuelling parties at reinforcement staging posts en route. Transport aircraft were used as convoy leaders for single-engined aircraft and to return ferry crews to base. Where possible advantage was also taken of the internal and external air lines to return ferry crews. Flying control on the reinforcement routes was exercised by the ferry wing.

Supply. The supply organisation was based regionally on one static Universal Equipment Depot (U.E.D.) in each of six areas. Each of these U.E.D.s held, maintained and distributed wholesale a universal range of equipment to the equipment parks and air stores parks within its area. Stocks were dispersed amongst the U.E.D.s according to the area and to security requirements.

¹ No. 230 (Maintenance) Group was formed on 15 December 1943.

² A.H.B./11 J51/27 Maintenance Organisation, R.A.F., India Command.

The supply of equipment in the field was normally under the control of the operational groups and wings, but in the Bengal and eastern forward areas, this function was performed by No. 186 Wing, known initially as the Bengal Maintenance Wing.¹ It consisted of a headquarters, semi-static equipment parks and mobile air stores parks. The equipment parks held, maintained and distributed, on a retail basis, a range of equipment appropriate to the consumer units in their area. They were semi-static units, divisible into sections which could be detached to serve close behind the consumer units. On the other hand the air stores parks were normally held complete and in a state of readiness at selected U.E.D.s. When operational the air stores parks were mobile units, also divisible into detachable sections. They held, maintained and distributed equipment appropriate to the units in the forward areas. Both the equipment and air stores parks were capable of leap-frog progression in the event of a rapid advance by the air forces. The maintenance wing organisation appeared to be the solution to the problem of effectively co-ordinating the supply of equipment in the field, and plans were therefore in hand to extend the scheme throughout the whole Command.

The master provision office was situated in New Delhi and was responsible for the provision and distribution of equipment to the six universal equipment depots. It held a central record of all the stocks of every item of equipment at each U.E.D. as well as all receipts and issues. The U.S.A.A.F. counterpart was the master control depot at Agra to which an R.A.F. liaison officer was attached.

In order to release Service personnel for duties in the field it became necessary to civilianise the U.E.D.s. The plans for this had to allow for adequate instruction and supervision of the civilians by Service personnel during the change-over period, as well as for the retention of an adequate number of Service personnel for subsequent control.

Aviation Fuel. The supplies of high octane aviation fuel in India were mainly obtained from Abadan via the main ports. Certain supplies of low octane fuel were, however, obtained from the refineries at Digboi and Rawalpindi. The major bulk aviation fuel installations or supply depots were strategically sited throughout India and Bengal and were responsible for supplying the airfields within their area of operation.

The policy was to equip each operational airfield with bulk tankage. If a railway siding was within two miles of the airfield the bulk tankage was placed there, otherwise it was located within one mile of the airfield perimeter. In the latter case an 'expense' tank was installed at the nearest rail siding in order to obviate any delay in decanting from rail tank waggons.

The servicing of the bulk installations at airfields was the responsibility of the parent supply depots, except for certain non-operational airfields supplied by the petrol companies. In order to conserve Service man-power it was planned to extend the scope of the petrol companies to include the majority of the non-operational airfields.

¹ At the end of 1943, No. 186 Wing was absorbed into the newly-formed No. 230 (Maintenance) Group.

Airfields which were not equipped with bulk tankage were maintained with packed stocks (barrels or tins) from the supply depot upon which they were dependent. In addition to these stocks supply depots also held a packed reserve of 15 days' requirements for each operational airfield, and a further 15 days' reserve was held in Army or Trade tankage in the appropriate Army area.

Explosives. The central holdings consisted of common stocks which were held in Army arsenals or ordnance depots and were controlled by Air Headquarters, India. These central holding units generally distributed to advanced ordnance depots, including R.A.F. 'X' maintenance units, Ceylon. The advanced ordnance depots in turn fed the ordnance field depots which replenished the Air Force stations in their respective areas. They also fed certain Air Force stations direct, the Army being responsible in each case for delivery if they were within a range of 25 miles. The Air Force holding at the Army depots was controlled by Command or Group Headquarters in whose area they were located. Air Force officers qualified 'X,' with their appropriate staffs, were attached to the Army holding units. At this time plans were being made to form these officers and their staffs into R.A.F. 'X' maintenance units bearing identity numbers. The effect would be similar to a squadron on a station, the 'X' officer being O.C. 'X' M.U. and the Army officer commanding the depot being station commander.

Repair, Major Servicing and Salvage. The static repair organisation consisted of Service-manned base repair depots and civilian repair depots to which Service personnel were attached. They undertook the major repair and overhaul of airframes, engines, ancillary equipment and all technical equipment of the air forces in India. These depots also assisted local units on work which was beyond unit capacity or facilities.

The repair and salvage organisation in the field at that time varied according to the area. In southern India and Ceylon mobile repair and salvage units were provided under the control of No. 225 Group and No. 222 Group respectively. In these areas they formed an integral part of the operational wings. In central, north and north-west India the repair and salvage sections could be located as necessary under the control of No. 226 (Maintenance) Group. However, in Bengal and the eastern areas, until the formation of No. 230 (Maintenance) Group in December 1943, repair and salvage were controlled by No. 186 (Maintenance) Wing. It consisted of a headquarters, static forward repair depots, semi-static repair and salvage sections, and one or more repair and salvage units. The forward repair depot acted as a 'fly-in' base for damaged aircraft and as a 'fly-in' centre for major inspections on aircraft of the operational squadrons.

The plans already mentioned to extend the maintenance wing organisation for supply in Bengal to the rest of the Command also included the extension of similar facilities for repair and salvage. It was also planned to civilianise the base repair depots in a similar manner to that already adopted for the universal equipment depots.

Mechanical Transport and Marine Craft. The supply of vehicles fell into two broad categories, specialist and common user. Specialist vehicles which arrived

by sea were received by embarkation units at Bombay and Calcutta and passed to mechanical transport storage units in these localities. Here they were inspected, given post voyage servicing and then stored or distributed to Air Force units according to requirements. It was planned in future to manufacture specialist vehicle bodies in India, and certain common user chassis had already been supplied to the mechanical transport storage units so as to build up a 'pool' of chassis which could be drawn on when the specialist bodies became available. The design of these bodies was controlled by the Director of Mechanical Transport, situated at Air Headquarters, whilst their construction was to be carried out in civilian factories under the supply department. The common user vehicles were supplied by the Army and despatched in convoys to Army vehicle reserve groups from where they were either issued to mechanical transport storage units or direct to consumer units.

At this time the maintenance of air force vehicles was entirely the responsibility of the air forces, but a civilian repair organisation for mechanical transport was in the process of formation. Under this arrangement maintenance would be carried out at selected garages. The air forces were to be responsible for the selection of the garages, the supervision of the work and for the supply of spares. The supply department were to issue contracts, authorise repairs beyond the specified financial limits and pay the contractors for the work after it had been carried out. Mobile mechanical transport maintenance units, composed of sections equipped with workshop lorries, were being formed to maintain vehicles beyond the reach of the civilian repair organisation. Mobile diesel servicing and repair sections, specially trained for compression ignition work, were to maintain the static diesel installations. The supply of common user spares, hitherto demanded direct by units from ordnance depots, were in future to be stocked by air force supply units by arrangement with the Army.

Air Force schools were being formed to train Indian Air Force personnel as drivers so as to free R.A.F. drivers for work in the forward areas. Arrangements were also being made for mechanical transport officers to attend instructors courses which were being run for the Army by the Ford Motor Company. Mousel and Company, in Bombay, were to train fitters, mechanical transport, in diesel work.

The general maintenance and construction of marine craft was being carried out by the civilian repair organisation. The air/sea rescue maintenance was done in conjunction with the naval authorities with the exception of aero/marine engines which were maintained by the air forces.

CHAPTER 24

THE FORMATION OF S.E.A.C. AND THE WORK OF THE MAINTENANCE ORGANISATION, NOVEMBER 1943 TO AUGUST 1945

The Formation of South East Asia Command—November 1943¹

The origin of South East Asia Command may be traced back to the Trident conference at Washington in May 1943 when the United States and British Governments decided to co-ordinate all sea, land and air forces in South East Asia into one unified Command. Following the decisions made at Trident, the Prime Minister circulated on 21 June a memorandum which contained his proposals for the structure of the new Command. These proposals, about which much discussion took place during the summer of 1943, were of great importance to the British Air Forces in India since a radical change in the system of Command was anticipated.

The Commander-in-Chief, India at this time, was for all practical purposes the supreme authority in the sphere of air and military policy in India. The system of control in India was, therefore, quite different to that adopted in other theatres where all three Services worked as equal partners in plans jointly contrived. Whatever the merits or de-merits of the Indian system for dealing with the local defence of India, it was unsuitable for waging an offensive war against the Japanese in Burma and elsewhere, particularly since India Command was becoming less pre-occupied with the defence of India and more concerned with its use as a base for offensive operations.

At midnight 15/16 November 1943, the Supreme Allied Commander, South East Asia, Admiral Lord Louis Mountbatten, became responsible for all operations in the theatre against Japan. At the same time Headquarters, Air Command, South East Asia came into being with Air Chief Marshal Sir Richard Peirse as the Air Commander-in-Chief. The new Headquarters virtually comprised the old Air Headquarters, India and the subordinate units, which were transferred from India Command to South East Asia, remained substantially unchanged.

All the R.A.F. units were placed on the Imperial establishment and thus on a similar footing to other overseas commands. On the other hand, units of the Royal Indian Air Force remained on the Indian establishment even when under the operational control of Air Command, South East Asia. These units, like those of the Indian Army, were loaned to South East Asia Command. In addition to Headquarters, Air Command, South East Asia, the Command consisted of Air Headquarters, Bengal, which comprised Nos. 221 and 224 Groups, No. 222 (Coastal) Group, No. 223 (Training) Group, No. 225 (Coastal) Group, No. 226 (Maintenance) Group, No. 227 (Training) Group and all formations under their command. The only change in function related to No. 223 Group Peshawar, which relinquished responsibility for the North-West Frontier.

¹ W.P.(43) 253, A.C.S.E.A. File DACC/010.

OPERATIONAL CHAIN OF COMMAND IN
SOUTH EAST ASIA
DECEMBER 1943—JUNE 1944

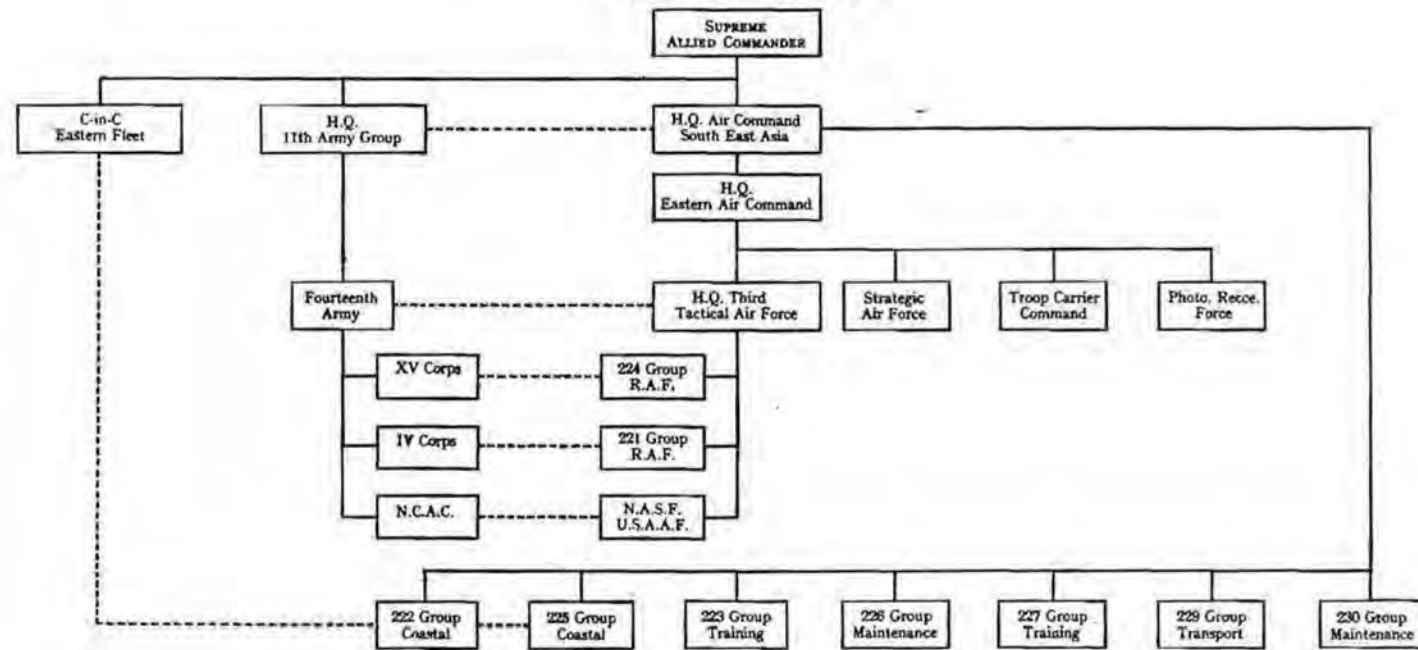


DIAGRAM 34

Two other groups were formed in December 1943, No. 229 (Transport) Group and No. 230 (Maintenance) Group. No. 229 (Transport) Group, which was located at New Delhi, served to co-ordinate the internal air services and ferrying within the sub-continent. Reference has already been made to No. 230 (Maintenance) Group which was formed at Calcutta on 15 December 1943, as an expansion of No. 186 (Maintenance) Wing, formerly known as the Bengal Maintenance Wing, and which became responsible for all R.A.F. maintenance within the Eastern Air Command area.¹

The maintenance organisation in the newly-constituted South East Asia Command covered supply, servicing, repair and salvage of all air force material in India, Ceylon, Assam and Burma, an area larger than the whole of Europe. It was impossible to have the same maintenance system operating throughout this vast area, owing to the extensive topographical differences. Broadly speaking, one system operated in Ceylon and India up to the Brahmaputra, and an entirely different one was evolved to apply eastward from that river, throughout Assam and Burma.

In the first area, where ground communications were reasonably good and there were no considerable land or water barriers to circumvent, an extensive Base Maintenance Organisation had been built up under No. 226 (Maintenance) Group. It was in this area that the main Repair Base Depots, Equipment Depots and Aircraft Storage Units were located and which served as a 'pool' for the far-flung operations beyond the Brahmaputra and the Bay of Bengal.² In this latter area, in which the whole of the R.A.F. maintenance became the responsibility of No. 230 (Maintenance) Group from the 15 December 1943, land communications were so bad as to be almost non-existent. The inadequate railways in Assam suffered from the handicap of frequent changes of gauge. All rivers with their primitive forms of river craft, lay athwart the lines of communication and all the so-called roads disappeared beneath the flood waters, during the monsoon period.

It was in such terrain and under such conditions that air transport came into its own. From the time of the siege of Imphal, in April 1944, to the capture of Rangoon, on 3 May 1945, both the Royal Air Force and the Army had to be provisioned by air. Airlift was restricted to essential needs and could not be provided to support avoidable maintenance at forward aerodromes. As a result, a policy was adopted of flying aircraft back to India for comparatively simple servicing requirements. Aircraft which crashed away from airfields had usually to be written off charge, while those that crashed on airfields, provided the damage was not too great, were repaired on site. Surface movement back to India was restricted to the minimum, because damage to an aircraft during transit was normally so great that it was beyond economical repair when it reached its destination. As a result, damaged fighter aircraft were dismantled and flown back to India inside Dakotas.

The Command reserve of motor transport vehicles was kept in Calcutta and, owing to the appalling difficulties of travel in the forward area, by the time replacement vehicles had reached their destination with forward units they

¹ A.H.B./II M/C186/1 and IIM/B230/1.

² A.H.B./II J50/74, II J51/27 and VA/23.

had frequently expended the greater part of their useful 'lives.' It was therefore only due to the efforts of the M.T.L.R.U.s and mobile echelons of the M.T.M.U.s of No. 230 Group that the flying units were able to remain mobile on the ground.

The whole of this extensive and complex maintenance commitment in the forward area became the responsibility of No. 230 (Maintenance) Group when, as has already been mentioned, it took over the duties of No. 186 Wing at the end of 1943. The Group was primarily responsible for the repair and supply organisation of the operational Nos. 221 and 224 Groups of the Third Tactical Air Force, and its units worked in the forward areas with these groups. No. 230 (Maintenance) Group comprised all maintenance units to the east of and including Allahabad and Calcutta, Air Stores Parks, Forward Repair Depots, Motor Transport Light Repair Units, glider units and Air Storage Units. The function of these units in the forward area under No. 230 (Maintenance) Group was mainly as follows :—

- (a) *Repair and Salvage Units.* These units supported squadrons at forward airfields by taking over all work that the flying units were unable to complete within 48 hours.
- (b) *Air Stores Parks.* These units also supported squadrons at forward airfields by providing the spares and equipment that they required. They aimed to carry stocks of consumable spares estimated to keep their part of the force going for three months.
- (c) *Forward Repair Depots.* Four Forward Repair Depots were established far enough forward to undertake major inspections and 'fly in' repairs beyond the capacity of the Repair and Salvage Units. This had the effect of shortening the time during which aircraft remained unserviceable.
- (d) *Motor Transport Light Repair Units.* The work of these units has already been referred to. Together with the Motor Transport Maintenance Units, their main function was to keep the operational squadrons mobile. This they managed under appalling difficulties which, apart from the terrain, included a perennial shortage of spares, and the unsuitability of civilian-type transport for the type of work it was called upon to perform.

On 15 May 1945 shortly after the fall of Rangoon, No. 230 (Maintenance) Group was absorbed into H.Q. R.A.F. Bengal/Burma and moved forward from Calcutta to a new location at Rangoon.

The Maintenance Policy in the Far East 1944-1945¹

Although the strategy to be employed in the newly formed South East Asia Command had not been determined by December 1943, nevertheless it was essential as a matter of urgency to decide what administrative preparations should be put in hand to enable the Command to carry out operations in 1944 and 1945. The conditions under which such operations would be fought were of paramount importance. The war would be fought at great distances from any base, sometimes in jungle and mountainous country, while the theatres of operations themselves would be widely separated. Operations would be phased

¹ A.H.B./II JI/90/98 and IIM/A44/1A.

over wide areas and it would be likely that at times it would be necessary to move forces over considerable distances as rapidly as possible. The anticipated cessation of hostilities in Europe would make available the major resources of the United Kingdom and the Middle East, but their geographical remoteness would impose certain limitations on the degree of backing which they would be able to supply. The Middle East had built up an efficient maintenance organisation with a large repair capacity, but experiences in all theatres, including the Middle East, had shown that it was vital that maintenance backing should be as close as possible to the area of operations.

The expansion of the maintenance organisation in India continued during 1944 and it was not until the autumn of that year that any important steps were taken to settle the degree of maintenance support which the Middle East should give to Air Command, South East Asia. In September 1944 the Director of Maintenance and Supply for the Mediterranean Allied Air Forces paid a short visit to the base areas of India and on his return to the Middle East produced a detailed report on the maintenance organisation in India. The most important contention was that India could not provide—anyway within the necessary period of time—a great repair and base maintenance organisation for Air Command, South East Asia, comparable to that which had been built up in the Middle East. Under these circumstances the Director of Maintenance and Supply maintained that it would be more efficient, especially as the campaign moved on from Burma, to by-pass India altogether and supply the necessary maintenance backing from the United Kingdom and Middle East direct. However, as the senior maintenance staff officer of Air Command, South East Asia, pointed out, repair capacity in India had been planned on the 156 squadron basis and more than sufficient was available for the existing target figure of 118 squadrons. If backing was to be provided during the campaign in Burma, there was little object in later disbanding the organisation in India, unless such a course was imperative on account of the shortage of shipping.

Eventually the Air Ministry sent a directive to Headquarters, Air Command, South East Asia, on 6 February 1945, as to the broad principles of maintenance policy in the south-east Asia theatre. It also included a review of the use which could be made of the facilities and resources of the Middle East Command. It was decided that, apart from the use of the aircraft storage facilities available in the Middle East for a proportion of reserve aircraft, the Middle East should not undertake any major part in the maintenance of the air forces in the Far East.

With regard to repair policy it was agreed that the repair organisation in Air Command, South East Asia, should continue to make a maximum contribution towards maintaining reserves of serviceable aircraft and equipment. It was not intended to use the Middle East in this respect except for the repair of special equipment which would be difficult to repair in India due to climatic conditions. It was realised that as the war progressed farther from India, airframe repairs would be limited more and more to repairs on site and fly-in repairs, and it was therefore agreed that aircraft outside this category should be reduced to serviceable and repairable components. Salvaged items (other than airframes) which were beyond the local resources set up were to be returned for repair to India, Middle East or United Kingdom according to the available capacity.

It was intended that India should remain the equipment base for operations in south-east Asia. The alternative use of the Middle East as an intermediary base for the reception of supplies from the United Kingdom and redistribution direct to the forward areas in the Far East was considered impractical. Assistance would therefore be limited to the satisfaction of urgent A.O.G. demands. It was the Air Ministry policy that equipment should be received and stored at the nearest point to where it would be used. As the campaign progressed it would be found more economical for supplies to be shipped direct to forward areas from the United Kingdom, thus avoiding trans-shipment and double handling in India. This would necessitate the establishment of forward stock holding units with independent channels of demand and supply. Until this point had been reached the distribution of initial supplies to forward areas would require the bulk transfer of stocks held in India.

The full details of this maintenance policy were to be discussed with the Air Officer Commanding, Air Command, South East Asia, when the Air Member for Supply and Organisation visited the Far East in 1945.

As a result of this Air Ministry directive the Chief Maintenance Officer (C.M.O.) visited Kandy on 19 May 1945 to discuss the proposals for a re-orientation of the maintenance organisation as the battle-front moved farther from the static repair and overhaul bases which had been built up in India. The proposals were the outcome of a conference held by the C.M.O. in Delhi earlier in the month. They reflected a reversion from the centralised system of maintenance, which had so far obtained in this theatre, in favour of a more widespread dispersal of tasks to maintenance units in the field and to the squadrons themselves. The reorganisation was therefore a change in the centre of gravity. The proposals were briefly as follows :—

- (a) Abolish the forward repair depots and build up the repair and salvage units.
- (b) Invest Group Commanders with the responsibility of repair and overhaul of their squadrons' aircraft.
- (c) Give squadrons their full U.E. of aircraft instead of retaining a proportion of them in the maintenance organisation as hitherto.
- (d) Each repair and salvage unit and air stores park would work for a wing and specialise in the type of aircraft operated by that wing.

The Air Commander-in-Chief approved the proposals in principle and then discussed the best ways and means of implementing them. The timing of the changeover was dependent on the availability of extra tools, ground equipment, etc., for the forward units, and the C.M.O. was able to promise that these would be fed into the squadrons before the additional load was applied. The phasing of the reorganisation was dependent on the operational situation, but the Air Commander-in-Chief favoured the following order of priority :—

- (a) No. 224 Group first, since it was due for refit and training and would be the first to require the benefits of the new system.
- (b) Next No. 231 Group, as it was operating from established airfields and the transition could be effected with the minimum disturbance.

- (c) Thirdly No. 232 Group, which would be the most difficult as the transport squadrons were those most committed to the centralised system of maintenance.
- (d) Finally No. 221 Group, as this was the most forward of the Groups and therefore still engaged on active operations.

The meeting emphasised once again the desirability of reducing the Command holdings of reserve aircraft as soon as the current backlog aircraft had been eliminated and an uninterrupted flow of replacements and equipment had been ensured. The Air Ministry decision to reduce the production of spares and thereby allow a quicker write-off of unserviceable aircraft had resulted in a revised maintenance policy for the future. The provision of spares should be confined to those articles which wore out quickly; mainplanes, etc., should be provided from crashed aircraft whose repair now absorbed more man-hours than the salvage justified.

A further point which emerged from the conference was the increased necessity for airborne salvage sections to be attached to the repair and salvage units. Such sections had proved extremely useful in the past and an extension of the scheme had only been impossible because it had not been thought that the importance of their work justified the allotment to them of scarce Dakota aircraft. Now that the repair and salvage units would be taking a greater load, the provision of Dakota aircraft was essential.

The maintenance policy outlined above was put into effect as the year progressed, but its full development under operational conditions was prevented by the cessation of hostilities against Japan on 16 August 1945.

The Work of the Maintenance Organisation in S.E.A.C. during 1944-1945

Throughout 1944 aircraft maintenance in Air Command, South East Asia, was divided into four stages, first, second, third and fourth line maintenance. This division was made necessary by the limited maintenance facilities available on the forward airfields, the necessity for mobility at the front and for units directly supporting the forward forces, the shortage of spares and equipment and the desirability of utilising as far as possible the Indian civilian labour available in the rear.

First line maintenance consisted of daily servicing on the airfield, and varied from hour to hour and from day to day. It was performed by squadron personnel.

Second line maintenance consisted of minor inspections, engine changes and rectifications, which were carried out on the airfield by larger and more skilled gangs than the daily servicing crews. It was performed either by a servicing echelon which moved with the squadrons or by the squadron personnel. The work was normally limited to jobs which could be completed in two days (or five days in the case of non-operational flying units), and fluctuated considerably on squadrons according to flying hours.

Third line maintenance, or field repair, consisted of repair and salvage units (R.S.U.s), forward repair depots (F.R.D.s), and repair and salvage sections

(R.S.S.s). The repair and salvage units were located close to squadrons and were sufficiently mobile to follow in their wake. They were responsible for all salvage in the forward area, for assistance to squadrons on minor repairs, engine changes, etc., and for patching up aircraft to be flown back for repair. The field repair units were designed to carry out major inspections as well as repair work and were more fully equipped and correspondingly less mobile than the R.S.U.s. The repair and salvage sections on the other hand were semi-static units situated in the base area, to deal with field repair work on training aircraft, squadrons, re-equipping, etc. The work on hand at field repair units varied considerably, but was usually sufficiently continuous to ensure full employment of the maintenance personnel.

Fourth line maintenance, or base repair, was essentially static and was thus able to make full use of local civilian labour and to amass heavy equipment. Since the flow of repair work at this level was comparatively constant, except for seasonal changes or drastic alterations in the Command flying effort, work could be organised on a mass production basis, thus achieving a greater output per man-hour. Jobs normally consisted of major inspections, major repairs and any other work which was beyond the capacity of field repair units. The base repair depots also carried out the reduction to produce and spares of those aircraft which had been 'written-off' on the unit. Airframe repair was undertaken at seven civilian maintenance units and three Service repair depots, of which one, No. 322 Maintenance Unit, was the largest maintenance unit in the Command. It had a capacity equal to about one-third of the total base repair organisation, Service and civilian. The repair of engines was carried out at engine repair shops attached to most of the maintenance units which dealt with airframes. A similar policy was pursued with regard to the repair and overhaul of propellers, armament and other accessories. Certain other civilian maintenance units were employed on the manufacture of aircraft spares and equipment.

Crated aircraft were erected at Service and civilian units specialising in this work, whilst 'fly-in' aircraft were inspected and serviced at the terminal staging posts. They were then passed to one of six aircraft storage units and then to one of two (formerly three) reserve aircraft pools. These pools were designed to hold a serviceable reserve of aircraft equal to two weeks' wastage and were located within easy reach of the operational squadrons. The air storage units were originally planned to hold two-and-a-half months' wastage, but this was varied considerably in relation to the number of aircraft under repair and the extent, regularity and time lag of the expected flow. Command modifications and other servicing could be carried out at the air storage units.

Gliders were maintained by twenty-three servicing echelons which undertook all light repairs. There was no field or base repair organisation for gliders, although they were occasionally serviced at aircraft field repair units. Gliders were erected and modified at a Service maintenance unit designed for this purpose.

The civilian maintenance units were manned by Indians under the supervision of British other ranks in the ratio of approximately one B.O.R. to five Indian. Civilians were also employed on unskilled work in Service repair depots,

and to a certain extent on skilled work, although this did not prove to be altogether satisfactory.

The maintenance of mechanical transport was organised on a four line system similar in principle to that used for aircraft.

First line maintenance was the responsibility of each user unit, and included minor repairs, replacements and inspections up to and including 2,000-mile inspections. It was carried out by F.M.T./M.T.M. personnel on the basis of one fitter to ten vehicles.

Second line maintenance consisted of minor repairs, exchange of minor components, servicing on site and recovery of unserviceable vehicles.

Third line maintenance consisted of major repairs, exchange of major and minor components, storage of vehicles and stock holding of spares. Both these classes of maintenance were carried out in the forward areas by M.T. maintenance units, and in base areas by civilian units under the civilian repair organisation with Service M.T.M.U.s to deal with any excess of the C.R.O. capacity.

Fourth line maintenance consisted of the reconditioning of engines and major components, and maintaining components for second and third line units. It was undertaken in the base areas either by the civilian repair organisation or by M.T. repair depots. Fourth line maintenance of common user engines was carried out by Army fourth echelon workshops.

The maintenance of diesel engines was contracted where possible through C.R.O. Apart from this, three Service base diesel depots were established to carry out third and fourth line maintenance. Second line maintenance was undertaken by twenty-nine mobile sections detached from the base depot and established with one B.O.R. to five diesels.

The maintenance of marine craft was contracted through the Director General, Shipbuilding and Repair, supplemented by two marine maintenance units. Engines were overhauled and repaired through C.R.O. (M.T.) except for Napier Sea Lion engines, which were overhauled at No. 2 C.M.U. under the supervision of R.A.F. fitters, marine, and Hall Scott and Packard engines, overhauls of which were carried out by R.A.F. personnel attached to Coastal Forces Workshops.

The total man-power requirement in March 1945 for second, third and fourth line maintenance of mechanical transport and marine craft was estimated at 2,951 technical British and Indian other ranks.

The supply of equipment to consumer units was the responsibility of equipment depots, or, in the forward areas, air stores parks (A.S.P.s). In the forward areas the A.S.P.s were mobile, each serving the squadrons and other units of one or more operational wings. They held thirty days' requirements and made fortnightly demands for replacements. In the base areas they were semi-static and were established to hold a minimum of two and a maximum of three months' requirements.

The wholesale distribution of equipment to A.S.P.s and retail distribution to consumer units in the base areas was through seven equipment depots which operated regionally in two areas, four depots in the south and west and three in

the north and east. Normally all ranges of equipment were held in both areas, one depot in each area being responsible for any particular range. The stock was usually divided on the basis of sixty per cent in the north-eastern area and forty per cent in the south-west. In certain instances of slow-moving equipment one hundred per cent was held in one depot.

The total storage space available in equipment depots in May 1945 was approximately four million square feet out of a target of four and a half millions. Air conditioned storage space for photographic equipment amounted to 108 thousand cubic feet available out of a target of 360 thousands.

Explosives were held by central ammunition depots and issued to advance depots which supplied R.A.F. units either direct or through forward depots. The holdings for the Command were on the basis of twelve months' estimated requirements plus one and a half months' tactical reserve. The R.A.F. ammunition depots were frequently lodger units with Army ammunition depots. There were eleven ammunition depots with a total storage capacity of 114,000 short tons, and in addition to these there were fourteen detached sites with a total capacity of 16,350 short tons.

The oxygen supplied to the Royal Air Force was manufactured mainly by the Indian Oxygen Company, but in addition to this, twenty mobile oxygen plants operated with the Royal Air Force with a further six in storage.

The Work of the Wing Maintenance Organisation during the Burma Campaign¹

Personnel. At the beginning of December 1944, the units in the wings were fairly well up to strength with a large number of experienced personnel. Many of these were lost from various causes during the early stages of the campaign but by May 1945 this had been made good by fresh drafts. Thus, apart from a short period in March, there was no shortage of personnel. The original personnel had mostly been with their units in the forward areas for some time and consequently had experience of individual types of aircraft and active service conditions. This proved to be a vital asset in maintaining aircraft serviceability during the intensive operations which ensued. As the replacements had not this experience this meant an additional instructional load on the existing personnel.

Aircraft Servicing. Technical defects were few due to previous operational experience with the types in this theatre. Nearly all the defects which did arise could be attributed to the state of the airfields being used or, in the case of Hurricanes, to the age of the aircraft. The normal commitment of a Spitfire fighter squadron was continuous operation during the hours of daylight, giving an average monthly total of 1,100 flying hours.

Airfields. Airfields and airstrips were constructed at very short notice in difficult country. They were normally built on the two strip principle, with a connecting link at one end incorporating an unloading bay. The big difficulty in most cases was dust and the efforts to overcome this included the use of oil and water. One of the most successful airfields in this respect was constructed at Sinthe. No attempt was made to grade the top consolidated layer of soil,

¹ A.H.B./II J51/48/1/1 Mobility of Technical Units. Loose Minute H.Q., No. 221 Group.

so that the strips consisted of good dry paddy with the cracks filled in, and rolled. Consequently the only dust encountered was that caused by the abrasive action of tyres and slip stream on hard earth. A system of culverts was constructed to divert a portion of the local river into artificial storage ponds on the airfield. From these, fire pumps were able to cover the strips with a fine spray which effectively eliminated the dust. The only serious defect was that the cracks in the ground caused vibration on the small wheels of the fighter aircraft and thereby increased the consumption of undercarriage legs.

Japanese bombing made it necessary to disperse the domestic sites and consequently much working time was wasted proceeding to and from work.

Salvage of Aircraft. The repair and salvage detachments allotted to the wings for the salvage of aircraft and the carrying out of Cat. A.C. repairs invariably arrived late and therefore the responsibility for removing crashed aircraft from flying strips devolved on to the wing. The wing did not possess salvage equipment but this difficulty was normally overcome by borrowing a crane or bulldozer from the nearest army unit.

The inspection of crashed aircraft within the wing area was the responsibility of the wing engineer officer. This commitment proved to be very heavy and had an adverse effect upon the work output of the wing. This could have been overcome by making repair and salvage unit crash inspectors responsible for investigating all crashes beyond the bounds of an airfield.

Airborne Salvage. On 23 March 1944, No. 1 Airborne Salvage Squadron was formed at Dum Dum, near Calcutta.¹ The only unit of its kind in S.E.A.A.F., its main job until Japan surrendered was the emergency repair of Dakotas which had forced landed in Burma, so that pilots of the squadron could fly them back to bases where full repairs could be carried out.

In the next few months the two officer pilots of the squadron flew self-contained repair units to almost every part of northern Burma so that Dakotas which would otherwise have had to be 'written-off' were made sufficiently serviceable for them to be flown back to the repair shops. Many of these aircraft had damaged their mainplanes beyond repair and spares were therefore required. The Americans in the U.S.A. had devised a modification so that a mainplane could be carried underneath a Dakota but their engineers considered this method impossible in the Far East owing to the bad flying conditions. Nevertheless some method had to be found to get the mainplanes up to the forward areas and so the squadron engineers set to work with the same idea in mind, and designed and fitted their own modification, which was a great success.

During the advance through Burma crippled Spitfires were frequently crash landed on forward airstrips and damaged too badly to be even temporarily repaired on the spot. After numerous experiments the squadron Dakotas were successfully modified to carry a Spitfire apiece. With one wing strapped underneath the fuselage of the Dakotas and the rest of the fighter stowed inside, the Dakotas carried numbers of fighters back to the maintenance units to be repaired and sent into action again. Later a further modification enabled both port and starboard mainplanes to be carried beneath the Dakotas, thereby saving a great deal of flying time.

¹ O.R.B. Appendices of No. 1 Airborne Salvage Unit later No. 5 Repair and Salvage Unit.

Soon after Rangoon was retaken the unit moved forward to Mingaladon. Although repairs at the front were still being carried out regularly, freight-carrying and the ferry of aircraft spares now became the main job. This reached a peak of just over a million pounds of freight in July 1945.

U.S.A.A.F. Flying Control. The U.S.A.A.F. flying control section, attached to the Wing in lieu of an R.A.F. section, proved to be a most valuable and efficient unit. They were very well equipped with all the necessities for the job and had experienced and co-operative personnel. However, the absence of an R.A.F. flying control section increased the maintenance organisation responsibility for the care and maintenance of the airfield and of the R.A.F. flying control equipment.

Movement by Road. As soon as the location of a future airfield had been decided it was customary to move in an advanced party by road to prepare the operational and domestic facilities. The destination of the parties was frequently changed after they had left and such alterations were passed to them either by dropping messages from the air or through Army units on the route.

Movement by Air. The movement of squadrons and servicing echelons by air was a unit responsibility supervised by wings and consequently varied from time to time. However, it was found by experience that the following could be accomplished :—

- (a) A squadron need never stop operating.
- (b) The supply of airlifts, however irregular, need not affect operations, providing the aircraft were not moved until at least half the ground crew had arrived.
- (c) All airlifts can be self-supporting for rations and tentage.
- (d) A squadron can carry out intensive operations for at least a week on half its ground crew strength.

At this period the maximum airlift for any squadron and echelon was 17 Dakotas. This made it rather difficult for the fighter-bomber squadrons owing to the weight of the bomb-handling equipment and the extra armament personnel involved. From the units' point of view and for general economy a more reasonable figure would have been 20 Dakotas for fighter-bombers and 18 for fighters.

Equipment. In many instances the Army supply items, mainly petrol, oil and lubricants, were under-provisioned for in Army airlifts. The result of this was a serious shortage of these items on a number of occasions, especially during the initial stocking of new airfields, and necessitated emergency measures to rectify the situation.

Of the R.A.F. supply items the one which caused the most trouble was breathing oxygen. Consumption rates were miscalculated and consequently the bottles supplied were expected to last longer than in fact they did. Items such as split pins, locking wire, tab washers, hydraulic oil and dopes were consumable and could not therefore be obtained by robbing categorised aircraft. Priority should have been given to these instead of to the non-consumable items which could be and were obtained by cannibalisation.

APPENDIX 1
OFFICE MEMORANDUM
No. 56/40

**RESPONSIBILITY FOR THE SERVICING AND REPAIR OF
EQUIPMENT AND FORMATION OF DIRECTORATE OF REPAIR
AND SERVICING AND DIRECTORATE OF MAINTENANCE DESIGN**

The control of the servicing of equipment in the Royal Air Force and its repair in Royal Air Force Units and in the Civilian Repair Organisation now in course of development is vested in the Air Member for Supply and Organisation who will be responsible for all questions connected with the maintenance of equipment in service, that is, its supply to Units, servicing, salvage and repair. A.M.D.P. is responsible for ensuring that the design of equipment is carried out with due regard to ease of servicing, replacement and repair, and for the maintenance questions specifically connected with the design of the equipment. A.M.D.P. is also responsible for defining methods and strengths of subsequent repairs and permissible worn limits and tolerance of working parts.

2. With regard to engines, A.M.S.O. will be responsible for the repair of engines in R.A.F. Depots and for the servicing of engines on R.A.F. Stations. A.M.D.P. will be responsible for all engine repairs other than the above.

3. The appointment of Lord Nuffield as Director-General of Maintenance, under the Air Member for Supply and Organisation, has already been announced in Office Memorandum 205 (39). A Directorate of Repair and Servicing (short title D.R.S.) has been formed under D.G.M. and is located in Ariel House. The responsibilities of D.R.S. may be stated briefly as follows :—

- (a) The repair and servicing of Royal Air Force equipment.
- (b) The salvage of crashed or forced landed aircraft, including enemy aircraft.
- (c) The arrangements for holding repairable material.
- (d) The compilation of lists of tools, spare parts and material for repair and servicing (based on initial estimates supplied by D.M.D.) to enable D. of E. to provision.
- (e) The repair and servicing aspect of plans for implementing Air Staff proposals.

4. The selection and development of civilian industrial capacity for the repair of Royal Air Force equipment and the allocation of repair work to selected capacity will be carried out by an organisation formed within Morris Motors Ltd., acting under contract with the Department. This Organisation will be known as the Civilian Repair Organisation and will operate at the offices of Morris Motors Ltd., at Cowley, Oxfordshire ; it will act under the direction of D.G.M. who will co-operate with the Director-General of Production as regards allocation of capacity, and with the Directors of Contracts as regards the placing of contracts with those firms working under the direction of D.G.M. The Directors of Contracts will remain responsible for considering the contractual eligibility of firms to receive such Government contract and for the due observance of the normal contractual safeguards prescribed by Government practice.

5. A new branch of the Secretarial Division attached to A.M.S.O.'s Department has been formed for co-ordination and correspondence duties in D.G.M. The branch is styled S.9(M) and is located in Ariel House.

6. In A.M.D.P.'s Department the Directorate of Repair and Maintenance will in future be known as the Directorate of Maintenance Design (short title D.M.D.). The duties of the reconstituted Directorate will be (i) to watch and influence the design and manufacture of Royal Air Force technical equipment with a view to

securing ease of repair and maintenance and interchangeability of parts; (ii) the preparation of all descriptive notes, repair instructions, amendments relating to airworthiness and strength and initial maintenance schedules; (iii) the analysis of defects and advice on modifications.

7. A detailed allocation of duties of the Directorates and Branches affected will be issued in due course. The foregoing information is promulgated meanwhile for general guidance.

A. W. STREET.

19 *March* 1940.

APPENDIX 2
OFFICE MEMORANDUM
No. 141/40

**FORMATION OF AIRCRAFT PRODUCTION DEPARTMENT—EFFECT
ON FUNCTIONS AND STAFF AT AIR MINISTRY**

The Ministry of Aircraft Production was constituted by Order in Council dated the 17 May 1940.

2. The London Headquarters of the new Ministries are housed in the offices of Imperial Chemical Industries Ltd., Millbank, London, S.W.1.

Staff transferred to the new Ministry

3. An official notification will be shortly issued to each member of the staff of the Air Ministry who is transferred (or, in the case of the Royal Air Force personnel, lent) to the new Ministry. Meanwhile the staffs of the Departments of A.M.D.P. and C.M.D.P., together with the Secretariat, Finance, Contract and other branches now associated with their Departments will be regarded as forming the main body of the new Department. F.4 and F.6 will continue for the time being to act for both Departments and when they are acting for the Air Ministry they will use their existing designations.

Arrangements for Correspondence of new Ministry

4. All correspondence from the new Ministry is being conducted in its own name, whether that correspondence emanates from the London Headquarters or from branches accommodated in Harrogate or elsewhere.

Passing of files between the two Ministries

5. The Ministry of Aircraft Production will work in close conjunction with the Air Ministry, and in order to facilitate the transaction of business it has been arranged that files shall be passed between branches of the two Departments in the same way as hitherto.

A.M.D.P.'s Department taken over by the new Ministry

6. The functions hitherto allotted to the Department of the Air Member for Development and Production in the Air Ministry have been taken over by the new Department.

Equipment Department to remain with the Air Ministry

7. The organisation controlled by the Deputy Director-General of Equipment will continue to form part of the Department of the A.M.S.O.

Servicing and Repair Organisation

8. The Air Ministry (A.M.S.O.) will continue to be responsible for servicing and repair within the capacity of the Service Units or Stations at home and for all servicing and repairs in overseas Commands. The new Ministry will, however, take over and be responsible for all repair work beyond the capacity of the Service Unit or Station at home, including the work of the Civilian Repair Organisation. It will also be responsible for planning repair capacities in accordance with forecasts supplied by D.D.G.E. of the repairs likely to be required.

9. The R.A.F. Repair Units and Depots will continue to be administered by the Air Ministry through H.Q., No. 43 Group, who will have a priority call on certain personnel for special work unconnected with repairs. The technical control of

repair work carried out in R.A.F. Units and Repair Depots at home will be transferred to the new Ministry and exercised through H.Q., No. 43 Group. The existing machinery of the Equipment Service will continue to be used for the provisioning and issue of equipment to these Repair Depots.

Salvage Organisation

10. R.A.F. Salvage Units at home and overseas will continue to be administered by the Air Ministry but the technical directions to these Units at home will be issued by the Ministry of Aircraft Production and will normally be conveyed through No. 43 Group, R.A.F. Copies of such instructions will be sent to the Air Ministry at the same time as they are issued to the Units.

Aircraft Storage Units

11. The arrangements in regard to the control of the Aircraft Storage Units will be as follows :—

- (a) The Aircraft Storage Units will continue to be administered by the Air Ministry through H.Q., No. 41 Group, and civilian personnel employed in them will be engaged and paid by the Air Ministry. It will be the responsibility of the Ministry of Aircraft Production to bring all aircraft in these Units up to a fully completed and modified state at the earliest possible moment, subject to the priority directions dictated by the R.A.F. These priority directions will be given by the Air Ministry (A.M.S.O.) to H.Q., No. 41 Group.
- (b) The work of modifying and fitting the equipment to the aircraft up to the required operational or training standard will be controlled by the Ministry of Aircraft Production through H.Q., No. 41 Group.
- (c) The storage, maintenance and issue of completed aircraft will be controlled by the Air Ministry (A.M.S.O.) through H.Q., No. 41 Group.
- (d) The existing machinery of the Equipment Service within the Air Ministry will continue to be used for the provisioning and issue of equipment to the Aircraft Storage Units.

Repairs at Service Units

12. The Ministry of Aircraft Production will be responsible for the supply and technical supervision of working parties from aircraft firms when these are needed for the purpose of carrying out modifications and repairs at Service Units. Minor modifications and repairs carried out at Service Units by R.A.F. personnel will, however, continue to be the responsibility of the Air Ministry (A.M.S.O.).

Experimental Establishments

13. The Royal Air Force Experimental Establishments will, for the purpose of technical supervision, come under the Ministry of Aircraft Production in the same way and to the same extent as they have hitherto come under the supervision of the A.M.D.P.

Motor Transport, Marine Craft and overseas purchases of Aircraft Supplies

14. The Ministry of Aircraft Production will be responsible for the production of all equipment at present dealt with by the department of D.G.P., including motor transport and marine craft. The new Ministry will also be responsible for the purchase to Air Ministry requirements of aircraft in the United States of America and for other overseas purchases of aircraft supplies. It will also be responsible for the assembly and completion in this country of aircraft purchased abroad.

Authorisation of requisitions and of payments to contractors

15. The responsibility for the financial authorisation of requisitions raised by the D.D.G.E. will remain with the Air Ministry, but the responsibility for contract prices and for payments to contractors will be transferred to the new Ministry.

Oil and Petrol Supplies

16. The responsibility for oil and petrol supplies will remain with the Air Ministry, but the responsibility for special production schemes (e.g. for the supply of high octane fuel) will be vested in the Ministry of Aircraft Production.

Rations, Clothing, General Stores and Non-Technical Equipment.

17. The responsibility for the provision of rations, clothing and general stores will remain with the Air Ministry. The Air Ministry will be similarly responsible for the repair of non-technical equipment such as furniture, barrack stores, tentage, etc.

Warlike Stores

18. The Ministry of Aircraft Production will be responsible for the production of all warlike stores other than those produced under Ministry of Supply or Admiralty arrangements.

Services common to the two Ministries

19. For the time being, a number of common services will continue to be provided by the Air Ministry for both Ministries—e.g. the Air Ministry will continue to deal with the requisitioning of land and buildings, and with the purchase of land, for both Ministries, and D.D.E.9 will provide transportation services for the new Ministry; the payment of contractors and other bills, and of salaries, wages and travelling allowances will also continue to be made by the Air Ministry, . . .

Pay and Allowances of R.A.F. personnel employed in the new Ministry

20. The Air Ministry will be responsible for issuing the necessary instructions in regard to the pay and allowances of Royal Air Force personnel employed under the Ministry of Aircraft Production.

A. W. STREET.

1 July 1940.

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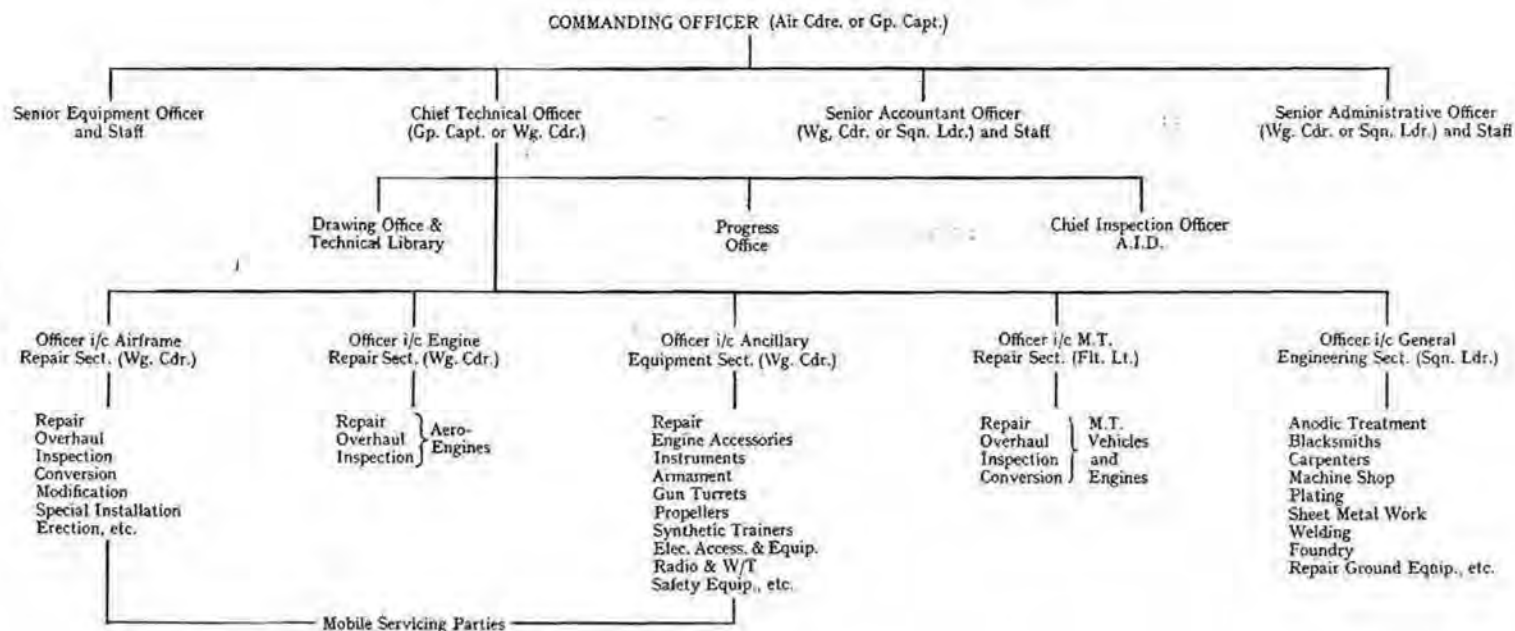
A. W. STREET.

1 July 1940.

APPENDIX 3
No. 43 GROUP EXPANSION
OCTOBER 1940 TO MARCH 1942

Units at October 1940	Expansion—Actual and Projected		Remarks
	Actual	Projected	
No. 13 M.U. Henlow No. 30 M.U. Sealand No. 32 M.U. St. Athan No. 1 M.U. Kidbrooke No. 4 M.U. Ruislip No. 26 M.U. Cardington <div style="display: inline-block; vertical-align: middle; margin-left: 10px;"> } Service Manned } Civilian Man- } ned with } officer staff. </div>	Floor space extended by approximately 350,000 square feet for extra commitments.	—	This increase took place gradually to accommodate repair of new types and increased arisings (See Appendix 4).
—	<i>Marine Maintenance Units</i> No. 84 M.U. Calshot No. 85 M.U. Felixstowe No. 88 M.U. Meickle Ferry No. 97 M.U. Ferry Side No. 213 M.U. Dumbarton	<i>Marine Maintenance Unit</i> No. 214 M.U. Howden-on-Tyne (to be opened in May 1942).	During the last few months of the period No. 43 Group took over the full responsibility for the repair and overhaul of R.A.F. marine craft in the British Isles. In addition to taking over Calshot and Felixstowe and opening up 4 new Marine Maintenance Units this involved controlling the input and progress of repair work to civilian yards as and when circumstances dictated.
—	No. 218 M.U. Colerne	—	A new unit created for the erection and modification of Airacobra aircraft at the rate of 60 per month.
—	—	A new S.R.D. probably No. 24 M.U. Ternhill.	This was to be the second largest S.R.D. in existence and was designed for the repair of Lancasters and Spitfires, American aero-engines and aero-engine accessories. It was to possess the largest propeller shop in the R.A.F. and undertake the repair of other ancillary equipment.
—	—	A new M.T. repair depot in N.E. Scotland.	This project was to be investigated as adequate repair facilities could not be found in this part

APPENDIX 5 ORGANISATION OF A SERVICE REPAIR DEPOT OF No. 43 GROUP



APPENDIX 6

STATISTICAL RECORD No. 43 GROUP REPAIR AND PRODUCTION, 1943-1944

Section (a)—Aircraft (Exclusive of Radar Installations)

	Output 1943	Output 1944
Repair	497	630
Modification and conversion in repair depots ..	340	674
Modification on site	146	1,733
Assistance to civilian contractors	—	54
Total aircraft	983	3,091

Section (b)—Engines (Aero, Marine and M.T.), Propellers and Aero-Engine Accessories (1944 only)

Aero-Engines (Complete Overhauls)

Pegasus XVIII	1,368
Hercules XI and XVI	1,151
Merlin XX, 22 and 24	905
Allison F.3R	377
Pratt and Whitney Wasp	894
Total aero-engines	4,695

Marine Engines (Complete Overhauls)

Napier Sea Lion	320
Ford 18 Marine	245
Thornycroft RY12	39
Meadows	111
Miscellaneous	78
Total marine engines	793

M.T. Engines

Various types—Repairs	274
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Propellers

Propellers—Complete overhaul	2,404
Propeller blades (metal)—Repair	2,821
Propeller blades (wood)—Repair	931
Total propeller repair/overhaul	6,156

Aero-Engine Accessories (Complete Overhauls)

Hydraulic pumps	20,912
Vacuum pumps	7,580
Fuel pumps	9,592
Air compressors	16,703
Combustion starters	770
Combustion starter breeches	1,068
Carburettors	3,801
Total aero-engine accessories	60,426

Section (c) Radio								Output 1943	Output 1944
<i>Radio Repair</i>									
Radar	..	..	..	..	..	..	..	4,630	11,142
W/T	..	..	..	..	..	..	..	5,400	8,200
<i>Radio Manufacture</i>									
Radar, Countermeasures and W/T	..	..	..	..	..	..	..	780	1,650
Typex	..	..	..	..	..	..	..	54,000	94,165
Section (d) Special Aircraft Installations—Radar									
<i>Aircraft Radar Installation</i>									
Radar Interception and Intruder equipment (night fighters)	..	..	..	..	..	..	..	655	714
Radar countermeasures	..	..	..	..	..	..	..	33	95
Navigational aids	..	..	..	..	..	..	..	235	962
Radar equipment for blind bombing (H2S—heavy bombers)	..	..	..	..	..	..	..	592	807
Interception of submarine and surface vessels	..	..	..	..	..	..	..	284	192
Radio altimeters	..	..	..	..	..	..	..	—	663
Radar gun-laying equipment (heavy bombers)	..	..	..	..	..	..	..	—	76
Enemy aircraft warning devices in bombers	..	..	..	..	..	..	..	292	—
Total aircraft installations	..	..	..	..	..	..	..	2,091	3,509
<i>Radar Vehicle Installations</i>									
Self-contained mobile radar installations (convoys)	..	..	..	..	..	..	..	..	320
Transportable ground radar installations	..	..	..	..	..	..	..	..	720
Section (e) Instruments and Electrics									
<i>Instruments</i>									
Repair of instruments (including armament, gyro, navigation, auto-pilot and miscellaneous)	..	..	..	..	..	..	..	50,264	59,965
Instrument installation (bombsights, auto-pilots, gyro gunsights, etc.)	..	..	..	..	..	..	..	3,313	4,589
Instrument modification and manufacture	..	..	..	..	..	..	..	—	5,570
Instrument component repair	..	..	..	..	..	..	..	19,442	18,802
Instrument test vehicles	..	..	..	..	..	..	..	—	7
Instrument test rig manufacture	..	..	..	..	..	..	..	—	334
<i>Electrics</i>									
Repair of magnetos, starters and generators	..	..	..	..	..	..	..	30,322	41,516
Repair of ignition harness	..	..	..	..	..	..	..	5,589	7,707
Armature re-winding	..	..	..	..	..	..	..	3,722	5,858
Repair, manufacture and modification of miscellaneous electrical and armament accessories	..	..	..	..	..	..	..	46,286	52,445
<i>Photographic Equipment</i>									
Repair and modification of cameras	..	..	..	..	..	..	..	..	363
Camera manufacture	..	..	..	..	..	..	..	..	90
Repair and manufacture of camera accessories	..	..	..	..	..	..	..	..	1,427
Repair and installation—Photographic ground apparatus	..	..	..	..	..	..	..	..	180
Repair of photographic components	..	..	..	..	..	..	..	..	137
<i>General</i>									
Major servicing of type 'P' torpedo compressors	..	..	..	..	..	..	..	..	20
De-magnetisation of aircraft	..	..	..	..	..	..	..	..	68

Section (f)—Armament	Output 1943	Output 1944
Machine guns—Overhaul, repair and modification, Recovery of spares	16,294	24,220
Cannons—ditto	2,450	3,647
Bomb carriers—ditto	11,899	19,782
Turrets—Frazer Nash, Boulton and Paul, Bristol and A.V.—ditto	1,062	1,479
Sunderland turret conversion	—	292
Hydraulic bomb winch—Modification to facilitate speedy loading of bombs to heavy bomber aircraft	—	150
Belt feed mechanisms—ditto	758	7,950
American turrets—Repair of turrets and production of spares for operational squadrons	27	87
Turret demonstration trolleys—Manufacture of trolleys and fitting of new type turrets	—	6
Project 19—Assembly of secret equipment for mines R.P. apparatus—Repair and modification of com- ponent parts	—	900
Small arms—Overhaul, repair and modification	7,361	8,204
Firing gear—ditto	591	3,412

Section (g)—Synthetic Trainers

Repair	208	803
Modification	—	321
Manufacture	—	10
Installation	695	1,560
Major servicing	2,435	3,766
Total synthetic trainers	3,338	6,460
Synthetic Trainers Component Repair	1,155	4,593

Section (h)—Marine Craft and Moorings

Marine Craft (Repair and Refit)

High-speed launches (Air/Sea Rescue)	194	718
Pinnaces	193	199
Seaplane tenders, marine tenders and fire tenders	337	357
Airborne lifeboats	18	40
Refuellers	49	38
Miscellaneous	201	222
Totals	992	1,574

Marine Moorings

Buoys—Repair and test	482	
Chain Cable—Anneal and test	3,664	fathoms
Shackles—Anneal and repair	1,685	
Complete sets of moorings—Manufacture	178	

Section (i)—Other Activities

General Engineering Sections

During 1944 G.E.S. undertook the manufacture of 1,308 different external items, amounting to tens of thousands of individual items, examples of which are shown below :—

	<i>Output 1944</i>
Air/Ground equipment, e.g. steering arms, trestles, rigging boards, etc., for many types of aircraft	2,700
Transportation equipment for salvaged aircraft, e.g. beams cradles, trestles, etc.	800 sets
Modification to depth charge nose spoilers	4,000
Fixtures for jettisoning fuel tanks (Spitfires)	3,000 sets
Fitting out articulated box vehicles as caravans for use by aircraft salvage parties	50
Engine tool kit boxes	3,600
Propeller transportation and storage racks	1,000
Transit cases for propellers and spinners	2,900
Mats, mainplanes	4,100
Heater and weather covers	600
Curtains, valances, pelmets, and loose covers	20,000
<i>Balloons</i>	
Repair	2,011
<i>M.T. Vehicles</i>	
Complete overhauls	494
10,000-mile inspections	251
<i>Gaseous Apparatus</i>	
Oxygen cylinders—Repair and replenishment	134,000
Mobile oxygen plants—Test and modification	174

- (iv) The employing of personnel taken from the Airframe Repair Sections of S.R.D.s—when opportunity afforded due to their being lightly loaded—to meet 'rushes' of work.

7. In 1943 the number of aircraft repaired on site was 2,104, so that the figure for 1944 reveals a 75 per cent. increase in output. To appreciate the true significance of this increase it must, however, be realised that the number of heavy bombers and other multi-engined types included in the 1944 total was 1,178 or an increase of 163 per cent. on the previous year's figure. All this was achieved without any increase in establishment overheads. Full details of types repaired in 1943 and 1944 are given in Annex 'A.'

8. Apart from an encouragingly high standard of morale maintained throughout the year, despite the five months' embargo on leave, which to those who worked mostly in the open on crashed and broken aircraft served to emphasise the drudgery of their occupation, the fulfilment of the year's aim in the field of repair resulted from:—

- (i) Careful prediction of the incidence of work.
- (ii) Limiting the number of types of aircraft handled by individual R. & S.U.s, thus engendering skill by specialisation and ensuring economy in specialised equipment and spares holdings.
- (iii) A system of reinforcement operated from the Group Headquarters Control Room, for the purpose of adjusting man-power and equipment to the incidence of work.
- (iv) An improved system of progressing at Group Headquarters, the success of which relied on efficient spares 'chasing' and very intimate contact with the R. & S.U.s themselves (the Control Room Organisation embraced a direct telephone line to most R. & S.U.s).

9. It is, of course, true that one of the greater problems ever present in such an organisation is that of having to meet sudden peak loads of work resulting from fluctuations in the operational effort.

10. The following highspots of activity during the year serve to illustrate the magnitude of this problem:—

- (i) In April/May the IXth Troop Carrier Command, U.S.A.A.F., in preparing for Operation 'Overlord,' found that extensive deterioration had taken place in their Horsa gliders and that no fewer than 278 required immediately to be repaired. The work had to be completed in 16 days and it had to be shared between No. 43 Group Units and C.R.O. 60/40. All jobs were finished on the 13th May.
- (ii) In July the Group accepted all the uncompleted repair-on-site work of the mobile R. & S.U.s of 2nd T.A.F. on their departure to the Continent.
- (iii) The Arnhem operations of September resulted in heavy arisings of Dakota and Stirling repairs. At one time the Group had 30 Dakotas and 55 Stirlings under repair.
- (iv) Bomber Command's step-up in operations in October/November saw the Group at one time with 118 heavy bombers in the course of repair.

11. Apart from this orthodox type of work the Group managed always to provide assistance to Commands and civilian contractors where a deficiency in their resources had made this necessary. An average of 129 tradesmen was constantly employed on such work as urgent modification, installations of power units and the servicing of aircraft after repair. In addition an average of 68 tradesmen was on loan to Commands for work on aircraft other than those repaired as Category 'AC.' It is, moreover, to be remembered that No. 43 Group R. & S.U.s were the responsible agents for the repair-on-site jobs undertaken by C.R.O. contractors' parties to the following extent:—

- (i) Initial categorisation.
 - (ii) Progressing.
 - (iii) Final inspection.
- (The total number of such repair-on-site jobs was 7,130.)

12. Yet another special task devolved on the R. & S.U.s in the first five months of the year; that of converting 72 Stirlings from Mark III to Mark IV. The work had to be done under the auspices of contractors. The number of men employed was 150 and some 144,000 man-hours were involved.

13. Incidental to the assumption of responsibility for 2nd T.A.F. R.O.S. arisings in the U.K., the No. 43 Group Units affected automatically became the holding units of the aircraft and as such each had to be seen through the whole of the procedure of flight testing and equipping to scale before being handed over to No. 41 Group for disposal.

14. With the entry of the B.L.A. into the Continent, it devolved on No. 43 Group to provide repair parties to deal with those types of aircraft belonging to Commands other than 2nd T.A.F.

15. During 1944 these parties completed repairs to seven heavy bombers. They were administered by Headquarters No. 85 Group and a No. 43 Group Liaison Officer provided the necessary functional link. Each party was provided with a mobile repair shop and a caravan in which to sleep and feed.

16. The time factor to complete an average category 'AC' repair (R.O.S.) for a given type of aircraft is both a measure of efficiency and a datum to employ in the formulation of any plan. By the arrangement already referred to that R. & S.U.s should specialise in a minimum number of types, 'repair cycles'—that is to say the period covered from the date of commencement until the date of handover in a fully serviceable state—for 1944 have shown an improvement, whenever no extraneous influence has been present.

17. Average times for the main types of aircraft have been :—

			1943	1944
Halifax	..	..	49 days	34 days
Lancaster	..	..	55 days	21 days
Liberator	..	(ii)	37 days	40 days
Stirling	..	(ii)	25 days	31 days
Mosquito	..	..	33 days	30 days
Spitfire	..	..	32 days	28 days
Typhoon	..	(i)	28 days	41 days
Wellington	..	..	55 days	38 days
Horsa	..	..	45 days	20 days

Notes :—(i) Replacement engines for the Typhoons have not readily been available and the repair cycle has consequently been higher than it otherwise need be.

(ii) If the spares position for both these types were not so poor, the periods would be much lower.

The average man-hours expended range from 500 for a Spitfire to 1,500 for a heavy bomber.

Salvage

18. In dealing with the problems associated with the dismantling and transporting of crashed aircraft (Categories 'B,' 'E.1' and 'E.2') it is convenient to describe them in terms of 'standard aircraft' by which the Mosquito is taken as unity—the largest type as 2.5 and the smallest 0.6.

19. To forecast the arisings of salvage jobs for 1944 (covering the anticipated incidence of usage by Operational Commands, Training Commands and A.T.A., and inclusive of Operation 'Overlord' so far as the United Kingdom was likely to be affected) was not an easy task, but a figure of 17,500 standard aircraft was taken to be the load.

20. The actual number of arisings was 15,736, which gave a 10 per cent. margin of error on the safe side.

21. The comparatively small difference is accounted for by a combination of the following factors :—

- (i) Fewer operational crashes than anticipated.
- (ii) Increased tendency to categorise a crash as repairable on site, rather than to make it Category ' B.' This resulted from an improved degree of skill by R.O.S. parties.

22. Adjustments in salvage facilities to meet the year's estimate of work, including the addition of 170 long low loaders and other remedial measures set out in the forecast of the year, were fully justified. (It is to be remembered that all available salvage party man-power of R. & S.U.s, when not otherwise employed, is devoted to work on the unit's scrap dumps, where dismantling and sorting of salvage produce can always usefully be undertaken.)

23. The salvage figure for 1943 was 11,600 standard aircraft ; by way of comparison, therefore, the load for 1944 was 35 per cent. greater. The fleet of M.T. vehicles employed on salvage work comprised :—

Long low loaders	750	
Cranes	170	
3-ton tenders	357	Shared with R.O.S. Activities.
15-cwt. vans	47	
Light cars	96	
Light vans	78	

24. The average figure of serviceability throughout the year was 88 per cent.

25. The attainment of such an average was largely due to the progressive application of a system of ' planned use and planned servicing ' for M.T.

26. Operations on the Continent introduced two sea activities for the salvage element of the Group—the handling of loads of Category ' B ' and ' E.1 ' aircraft, repairable power plants, engines, M.T. vehicles and other equipment, via a ferry shuttle service, and the receipt, inspection and onwards routing of ' fly-in ' repair and major inspection jobs ex 2nd T.A.F. The ferry service opened up shortly after a bridgehead had been established in Normandy, employing L.C.T.s, and long low loaders. In six months the detachment at Gosport, provided by the regional R. & S.U., handled :—

500 aircraft of various types
400 power plants/engines
100 loads of other equipment
150 M.T. vehicles.

The ' fly-in ' reception which was instituted as a detachment at R.A.F., Odiham, started to operate shortly after ' D ' Day. Up to the end of the year 236 aircraft were dealt with.

27. Two new sea routes have recently been opened up, but too little experience has been gained to justify comment in this review. To meet these added commitments, the regional R. & S.U.s affected have been given the parental responsibility for this work and detached parties have been established and locally accommodated.

28. Handling technique in the dismantling and loading of aircraft has shown considerable improvement during the year. Fully comprehensive and illustrated notes prepared by the Headquarters staff and held by all units are constantly kept up to date as new types call to be handled, and as better methods evolve from experience.

29. The total number of aircraft, all categories loaded and delivered by road, was 12,089, of which 2,431 were heavy bombers. The mileage covered was 7,500,000 miles.

Epilogue

30. Similarly, relations between repair contractors and all those of No. 43 Group with whom they must necessarily come into continual contact in the course of their integrated duties could hardly have been better. The small salvage and repair element of the Polish Air Force established within the Group has made its bonded contribution in a manner typical of their efficiency and it is therefore unnecessary to single it out for comparison. The same remarks can be applied to the civilian salvage gangs—small in number though they be—who are affiliated by contract to a few of the R. & S.U.s.

32. Not the least deserving of mention is the sympathetic understanding and harmony that have attended the functional relationship between the Group and the Ministerial Departments—the Headquarters of Command and Groups—and the Units themselves, as well as all those formations of the U.S.A.A.F. which No. 43 Group has had the happy duty of assisting. (Details of work carried out on aircraft in use by U.S.A.A.F. Units are given at Annex 'B'.)

ANNEX 'A'

Type				Number of Repairs Completed	
				1943	1944
Multi-engined	Fortress .. ..	..	..	5	—
	Halifax .. ..	..	..	93	305
	Lancaster .. ..	..	..	62	464
	Liberator .. ..	..	..	38	53
	Stirling .. ..	..	..	245	351
	Sunderland .. ..	..	..	5	4
	Coronado .. ..	..	..	—	1
				448	1,178
Twin-engined	Anson .. ..	..	..	38	18
	Albemarle .. ..	..	..	28	42
	Boston .. ..	..	..	15	3
	Blenheim .. ..	..	..	30	9
	Beaufighter .. ..	..	..	174	164
	Beaufort .. ..	..	..	34	18
	Catalina .. ..	..	..	8	—
	Dakota .. ..	..	..	—	43
	Dominie .. ..	..	..	7	5
	Hudson .. ..	..	..	80	81
	Mitchell .. ..	..	..	7	55
	Mosquito .. ..	..	..	117	221
	Oxford .. ..	..	..	44	14
	Wellington .. ..	..	..	67	177
	Whitley .. ..	..	..	4	2
	Ventura .. ..	..	..	51	26
	Warwick .. ..	..	..	3	9
	Hampden .. ..	..	..	8	2
	Welkin .. ..	..	..	—	1
	Whirlwind .. ..	..	..	—	1
	Desoutter .. ..	..	..	—	1
				715	892
Single-engined	Botha .. ..	..	..	2	—
	Havoc .. ..	..	..	5	—
	Chesapeake .. ..	..	..	1	—

ANNEX 'A'—*contd.*

Type				Number of Repairs Completed	
				1943	1944
Single-engined — <i>cont.</i>	Albacore .. ..	..	..	1	2
	Avenger .. ..	..	..	—	13
	Auster .. ..	..	..	13	11
	Argus .. ..	..	..	3	2
	Battle .. ..	..	..	1	—
	Barracuda .. ..	..	..	6	32
	Bermuda .. ..	..	..	—	1
	Corsair .. ..	..	..	—	4
	Gladiator .. ..	..	..	1	—
	Defiant .. ..	..	..	6	9
	Firefly .. ..	..	..	1	4
	Fulmar .. ..	..	..	—	3
	Hellcat .. ..	..	..	—	4
	Henley .. ..	..	..	4	—
	Hurricane .. ..	..	..	120	101
	Harvard .. ..	..	..	—	3
	Lysander .. ..	..	..	1	—
	Martlet .. ..	..	..	3	—
	Master .. ..	..	..	39	5
	Magister .. ..	..	..	13	9
	Mustang .. ..	..	..	106	103
	Martinet .. ..	..	..	7	4
	Proctor .. ..	..	..	7	4
	Roc .. ..	..	..	—	1
	Stinson Reliant .. ..	..	..	—	1
	Seamew .. ..	..	..	—	1
	Seafire .. ..	..	..	3	14
	Sea Otter .. ..	..	..	—	3
	Spitfire .. ..	..	..	398	575
	Typhoon .. ..	..	..	31	117
	Swordfish .. ..	..	..	2	7
	Tarpon .. ..	..	..	—	1
	Tempest .. ..	..	..	—	—
	Tiger Moth .. ..	..	..	40	28
	Wildcat .. ..	..	..	1	7
	Miles Hawk .. ..	..	..	1	—
	Percival Q-6 .. ..	..	..	1	1
	Vengeance .. ..	..	..	—	6
	Puss Moth .. ..	..	..	1	—
	Skua .. ..	..	..	1	—
	Hector .. ..	..	..	1	—
	Tomahawk .. ..	..	..	8	—
	Walrus .. ..	..	..	3	5
				831	1,081
Gliders	Hadrian .. ..	..	..	—	1
	Horsa .. ..	..	..	59	447
	Hotspur .. ..	..	..	50	82
	Hamilcar .. ..	..	..	1	6
				110	536
Grand Totals				2,104	3,687

ANNEX 'B'

WORK CARRIED OUT FOR U.S.A.A.F. UNITS

	During 1943	During 1944
Aircraft repaired (including gliders)	NIL	280
Aircraft on which salvage action has been taken	400	1,400 -

APPENDIX 8
No. 41 GROUP MAINTENANCE UNITS
OCTOBER 1940

Aircraft Storage Units

Northern Region

No. 12 M.U. Kirkbride
No. 18 M.U. Dumfries
No. 22 M.U. Silloth
No. 23 M.U. Aldergrove
No. 44 M.U. Edzell
No. 45 M.U. Kinloss
No. 46 M.U. Lossiemouth

Midland Region

No. 9 M.U. Cosford
No. 24 M.U. Ternhill
No. 27 M.U. Shawbury
No. 29 M.U. High Ercall
No. 37 M.U. Burtonwood
No. 48 M.U. Hawarden
No. 51 M.U. Lichfield

Southern Region

No. 5 M.U. Kemble
No. 6 M.U. Brize Norton
No. 8 M.U. Little Rissington
No. 10 M.U. Hullavington
No. 15 M.U. Wroughton
No. 19 M.U. St. Athan
No. 20 M.U. Aston Down
No. 33 M.U. Lyneham
No. 38 M.U. Llandow
No. 39 M.U. Colerne

On 21 April 1941 Nos. 50, 51 and 52 Wing Headquarters were formed, taking over the maintenance units in the northern, midland and southern regions respectively. On 21 November 1942 these wing headquarters were disbanded and replaced by five regional officers for each region.

APPENDIX 9
SATELLITE LANDING GROUNDS

<i>Location</i>							<i>Operating date</i>
Slade Farm	1 December 1940
Middle Farm ..	..	..	..	..	..	..
Berrow	1 April 1941
Hornby Hall ..	..	..	..	..	..	..
Aberffraw ..	..	..	..	..	..	..
Rudbaxton ..	..	..	..	..	..	..
St. Brides	1 May 1941
Chepstow ..	..	..	..	..	..	..
Wath Head ..	..	..	..	..	..	..
Overley ..	..	..	..	..	..	..
Maydown ..	..	..	..	..	..	..
Murlough ..	..	..	..	..	..	..
Down Farm ..	..	..	..	..	..	..
Stravithie ..	..	..	..	..	..	..
Lennoxlove ..	..	..	..	..	..	..
Winterseugh ..	..	..	..	..	..	..
Langford Lodge	1 June 1941
Hodnet ..	..	..	..	..	..	..
Hutton ..	..	..	..	..	..	..
Ballywalter ..	..	..	..	..	..	..
St. Angelo	1 July 1941
Starveall ..	..	..	..	..	..	..
Woburn ..	..	..	..	..	..	..
Methven ..	..	..	..	..	..	..
Brockton ..	..	..	..	..	..	..
Barnsley ..	..	..	..	..	..	..
Low Eldrig	1 August 1941
Townsend ..	..	..	..	..	..	..
Hoar Cross ..	..	..	..	..	..	..
Blidworth	1 September 1941
Dornoch ..	..	..	..	..	..	..
Tatton ..	..	..	..	..	..	..
Barton ..	..	..	..	..	..	..
Kirkton	1 October 1941
Black Isle ..	..	..	..	..	..	..
Hardwick ..	..	..	..	..	..	..
Ollerton	1 October 1941
Bush Barn ..	..	..	..	..	..	..

APPENDIX 10
No. 41 GROUP UNITS
SEPTEMBER 1944

No. 5 M.U. Kemble (P.S. Reading) (P.S. Portsmouth) (22 S.L.G. Barnsley Park)	No. 23 M.U. Aldergrove (16 S.L.G. Ballywalter) (19 S.L.G. Murlough)
No. 6 M.U. Brize Norton (28 S.L.G. Barton)	No. 27 M.U. Shawbury (29 S.L.G. Hodnet)
No. 8 M.U. Little Rissington (3 S.L.G. Middle Farm) (P.S. Hatfield) (P.S. Luton) (34 S.L.G. Woburn)	No. 29 M.U. High Ercall (48 S.L.G. Teddersley)
No. 9 M.U. Cosford (30 S.L.G. Brexton) (33 S.L.G. Weston Park)	No. 33 M.U. Lyneham (31 S.L.G. Everleigh Down)
No. 10 M.U. Hullavington (23 S.L.G. Down Farm)	No. 38 M.U. Llandow (5 S.L.G. Berrow) (7 S.L.G. Chepstow)
No. 12 M.U. Kirkbride (39 S.L.G. Brayton)	No. 39 M.U. Colerne (1 S.L.G. Slade Farm) (2 S.L.G. Starveall Farm)
No. 15 M.U. Wroughton (12 S.L.G. Beechwood) (P.S. Cowley) (P.S. Coventry)	No. 44 M.U. Edzell (24 S.L.G. Methven)
No. 18 M.U. Dumfries (10 S.L.G. Wath Head) (27 S.L.G. Lennoxlove)	No. 45 M.U. Kinloss (41 S.L.G. Kirkton)
No. 19 M.U. St. Athan (6 S.L.G. St. Brides)	No. 46 M.U. Lossiemouth (40 S.L.G. Dornoch) (42 S.L.G. Black Isle) (43 S.L.G. Leanach)
No. 20 M.U. Aston Down (P.S. Gloucester) (14 S.L.G. Overley)	No. 48 M.U. Hawarden (P.S. Brough) (15 S.L.G. Bodorgan) (49 S.L.G. Knowsley)
No. 22 M.U. Silloth (8 S.L.G. Hutton) (9 S.L.G. Hornby Hall)	No. 51 M.U. Lichfield (32 S.L.G. Hoar Cross)
	No. 57 M.U. Uig Bay (Flying Boats)

Aircraft Storage Units (A.S.U.s).
Satellite Landing Grounds (S.L.G.s).
Purgatory Storage Units (P.S.).

APPENDIX 11
OXYGEN TRANSPORT CYLINDERS—SCALES OF ISSUE
13 MAY 1942

F.A.D.s and A.A.P.s	Present Est. of Cylinders	Revised Est. of Cylinders	Additional Quantity Required
No. 2 M.U. Altrincham	100	117	17
No. 11 M.U. Chilmark	75	175	100
No. 31 M.U. Llanberis	25	62	37
No. 36 M.U. Snodland	100	105	5
No. 59 M.U. Newland	62	66	4
No. 64 M.U. Newdigate	150	230	80
No. 64 M.S.U. Newdigate			
No. 77 M.U. Redcastle	120	122	2
No. 91 M.U. Southburn	39	110	71
No. 92 M.U. Brafferton	128	234	106
No. 93 M.U. Norton Disney ..	150	367	217
No. 94 M.U. Barnham	175	355	180
No. 95 M.U. Lords Bridge	150	202	52
No. 98 M.U. Mawcarse	150	130	-20
No. 26 A.S.D. Home Forces ..	50	122	72
No. 100 M.U. South Witham ..	New formation	121	121
No. 80 M.U. Escrick .. ..	..	188	188
<i>Total</i>			1,232

B.O.C. Filling Factories	Present Est. of Cylinders	Revised Est. of Cylinders	Additional Quantity Required
Belfast	50	195	145
Billingham	113	235	122
Coventry	100	190	90
Derby	150	220	70
Glasgow	30	170	140
Greenwich	100	195	95
Kentford	100	245	145
Leeds	250	280	30
Leigh	200	220	20
Rotherham	250	280	30
Southampton	150	270	120
Wembley	250	270	20
Witham	250	320	70
Wolverhampton	150	180	30
<i>Total</i>			1,127
Total additional cylinders required			2,359

APPENDIX 12
THE PETROLEUM BOARD

Note by the Petroleum Board on the Methods adopted to meet the Peak Requirements of Aviation Fuel and Oil

The U.S.A.A.F. commenced operations from the United Kingdom in the middle of the year (1942) and gave early evidence that their rate of fuel consumption was likely to be much more intensive than that of the Royal Air Force. This was due to a difference in operational planning, involving a more flexible composition of squadrons and a more generous allocation of squadrons to particular stations. The preparation of new aerodromes was going on apace, and our vehicles were very busily employed in delivering bitumen for the construction of large runways. There was a general sense of urgency and an indication of big things ahead, but it was difficult for us to obtain reliable data on which to base our own plans. We had received the estimates of probable monthly consumption for 1944 from the Air Ministry, whose previous figures had been sufficiently accurate to be worthy of respect. These gave figures for peak months in 1944 that were much higher than we had previously experienced, but still well within our existing powers to meet if the basis could be taken as the month's total spread evenly over the days of the month. Unfortunately an even spread could not be expected when dealing with a demand so erratic as that for fuel for flying, depending so much on the weather as well as on various other operational factors. The seriousness of the peaks and troughs depended therefore on the storage available at the stations.

In the summer of 1942 came a spell of R.A.F. bombing of Berlin, from which arose unprecedented demands, and these gave us some indication of our future problems. The first spell lasted for a week or so of moonless nights, and during the remaining three weeks of the month the demand was quite negligible. With practically all the month's demand occurring in one quarter of the month, therefore, the number of days' storage per aerodrome during the peak week was only one-quarter of the figure based on a month's estimate. This made the storage position so thin at the busy aerodromes that they were likely to run out of stock unless we kept them filled up day by day. The necessity to do this was a radical departure from our method in dealing with the peaks and troughs we normally encountered, which was to maintain deliveries at a steady level, the storage capacity absorbing the ups and downs. It entailed the introduction of additional vehicles to meet the peaks, and the working from temporary railhead supply centres, both to reduce the road mileage and therefore the number of extra vehicles required, and also to assist the handling facilities at our own depots. We overcame the immediate problems of the R.A.F. programme by both methods, but realised that we would have these problems considerably intensified when the Americans started serious operations. Their programme of day bombing, subject to interference mainly by bad weather, was not likely to involve quite such differences between peak and average day as the R.A.F. programme dependent on moon phases, but they were expected to achieve much higher loads of both average and peak, and also more sustained peaks.

These factors enhanced the problems of aerodrome storage in relation to demand, and emphasised the severity of the demands that would be made on our facilities. We made a number of moves to prepare for these demands. We approached the Air Ministry to deal with the problem at its source by increasing the storage at all key operational aerodromes, but they could do very little as they already had in hand a full programme of tank manufacture for the many aerodromes still under construction. They made some promises but it was evident that before these would be fulfilled the big operational programme would be on us, and to meet this we would therefore have to depend on strengthening our own resources. We had first of all to obtain adequate data. It was essential for us to know what a peak day's demand on each of our depots was likely to mean, and to do this we had to get a day-to-day

picture of operations in the key areas. We had to know what deliveries were made by our vehicles each day, but this was valueless unless we knew whether the aerodrome ullages were moving up or down.

We had to arrange therefore with the Air Ministry for a daily ullage return by aerodromes to our depots to replace the previous block-order system, this ullage advice to be given at 10 a.m. each day, with the understanding that further contacts should be made during the day if necessary. These might be initiated by the aerodrome if heavy demands arose which needed attending to before the next morning or by our depots if they were looking for work for vehicles. We further arranged that our depots in the operational areas should advise the Transport Officers each morning of the 10 a.m. ullage figures, together with their deliveries to stations during the previous 24 hours, and that this information should be passed on to H.O. This enabled us not only to deal with day-to-day emergencies, but gave us invaluable data for our planning.

Initially we assumed an emergency when the ullages at the stations based on a depot substantially exceeded that depot's capacity to rectify them during the following 24 hours, even with the assistance of adjacent depots. We dealt with an emergency either by opening a railhead and loaning vehicles temporarily to work it, or by sending extra vehicles and drivers to the depot for more permanent retention. Both methods had their disadvantages. A railhead was least efficient when it was worked for one day only to handle one train. Railhead staff and pumps, drivers and vehicles had to be sent there, often from distances away. To be of any use the railhead had to be in operation quickly, meaning that the Railway Company were given short notice of our intention to work it, and that the train had to be given quick transit to arrive in time. Should it be late, then not only would staff and equipment be kept idle until it arrived, but it became difficult to discharge it in the one day, as daylight operations only were possible. This particular difficulty did arise on occasion, and the discharge of the train was completed on the second day, necessitating special short notice arrangements for billeting and feeding staff. To be fair to the excellent service achieved by close co-operation between the Railway Companies and ourselves, such occasions were the exception, but in general the special arrangements necessary to open a railhead were repaid only by working several trains on consecutive days. A railhead operation had one distinct advantage, however—when it had served its purpose, the staff and equipment could be returned to home base until required again. This was not so in the case of the other method of dealing with an emergency.

When extra drivers and vehicles were sent to a depot they were assumed to be permanent additions to the depot strength. This was a fair assumption, as the demands at the aerodromes were steadily rising, and calls were continually being made by Transport Officers for extra equipment, always at short notice, and often for quite substantial additions to their fleets. Such calls embarrassed us, as we had no large pool of surplus vehicles on which to draw and were dependent largely on arrival of new vehicles from the manufacturers. The very short notice, moreover, meant the transfer, within hours, of drivers, involving them in difficulties with rations, and ourselves in billeting difficulties. They went willingly enough, but reasonably asked for a little more time to make their domestic arrangements. They reacted strongly if they arrived under these conditions, were uncomfortably billeted, and then found that after a day or two there was no work for them. This was quite a possibility when the Transport Officer asked for these additions on the strength of big ullages on one particular day, reinforced often by advance information as to operations which turned out to be false. The allocation of extra vehicles to depots could not be allowed to continue in this haphazard way, and had to be put on a more scientific basis.

We decided that the really essential figure to know was the daily consumption of fuel by all the aerodromes based on each depot, and that our aim should be to deliver the same gallonage to them a day later. This meant that each depot should be provided with a fleet to deal with the known peak days' consumptions by all the aerodromes based on it, and we decided that the fleet should not be increased until a new peak arose. These consumption figures were arrived at by simple

calculation from the daily advice of ullages and deliveries, and we had to segregate the ullages which arose from consumption from those which arose because new storage had been brought into commission on the aerodrome. The latter were numerous during the second half of 1943, with the opening of new aerodromes, and the installation of new tanks on existing aerodromes. New storages often unduly inflated the ullage totals and had led, in part, to the panic calls for assistance, followed by the slumps which had led to unnecessarily idle drivers and vehicles at the depots.

It may be that the drivers would have been idle at their home depots, but there is a difference between idling at home and idling at a place where social amenities were non-existent and billets may be none too comfortable. When it is realised that there were hundreds of drivers engaged on aerodrome deliveries who were living away from home, it will be appreciated that both their control and their welfare were of fundamental importance. It became evident that neither would receive adequate attention from the existing depot staffs, who, with the increasing gallonages, were becoming busier in all directions just at the time that the numbers of drivers and their problems were increasing. We therefore appointed a Traffic Controller for each depot, to be responsible for the economic utilisation of the vehicles, and also the control and welfare of drivers. They were selected mainly from among the drivers, although some of them were wartime acting drivers, having been salesmen or clerks pre-war. They were given a brief spell of training at Installations where the Traffic Controllers had been doing an invaluable job from the beginning of the war, and were then sent out to the depots to commence their jobs. A few failed, but the majority, particularly those promoted from the ranks of clerks and regular drivers, were a marked success, and unquestionably played a key part in keeping the huge bomber fleets in the air. We also increased the number of Transport Officers to advise and assist them, to co-ordinate the work of the various depots and to overcome any difficulties they might have with the Equipment Officers at the aerodromes. We not only encouraged but insisted on the Traffic Controllers making and maintaining contact with the Equipment Officers and staff, and feel sure that these gentlemen would be the first to admit that petrol was the least of their worries. This was to a degree due to our determination to replenish their consumptions within 24 hours, and their confidence in us was certainly worth achieving, as it eliminated the chances of panic, irritation, and harassing of our hard-pressed staff that would certainly have accompanied an atmosphere of mistrust. On the other hand, it had to be achieved at a price. Our daily records soon revealed that the consumption on a peak day was more than twice the average, which meant that we had to allocate more than twice the fleet that would have been necessary had the aerodrome storages been large enough to bear the ups and downs. The problem of idle drivers still had to be faced, but the new system eliminated many of the troubles that occurred with the earlier, more haphazard, methods. Extra drivers still had to be sent away at short notice, but they could now be given sufficient time to make domestic arrangements, and they went to billets which had been earmarked for them, as we had arranged that each depot could obtain and pay for a given number of reserve billets. Moreover, they were sent to meet a known increased aerodrome consumption, which was certain to be repeated, and probably soon exceeded. If they were temporarily idle, it was probably because of bad weather or for some other reason which they could see for themselves. To help overcome slack periods we arranged other work for the vehicles by way of bridging Pool Spirit and Kero. Wherever possible we gave the depot fleets specific bridging programmes to maintain, and during the peak Aviation periods, the 'Pool' depot stocks were allowed to fall, and vice versa. This work relieved rail and other Installation vehicle fleets, but we had always to be prepared to assist by other means when a sustained Aviation peak led to a dangerous stock position at the 'Pool' depots. Having by the autumn put the Aviation deliveries on to this sound footing, we were then presented by the Air Ministry with heavily increased estimates for 1944 consumption, which immediately revealed the inadequacy of our vehicle and driver strength, and also of our depot facilities.

We were given six months to plan and execute the most radical readjustments, including the doubling of facilities at most depots for discharging railcars and loading road vehicles, and also the siting and building of new depots. We computed

that we would require between 200 and 300 extra vehicles of 2,000 gallons capacity, and 600 drivers. This was based on working all Aviation vehicles 22 hours per day, 7 days a week, with one break of 4 hours per week for maintenance, with the drivers worked on a rota, allowing them days off and periodical weekend leave, involving the provision of five drivers for every two vehicles. We applied to the Ministry of Labour for the 600 drivers, and made approaches to the Air Ministry, War Office, and the Americans to assist us in obtaining the vehicles.

It was soon evident that we would obtain only a portion of the number required from outside, and that we should have to squeeze out the remainder from our own resources. This entailed an up-to-date analysis of the performances of all vehicles of 1,500 gallons capacity and over, and their redistribution, so as to ensure that the largest vehicles would run the longest mileages. This in many cases involved a complete reversal of previous policy, which had economy of fuel consumption as the basis of allocation to long-distance work. It also meant the location of the largest vehicles in the areas where large mileages could be guaranteed every day. This did not include the Aviation areas where the distances were short, averaging 40 miles per round trip, and where the frequent slack days reduced the average mileage per day to a little less than 200. On the other hand, small vehicles were quite unsuitable for Aviation deliveries on a big scale, in view of likely congestions at loading and receiving points.

We computed, therefore, that the 2,000 gallon units should be concentrated on Aviation deliveries, and these mainly consisted of Bedford Scammells, which gave their best mechanical performance over the flat Aviation country. All vehicles of over 2,000 gallons capacity were given work that averaged 250 miles per day, and into this category we also brought the 1,500 gallon International vehicles, which gave a magnificent mechanical performance over any country. . . . We introduced our vehicle reallocations to conform to the above-mentioned standards, and thereby created a useful reserve of large vehicles. At the same time we aimed at ensuring the utmost economy in the use of Aviation vehicles by tightening up the routing, as a large number of extra vehicles would be required by even a little slackness in this vital job. To this end we appointed additional Traffic Controllers, doubling up at most of the depots.

Report by the Petroleum Board on the Extension Programme

The decisions taken at the Quebec Conference, involving the intensification of the air war on Germany from the U.K., were first manifested to the Petroleum Board as estimates of increased consumption of aviation fuel in the autumn of 1943. In effect they represented an increase from 300,000 tons per month of 100 O.N. fuel to 420,000 tons per month. It was evident, moreover, that the weight of the increase would fall almost wholly on the operational key areas, namely, Eastern Region, with a substantial part of North Midland and a small part of North Eastern Regions.

The basic tankage unit at distributing depots had been from two to four thousand tons. Analysis of the new estimates in relation to the dispositions of operational squadrons, and in the light of the peaks in consumption which are inseparable from operational flying, showed that certain depots might be expected to meet daily peaks of 800 tons, which, if maintained, meant a stock of less than three days.

Regarding storage and replenishment capacity together, and bearing in mind that peak requirements must coincide with periods of maximum strain on the railways, and not improbably disruption caused by enemy activity, the need for additional tankage was both evident and urgent.

Apart from additional storage already in train, a programme involving some 33,000 tons of tankage at those depots most affected by the anticipated increase was drawn up, this involving an average addition of 4,000 tons of storage at the selected depots. Certain additions to existing rail facilities in the shape of extended sidings and rail gantries were also required if benefit was to be derived from the additional storage capacity. All this looked to the first part of the problem, but the second part of the same problem involved the capacity of the depots concerned to load outwards and to despatch by road quantities to the order anticipated. The governing factor being essentially the daily peak consumption, the issue turned on

the vehicle fleet necessary to meet that peak, and the capacity of the depot to manoeuvre, fill and despatch them, without those delays which must quickly defeat the purpose of the increased vehicle allocations.

Additional road loading bays were essential, but could be of no value without additional pumping capacity and the lines to take advantage of that extra capacity. Parking and manoeuvring space similarly were essential to avoid congestion. Flexibility of pumping between rail discharge and road loading had to be secured if all the other provisions were not to be fully nullified, the whole programme requiring to be fully integrated throughout.

Some £200,000 worth of work was involved, quite apart from the storage extensions, but including two items each of approximately £25,000 (somewhat exceeded in the result) for two new 2,000 tons one-grade 'utility' depots sited to fill the biggest gaps revealed by the incidence of the new estimates. These two depots were planned on simplified lines in the interests of speed, and in deference to shortages which must otherwise have proved fatal to their completion within the time available.

Such was the bare outline of a programme put forward for Air Ministry sanctions as a matter of outstanding urgency in the autumn of 1943. But while the proposals were under review, it was daily becoming apparent that the increased estimates, staggering as they had appeared, were likely to be below actuality. At the same time, redistributions of strength, and the developing technique of the American daylight offensive, were throwing strains of an incalculable order on to certain depots which had hitherto been no more outstanding than others in the operational areas. Daily experience was also proving that earlier ideas of the possible daily peak were but pale shadows of what was by then imminent, and when related to the standard storages at stations of 144,000 gallons (often only 72,000 gallons at that time) would render such storage no more than 1½ days' stock. Just as storage at the distributing depot could not be separated from the rate of replenishment, so storage at the station, or rather the lack of it, was inevitably bound up with the capacity of the depot to make good consumption. The strength of the chain starting (from the Board's point of view) at the Ocean Terminal, and ending at the 30 × 9 tank on the station, was as strong as, and no stronger than, the weakest link. To strengthen the chain at one point, in deference to the increased estimates, inevitably meant strengthening it at other links as well. Time was not expected to exceed four months; speed was vital and entailed the defeat of conflicting priorities, regarded by others as no less vital, if it was to be achieved. Priorities affected materials, but equally labour. The problem for those concerned was now to establish a sequence of the vital and just perceptibly less vital when the emphasis tended to shift from week to week, as actual performance corrected the estimates. Certain additional items had to be put up to Air Ministry, and on occasion proved more urgent than parts of the main programme, whilst approval in principle often had to cover the initial moves in schemes not formally approved.

The emphasis meanwhile focused more and more on two crucial depots, Claydon and Hethersett, and as a measure of the fluidity at that time it is noteworthy that the latter had not, a month or two before, been considered to justify certain additional facilities, it being one of the 'after thoughts' for approval. It was becoming evident that both must expect peaks of over 1,000 tons per diem, and allocations of 40/50 2,000 gallon vehicles. The 'utility' depots were completed in record time and one of the two enabled Hethersett to survive a rate of consumption which must otherwise have proved overwhelming. Within a few weeks of completion this 'utility' depot was itself coping with 800 tons per day, and Hethersett with 1,400 tons, during comparable periods.

The fact that all the most essential extensions were completed and in operation by the end of April meant that there was a margin, albeit a small one, for staffs to become accustomed to the operation of the extended facilities before the full spate of demand came upon them. The narrowness of the margin, and the issue at stake, justified the pressure which had to be exerted on all concerned with the progress of the work, and justified also the priorities which the Board claimed, and largely obtained, in the matter of labour which was becoming increasingly scarce throughout the period.

In the event, the estimates were much exceeded as it had become evident that they would be, from a study of the actual performances daily outrunning the regularly submitted estimates. 1,400 tons a day became a commonplace on peak days at the depots named, whilst Sandy, the vital advanced rail issuing point at the focus of the operational area, despatched fourteen trains a day against the ten which had come to be regarded as the practical limit.

Had the extension programme been delayed in its completion for even a few weeks, as it would undoubtedly have been delayed had not unrelenting pressure been applied, then it is hard to see how the organisation could have avoided collapse under the progressive strains from mid-May onwards past 'D' Day.

Report by the Petroleum Board on the Delivery Organisation for Aviation Fuel and Oil to the Advanced Landing Grounds.

The Second Front was now looming ahead, and we had been assured that our responsibility on the Aviation side would be to maintain heavy supplies to our regular airfields. It was known that the small airfields all along the South Coast, known as Advanced Landing Grounds, would be brought into commission for the fighters covering the operation, but the Air Ministry were intending to cover all the fuel requirements in packages. At the end of March they decided that this was impracticable, and asked us if we could maintain supplies in bulk. Their peak estimates revealed that with only small vehicles available to us we would need 200 drivers more. We protested at the lack of notice, but were informed that unless we undertook the work the Second Front would be indefinitely deferred. We thereupon accepted and entered on a period of intensive planning. We did not know when the Second Front would start, but thought that it would be any time in May. We aimed therefore at having our A.L.G. delivery organisation completed by the end of April. This entailed the improvement of facilities not only at our depots but on the airfields. It meant the psychological preparation of our staffs at depots where little had been happening for years, and it meant the training of additional Traffic Controllers for those depots. It also entailed the drafting in of additional depot staff, and extra motor repair staff, as well as drivers, and the reservation of billets. To provide the additional vehicles we had to make inroads into our Emergency Reserve, which had been created two years earlier, and consisted of vehicles which by ordinary commercial standards would have been on the scrap-heap, but which had been overhauled and kept in train for such emergency. To obtain the extra drivers we fell back on our last resource, and raised the general level of hours worked. In the Regions affected we also introduced the daily teleprinter advice to Head Office of the aerodrome ullages and deliveries, thus bringing them into line with the key Bomber areas. In January we had arranged with the Air Ministry for our depots to receive the station ullages twice a day, at 10 a.m. and 6 p.m. The 6 p.m. ullage, rendered at 7 p.m. for the summer months, was the key ullage on which the day's work was organised. At this time we could get the best indication of the day's consumption by the U.S.A.A.F., which we would have to make good during the following 24 hours. The 10 a.m. ullages gave us a useful check, but it was still clearly understood by both sides that the rendering of these ullages should not preclude contacts, between the depots and stations at other times of the day, should either feel it necessary.

The A.L.G.s were allocated to a large extent to the U.S. 9th Air Force, who offered to assist in delivering to their own stations by their newly formed Bulk Petrol Companies, of which there were ultimately four, each consisting of 32 vehicles, driven by men quite inexperienced in the handling of bulk spirit, and who required training for overseas. We suggested to the O/C these Companies that they would get their best training by being attached to our depots and acting as part of our fleet, delivering spirit not only to their own stations but to the R.A.F. as well. This was readily agreed, and the Companies played a valuable part in maintaining supplies until after 'D' Day, when pressure was relieved by the transfer overseas of the 9th Air Force. Our depot people described them as gluttons for work, and in return gave them every assistance in their training.

Report by the Petroleum Board on the Liberation of N.W. Europe.

News of the arrival of 'D' Day came to us in a most unexpected way. We had expected operations to start on 5 June, but when that day passed without event we were left in the dark. Then, in the early hours of the morning of 6 June, telephone calls flowed in to us to the effect that numerous drivers who had left their East Anglian depots hours earlier with loads for U.S.A.A.F. stations had not returned. No intelligent explanations could be obtained locally, and it was evident that the drivers had been detained. We kept contact with American H.Q. throughout the night in an endeavour to get them released, but several hours elapsed before this was achieved. The total loss in men and vehicle hours was very substantial. . . . The ullages remained high for two or three days before a spell of poor weather enabled us to rectify them.

We met all other 'D' Day demands without a hitch. In the bomber areas the day's consumption was 20,000 tons. This was not much higher than the existing peaks, but we achieved remarkably high figures in the areas serving the A.L.G.s and other Fighter 'dromes, and the Air Transport Stations. Consumption here totalled 6,000 tons, against a previous peak of 3,000 tons. The peak estimates for which we were equipped amounted to 18,000 tons in the Bomber areas, and 7,000 tons in the other operational areas, and these were so nearly accurate that on 'D' Day we were neither over-equipped nor under-equipped. We maintained our Military deliveries and enjoyed full freedom of road movement. Only in one respect did we find ourselves over-equipped. This was in respect of the reserves that we had laid down along the coast to meet the Civil Defence and N.F.S. demands that we had anticipated from probable enemy action. To meet the N.F.S. demands we had filled several depot tanks with unleaded spirit for the operation of their pumps. Other plans for countering enemy action, which had taken a lot of preparation, but which were not called into action, included our instructions to drivers in the event of gas attack, and our alternative supply arrangements to meet disruption of depots or damage to railways. These plans had included the siting of numerous alternative railheads and the training of the necessary squads. . . . Very soon after 'D' Day there was a marked slump in the Aviation consumption in the embarkation areas. This can be ascribed entirely to the absence of enemy planes in the air on either side of the Channel, and it was evident that unless there was a change in enemy policy we should not again experience demands approaching the 'D' Day level. We took stock at the end of June, and found that the daily demand had fallen from the 6,000 tons level to 3,500 tons. The U.S. Army demand in the same area showed a slight drop for the first time, amounting to 45,000 tons in the month. In the Bomber areas on the other hand, we were recording an average of 13,000 tons per day and the vehicle allocation had increased by a further 92,000 gallons capacity over May.

Report by the Petroleum Board on Aviation Fuel Distribution, 1940-1944

Part of the Story in Figures

Notes on Attached Statements

Group A.—Deals with comparative movements by road, rail and pipeline.

- (1) Growth of rail movements in bulk 1940-1944. Rail movements in 1944 at approx. 3 million tons were nine times greater than in 1940. (Consumption figures 1940-1944 are also quoted.) The progressive increase in rail movements year by year reached a sudden climax in 1944 when the $1\frac{1}{2}$ million tons of 1943 were doubled. 9,235 special trains were run carrying Aviation Spirit in 1944. The Petroleum Board's fleet of spirit rail tank cars increased by about 70% (2,700 cars) between 1940 and 1944.
- (2a) Road, rail and pipeline movements—total in 1944.
- (2b) Road, rail and pipeline movements—month by month 1944.

Road movements in 1944 at $4\frac{1}{2}$ million tons, rail at 3 million tons and pipeline at $2\frac{1}{2}$ million tons represented 94%, 64% and 49% of the U.K. consumption respectively.

1944 consumption was two-and-a-half times the consumption of 1943. Within 1944 itself consumption in the four peak months (May, June, July and August) showed about a 60% increase over the first four months—the increases in movements during the four peak months over the first four months were :—

Road..	..	629,000 tons	..	51%
Rail ..	..	405,000	..	47%
Pipeline ..	..	299,000	..	50%

The percentages of consumption moved by the different methods during the four peak months were :—

Road	..	..	..	92%
Rail	..	..	..	63½%
Pipeline	..	..	..	44½%

Road and rail thus maintained during the four peak months round about the same percentages of consumption as for the whole of 1944—pipeline percentage was below its average for the year; this was due partly to the incidence of the increase of consumption in non-pipeline areas but more particularly because the pipeline had reached its then maximum capacity and rail had to supplement the supply in the pipeline areas by some 40,000 tons per month.

(2c) Road, rail and pipeline movements—four peak months 1944.

Apart from quoting the movement figures for the four peak months in a slightly different form than in statement (2b), this statement shows a dissection of the pipeline figures as between pipeline to depots and pipeline direct to stations. The percentage of consumption which moved by pipeline direct to stations gradually increased from 3% in May to 5% in August. The percentage of consumption delivered to stations by road varied from 88% to 94%.

Group B.—Statements intended to give an indication by figures of the intensity of performance at D.D.s in the operational areas.

(1) Issues and receipts at these D.D.s during representative month of June 1944.

This statement shows D.D. storage as having been turned over two to three times a month on average, rising to three to four times on average at the most crucial D.D.s—Claydon, Hethersett and Bilton, eight to eleven times a month at the stop-gap D.D.s Ellingham and Chappel (the building of these two depots began in January 1944 and was completed in March). At Huntingdon, three 40-ton pipeline fed tanks maintained an issue of 12,000 tons a month whilst the railhead at Horncastle in Lincolnshire (no storage) had a throughput of 8,500 tons.

The statement also indicates the number of rail and pipeline fed D.D.s and roughly the extent to which pipeline connected D.D.s have had their supplies supplemented by rail.

An indication of the intensity of rail receiving operations is the necessity during peak periods to handle an average of five trains a day in and out at Claydon/Ipswich, three trains a day at Ellingham and two trains a day at Chappel, Massingham, Kelmarsh and Watton.

(2) Daily road delivery performance during peak periods—July and August 1944.

An indication of the number of gallons loaded into and delivered by *all* vehicles working at each D.D. round the clock each day, the number of full loads loaded and carried by *each* vehicle during each twenty-four hours and the number of miles run by *each* vehicle outward and home.

Total road issues during peak periods amounted to 350,000–420,000 gallons daily at Claydon/Ipswich and Hethersett; 200,000–300,000 gallons daily at Sandy, Ellingham, Thetford, Brompton and Bilton; 150,000–200,000 gallons daily at Chappel, Massingham, Peterborough, Huntingdon, Saffron Walden, Killingholme, Redmile, Kelmarsh and Watton.

A day in day out performance of between five and eight outward loads (Huntingdon 10 loads) has had to be maintained by each vehicle each twenty-four hours, involving, out and home, between 200 and 250 miles to be run.

Group C.

- (1) Statement giving two columns of monthly consumption figures 1944—the first representing Total Consumption (including overseas consumption); the second representing Consumption in the United Kingdom.

Aviation Spirit Distribution

A. (1) Rail Movements, 1940–1944

Growth of Bulk Rail Movements, 1940–1944

Year	Total tons consumption	Total tons moved by rail tank car	Number of special trains of rail tank cars (as distinct from odd cars)
1940 ..	306,037	353,686	1,158
1941 ..	675,752	470,691	1,540
1942 ..	1,133,532	814,306	2,524
1943 ..	2,056,890	1,590,894	4,748
1944 ..	*5,225,546	3,094,456	9,235

* Includes approximately 436,000 tons exported overseas.

- Notes : (1) The fleet of rail tank cars available to the Petroleum Board for carrying spirit increased by about 2,700 (or approx. 70%) between 1940 and 1944—the increase consisted for the most part of the rail tank cars purchased by the Air Ministry.
- (2) During the years 1943 and 1944 the Board's rail movements of other than Aviation Spirit remained fairly steady at the rate of 2½–3 million tons per annum—about 60% of which was moved in about 6,200 special trains per annum.
- (3) The Aviation rail movements detailed above *exclude* Aviation Lubricating Oil movements by rail.

A. (2a) Movements

Road, Rail and Pipeline, 1944

Total Bulk Movements during 1944 by Road, Rail and Pipeline

	Tons	Percentage of U.K. Consumption
Road	4,505,225	94
Rail	3,094,456	64·6
Pipeline	2,363,582	49·35

Aviation Spirit Distribution—*contd.*

A. (2b) Movements

Road, Rail and Pipeline, 1944

Monthly Bulk Movements during 1944
by Road, Rail and Pipeline

	Road Tons	% of U.K. Consump- tion	Rail Tons	% of U.K. Consump- tion	Pipeline Tons	% of U.K. Consump- tion
January ..	222,750	97.7	154,183	67.69	139,007	60.9
February ..	269,300	98	205,807	75	133,914	49
March ..	348,275	98.55	257,445	72.87	150,141	42.5
April ..	386,300	98.8	249,372	64	178,420	45.63
May ..	454,500	88.6	336,866	65.66	221,800	43
June ..	491,400	93	342,130	66.55	225,400	42.53
July ..	444,300	92	286,956	60	215,500	45
August ..	465,800	94	305,491	62	237,700	48
September ..	402,800	94	258,849	60	234,600	54.7
October ..	377,300	93	243,945	60	237,100	58.5
November ..	327,700	93.3	226,840	64.6	194,600	55.44
December ..	314,800	93	226,572	67	195,400	58
	4,505,225	94	3,094,456	64.6	2,363,582	49.35

Aviation Spirit Distribution—*contd.*

A. (2c) Movements
Road, Rail and Pipeline
Peak Months, 1944

Bulk Movements by Road, Rail and Pipeline
during Peak Months of
May, June, July and August 1944

	MAY		JUNE		JULY		AUGUST	
(a) Total Consumption (including export) ..	521,700		550,600		507,800		551,300	
(b) U.K. Consumption ..	513,000		530,000		482,000		495,000	
Inland Bulk Movements (excluding barge and coaster movements)	Tons	% of U.K. Con- sumption	Tons	% of U.K. Con- sumption	Tons	% of U.K. Con- sumption	Tons	% of U.K. Con- sumption
Road	454,500	88·6	491,400	92·72	444,300	92	465,800	94
Rail	336,866	65·66	342,130	64·55	286,956	59·53	305,491	61·72
Pipeline :								
(a) to depots	206,800	40	206,800	39	195,800	40·6	213,461	43
(b) direct to stations ..	15,000	2·92	18,600	3·5	19,700	4	24,210	5
Total Inland Bulk Movements	1,013,166	—	1,058,930	—	946,756	—	1,008,962	—

Aviation Spirit Distribution—contd.

B. D.D. Performance in Operational Areas

(1) Road, Rail and Pipeline

Operations

Issues and Receipts during representative month

JUNE* 1944

Depot	Aviation Spirit Storage (in tons)	Issues in Tons (by road except where otherwise stated)	Method of Supply		
			Rail	Pipeline	Other
<i>Eastern Region</i>					
Claydon/Ipswich ..	10,000	35,000	Rail	—	—
Chappel	2,000	15,600	Rail	—	—
Ellingham	2,000	21,600	Rail	—	—
Hethersett	8,000	30,170	—	Pipeline	—
Thetford	44,000	19,000	35% Rail	65% Pipeline	—
Massingham	6,000	13,450	Rail	—	—
Peterborough ..	7,000	14,000	80% Rail	20% Pipeline	—
Huntingdon	120	11,950	—	Pipeline	—
Sandy	80,000	Rail 85,400	5% Rail	95% Pipeline	—
		Road 23,800			
Crawley Crossing ..	2,000	9,600	50% Rail	50% Pipeline	—
Mountnessing ..	2,000	9,575	Rail	—	—
Saffron Walden ..	7,000	Road 18,400	—	Pipeline	—
		Pipeline 18,600			
<i>North Midland Region</i>					
Brampton	8,000	11,500	80% Rail	20% Pipeline	—
Killingholme ..	18,000	9,500	—	—	Ocean Tanker
Misterton	80,000	Road 6,300	5% Rail	95% Pipeline	—
		Pipeline 65,000			
Langford	120	3,500	—	Pipeline	—
Redmile	5,000	8,100	50% Rail	50% Pipeline	—
Kelmarsh	15,000	14,500	Rail	—	—
Horncastle (railhead)	Nil	8,500	Rail	—	—
<i>North Eastern Region</i>					
Bilton	6,500	19,400	Rail	—	—
Watton	6,000	12,150	Rail	—	—
Hook	1,500	3,000	—	—	Barge

* The month of June is representative of the performance of D.D.s in the operational areas during the summer and is only slightly higher than the monthly average for the last six months of 1944.

Aviation Spirit Distribution—contd.

B. D.D. Performance in Operational Areas

(2) Road Operations

**Daily Road Deliveries during Peak Periods
July and August 1944**

Depot	Daily Road Deliveries					
	Total Deliveries in 1000 gallons		Number of Full Loads per vehicle per day		Miles per vehicle per day	
	July	August	July	August	July	August
<i>Eastern Region</i>						
Claydon/Ipswich	390	420	5	6.1	230	210
Chappel	132	173	4.7	4.8	200	192
Ellingham	242	287	6.5	8.3	195	199
Hethersett	357	356	6	6.6	200	198
Thetford	209	227	6.6	6.5	200	221
Massingham	147	146	5.8	6.2	220	217
Peterborough	165	167	6.7	5.7	240	211
Huntingdon	163	141	10.1	10.1	170	192
Sandy	304	251	5.1	3.8	180	175
Crawley Crossing	127	126	4.6	5	210	280
Saffron Walden	195	208	5.3	6.2	180	211
Mountnessing	97	59	4	2.7	160	146
<i>North Midland Region</i>						
Brampton	246	230	6.6	7.2	220	170
Killingholme	148	149	5.1	6.2	240	180
Misterton	84	95	5.1	5.8	200	197
Langford	45	49	7	8	150	128
Redmile	119	153	4	6.7	150	176
Kelmarsh	181	202	5.7	6.7	230	214
<i>North Eastern Region</i>						
Bilton	228	256	5	5.9	200	238
Watton	155	160	5.6	5.9	230	277
Hook	36	36	5.1	7.2	180	230

Aviation Spirit Distribution—contd.

C. (1) Consumption Figures, 1944

Aviation Spirit Consumption, 1944

			<i>Total Consumption Tons</i>	<i>U.K. Consumption Tons</i>
January	..	..	229,100	227,750
February	..	..	286,700	274,300
March	..	..	356,475	353,275
April	..	..	395,900	391,300
May	..	..	521,700	513,000
June	..	..	550,600	530,000
July	..	..	507,800	482,000
August	..	..	551,300	495,000
September	..	..	495,500	429,000
October	..	..	489,605	405,500
November	..	..	410,220	350,690
December	..	..	430,646	338,170
			<u>5,225,546</u>	<u>4,789,985</u>

**Total Aviation Fuel Throughputs at Key Depots
January–December 1944**

						<i>Tons</i>
<i>Eastern Region</i>						
Ipswich	..	..	..	..	..	52,459
Claydon	..	..	..	..	..	241,515
Chappel	..	..	..	..	..	87,522
Ellingham	..	..	..	..	..	141,849
Hethersett	..	..	..	..	..	282,916
Thetford	..	..	..	..	..	221,241
Massingham	..	..	..	..	..	122,918
Peterborough	..	..	..	..	..	148,108
Huntingdon	..	..	..	..	..	97,797
Sandy	..	..	..	..	..	205,375
Crawley Crossing	..	..	..	..	..	99,647
Saffron Walden	..	..	..	..	..	179,833
Mountnessing	..	..	..	..	..	63,643
<i>North Midland Region</i>						
Brampton	..	..	..	..	..	136,869
Killingholme	..	..	..	..	..	99,102
Misterton	..	..	..	..	..	73,442
Langford	..	..	..	..	..	26,651
Redmile	..	..	..	..	..	115,955
Kelmarsh	..	..	..	..	..	142,201
Horncastle (railhead)	..	..	..	..	..	57,145
<i>North Eastern Region</i>						
Bilton	..	..	..	..	..	175,630
Watton	..	..	..	..	..	106,259
Hook	..	..	..	..	..	20,532

Aviation Spirit Distribution—contd.
Aviation Fuel Throughputs at Key Depots—January–December 1944
(Figures in tons)

Depot	January	February	March	April	May	June	July	August	September	October	November	December	Total
<i>Eastern Region</i>													
Ipswich	23	255	1,738	2,728	1,687	6,050	7,200	8,000	8,050	5,978	5,540	5,210	52,459
Claydon	10,721	11,872	16,619	18,885	25,830	29,000	26,400	27,900	20,500	19,462	15,152	19,174	241,515
Chappel	—	—	—	3,951	15,086	15,600	9,400	11,100	8,450	8,509	7,426	8,000	87,522
Ellingham	—	—	—	9,387	15,024	21,600	20,300	19,500	14,500	16,792	12,284	12,462	141,849
Hethersett	11,853	15,696	20,921	22,778	27,784	30,170	28,200	30,900	23,150	27,466	21,693	22,305	282,916
Thetford	12,002	13,763	21,215	19,485	16,104	19,000	18,700	18,900	19,750	23,215	19,974	19,133	221,241
Massingham	5,633	7,677	8,641	8,021	11,861	13,450	12,000	11,700	12,275	12,882	9,467	9,311	122,918
Peterborough	11,379	12,065	11,981	11,142	14,264	14,000	14,350	13,750	11,500	12,348	10,969	10,359	148,108
Huntingdon	—	949	6,489	7,019	9,567	11,950	12,700	10,600	9,100	10,732	10,084	8,607	97,797
Sandy	13,546	14,837	17,359	14,127	16,214	23,800	22,500	19,000	14,250	17,538	17,660	14,544	205,375
Crawley Crossing	5,986	6,548	7,796	6,003	8,357	9,600	10,200	10,200	8,250	9,796	8,461	8,450	99,647
Saffron Walden	11,129	14,559	19,068	18,800	22,882	18,400	16,600	17,300	13,400	9,740	8,947	9,008	179,833
Mountnessing	2,576	3,944	6,735	7,136	9,280	9,575	7,200	4,860	4,400	3,547	2,425	1,965	63,643
<i>North Midland Region</i>													
Brampton	10,094	9,725	12,614	12,896	10,130	11,500	13,200	14,000	9,700	8,561	10,685	13,764	136,869
Killingholme	7,222	6,235	7,115	5,879	6,411	9,500	10,400	9,900	9,180	9,698	8,758	8,804	99,102
Misterton	4,450	5,558	5,340	5,914	7,620	6,300	8,000	7,280	7,150	6,268	5,191	4,371	73,442
Langford	—	—	—	—	2,378	3,500	4,000	3,800	3,800	3,249	3,010	2,914	26,651
Redmile	6,795	6,688	9,658	12,151	9,232	8,100	8,700	8,600	10,700	12,459	9,945	12,927	115,955
Kelmarsh	5,246	5,843	7,886	9,467	14,276	14,500	16,500	15,800	15,150	13,325	11,963	12,245	142,201
Horncastle (railhead)	—	—	—	—	10,114	8,500	8,900	9,000	8,400	7,705	4,526	—	57,145
<i>North Eastern Region</i>													
Bilton	5,377	9,817	12,314	12,557	15,166	19,400	21,200	19,100	16,600	16,922	14,662	12,555	175,630
Watton	3,615	5,287	7,062	6,821	7,856	12,150	10,400	12,300	9,900	11,445	9,813	9,610	106,259
Hook	—	—	1,051	1,621	1,714	3,000	2,500	2,750	2,100	2,203	1,795	1,798	20,532

Report by the Petroleum Board on 100 Octane Aviation Fuel Stock Position, 19 April 1945

Explanatory

Statement I shows that out of 691,000 tons of 100/150 Octane Aviation, the stocking of 100 Octane in bulk under P.B. control at 19 April 1945 amounted to only 351,000 tons.

Statement II compares 100 Octane bulk stocks under P.B. control at the beginning of the period of stock restriction on 1 March and the culmination of the stock restriction period on 19 April. Both dates are just prior to the next convoy arrival.

Usable stock decreased by 52½ per cent. from 616,697 tons on 1 March to 292,967 tons on 19 April.

The reduction of stock throughout the distribution system had to be effected according to a carefully organised plan and by detailed day-to-day adjustment in the light of actual day-to-day consumption. The greatest reduction (64%) had to be made at main Installations and that in spite of increased drawings from main Installations stocks for Continental requirements. The margin at the key main Installations necessary to guard against delay or irregularity in tanker arrivals practically disappeared. In this connection the greater certainty of the increased home production of 100 Octane helped substantially. ('Non usable' stock is estimated at 57,803 tons, consisting of 36,730 tons of tank bottoms and 21,073 tons in the pipelines.)

Statement III gives details of usable stocks as at 1 March and 19 April in relation to number of days' supply which they represent—main Installations, pipeline centres and key distributing depots are given individually.

Overall usable stock under P.B. control represented 14½ days' stock on 19 April—consumption of 100 Octane has been taken at the rate of 600,000 tons per month.

Stocks at Avonmouth, Stanlow and Thames Haven represented the equivalent of 2½ days, 5 days and 3 days respectively. Among key distributing centres, there were seven where stocks represented from 2½ days to 4 days of peak consumption.

General Conclusion

With stocks at such low levels throughout the whole chain of the distributing system, everything depended on the maintenance of an immediate replenishment of consumption, both overall by way of tanker importations and in detail internally from Installation by rail and pipeline to each distributing depot as daily required.

This vital regularity of replenishment has been achieved.

Shipments conformed to the schedule required practically 100 per cent. both as to quantity and as to time of arrival.

Internal movements by pipeline and rail were maintained without the slightest mishap or delay irrespective of how abnormal the movement might be.

The smooth running of the whole of the distribution machinery, including the handling of stocks at depot, cleared the way to our concentrating all our efforts on stock control by means of a detailed daily check on stocks at all Aviation stocking centres. By this detailed control (which still continues) it has been possible to work an intricate 'jigsaw' of daily stock manipulations: 'normal' issuing points have had to be perpetually relieved by drawing on 'abnormal' centres where stocks happened at the moment to be more plentiful.

A proportion of the shipments to France has from time to time been delayed for a few days with Air Ministry and SHAEF approval until the next tanker convoy has arrived.

I

Aviation Stocks, 19 April 1945

Total 100/150 Octane under control of P.B.*	..	469,000 tons
Plus :—		
(a) Continent .. .. .	..	120,000 tons
(b) Stations, U.K. .. .	..	102,000 tons
Total .. .. .	..	691,000 tons

*P.B. stock comprised :—

100 Octane

Bulk	351,000 tons
Packed	11,000 tons
	362,000 tons

150 Octane

Bulk	84,000 tons
Packed	23,000 tons
	107,000 tons
Total	469,000 tons

II

100 Octane Bulk Stocks under P.B. control 1 March 1945 and 19 April 1945

	Stock 1.3.45		Stock 19.4.45		Stock reduction on 19.4.45 compared with 1.3.45	
	Total Stock	Usable stock, i.e. less tank bottoms, etc.	Total Stock	Usable stock, i.e. less tank bottoms, etc.	Tons	% Reduc- tion
<i>Main Installations</i>						
Avonmouth ..	57,960	56,860	13,809	12,709	224,384	64%
Stanlow	133,081	126,081	*28,500	*28,500		
Bowling/Ardrossan			28,670	21,670		
Grangemouth ..	32,636	30,136	8,413	5,913		
Heysham	9,536	9,136	11,936	11,536		
Llandarcy	20,541	16,941	14,841	11,241		
Fawley/Hamble ..	25,975	22,975	19,819	16,819		
Belfast	3,228	2,878	3,905	3,555		
Thames Haven ..	86,915	83,915	15,595	12,595		
<i>Pipeline Centres</i> ..	116,193	95,120	81,352	60,279	34,841	37%
<i>A.F.R.D.s and A.F.D.D.s</i> ..	148,984	135,204	107,270	93,490	41,714	31%
<i>Backwood Storages</i> ..	39,451	37,451	16,660	14,660	22,791	60%
	674,500	616,697	350,770	292,967	323,730	—

Overall reduction of stock on 19.4.45 as compared with 1.3.45 = 52½%.

* Represents tanker loads which had just arrived but awaiting discharge and subsequent testing.

III
100 Octane Bulk Stocks under P.B. Control
Comparative Position 1 March 1945 and 19 April 1945

	Usable Stock 1.3.45	No. of Days Supply	Usable Stock 19.4.45	No. of Days Supply		Remarks
				Aver- age	Peak Period	
<i>Main Installations</i>						
Avonmouth ..	56,860	11	12,709 } *28,500 }	2½	—	*Represents tanker loads which had just arrived but awaiting discharge and subsequent testing.
Stanlow	126,081	30	21,670	5	—	The stock position on 19 April would have been much lower had it not been for the increased production of 100 Octane at expense of 150 Grade.
Bowling/ Ardrossan/ Grangemouth	30,136	60	5,913	11	—	During April forced to hold over replenishments to many Coastal Command storages in the Islands until Bowling's stock position improved at end of April.
Heysham ..	9,136	7	11,536	8	—	Increasing 100 Octane production materially assisted position here in April.
Llandarcy ..	16,941	19	11,241	12	—	—
Fawley/Hamble	22,975	16	16,819	10	—	Supplies received mainly by rail for trans-shipment to Continent. Immediately after 19.4.45 substantial quantity out-loaded for Continent.
Belfast	2,878	16	3,555	20	—	—
<i>Pipeline Centres</i>	32,604	13	12,527	5	—	—
	34,461	13	17,247	7	—	—
	28,055	8	30,505	8	6½	—
	83,915	20	12,595	3	—	—

III—continued

	Usable Stock 1.3.45	No. of Days Supply	Usable Stock 19.4.45	No. of Days Supply		Remarks
				Aver- age	Peak Period	
<i>Other Reserve Depots and A.F.D.D.s</i>						
Bilton	4,290	13	3,247	8	5	—
Brampton	6,701	15	4,375	9	7	—
Chappel	1,655	3	1,725	3	3	—
Claydon	4,500	5	4,522	5	3½	—
Crawley Crossing	956	3	1,099	3	3	—
Ellingham	1,247	2	1,730	3	2½	—
Hethersett	4,797	5	3,968	4	3	During April the stock at this Depot actually dropped to a level of 2,800 tons. Pipeline could not keep pace with Depot consumption and stocks from time to time were aug- mented by railcar transfers from Sandy.
Kelmarsh	11,476	21	5,949	11	8	—
Massingham	4,826	10	2,543	5	3½	—
Peterborough	5,219	10	3,090	6	4	—
Redmile	2,653	9	2,821	9	8	—
Saffron Walden ..	4,127	9	3,371	7	5	—
Thetford	7,000	10	5,337	7	5	Stock during April actually dropped at one period to as low as 3,700 tons. Here again Pipe- line could not keep Depot adequately supplied and rail replenishments were received ex Heysham.
Tiverton	1,313	12	1,213	11	10	—
Watton	5,500	16	3,642	10	6	—
Remainder of Depots	68,944	—	44,858	—	—	—
Backwood Storages	37,451	—	14,660	—	—	—
Grand Totals ..	616,697	31	292,967	14½	—	—

Consumption of Aviation Fuel, 1944-1945
(Estimates One Month Ahead)

Estimates v. Actual

<i>1944</i>	<i>Estimates</i>	<i>Actual</i>
January	211,300	229,100
February	232,000	286,700
March	269,200	356,475
April	346,800	395,900
May	382,700	521,700
June	413,000	550,600
July	516,000	507,800
August	599,300	551,300
September	594,500	495,500
October	505,200	405,500
November	502,300	350,690
December	493,300	338,170
<i>1945</i>		
January	460,900	380,000
February	467,800	452,775
March	499,400	640,215
April	506,200	631,320
		(670,000 issued)

Aviation Consumptions

1. 1944. 'D' Day 6 June to 15th

Eastern	25,684,000 gallons
North Eastern	3,706,000 "
North Midland	7,099,000 "
	<hr/>
	36,489,000 "

2. 1944. 16 July to 25th

Eastern	27,111,000 gallons
North Eastern	3,542,000 "
North Midland	7,181,000 "
	<hr/>
	37,834,000 "

3. 1944. 7 August to 16th

Eastern	23,891,000 gallons
North Eastern	4,248,000 "
North Midland	8,148,000 "
	<hr/>
	36,287,000 "

4. 1945. 20 February to 1 March

Eastern	29,603,000 gallons
North Eastern	4,365,000 "
North Midland	8,330,000 "
	<hr/>
	42,298,000 "

Aviation Distribution
Ten Days Road Deliveries ex selected D.D.s, 20 February to 1 March 1945
(Gallons)

Date	Hethersett	Claydon/ Ipswich	Ellingham	Sandy	Huntingdon	Thetford	Kelmarsh
20 February	417,000	376,000	202,000	284,000	112,000	252,000	162,000
21	426,000	388,000	216,000	274,000	166,000	260,000	243,000
22	438,000	390,000	234,000	296,000	178,000	331,000	255,000
23	439,000	402,000	220,000	332,000	138,000	288,000	223,000
24	540,000	465,000	258,000	374,000	160,000	304,000	280,000
25	440,000	435,000	230,000	332,000	126,000	282,000	210,000
26	418,000	459,000	253,000	406,000	128,000	262,000	217,000
27	385,000	380,000	218,000	375,000	126,000	341,000	240,000
28	418,000	402,000	202,000	333,000	136,000	300,000	257,000
1 March	424,000	372,000	264,000	240,000	182,000	294,000	218,000
	4,345,000	4,069,000	2,297,000	3,246,000	1,452,000	2,914,000	2,305,000
Storage	2,400,000	3,000,000	600,000	24,000,000	36,000	13,200,000	4,500,000
Stock	Full	2,500,000	Full	12,000,000	Full	4,200,000	Full

APPENDIX 13

(a) MONTHLY TURNOVER AND STOCKS OF HIGH EXPLOSIVES AND INCENDIARIES AT No. 42 GROUP UNITS FROM FEBRUARY 1943 TO MAY 1945

Year	Month	Turnover of explosives in tons	Stock of explosives in tons	Stock of Incendiaries in tons
1943	February	85,000	173,155	19,331
	March	Not available	Not available	Not available
	April	" "	175,400	23,753
	May	" "	Not available	Not available
	June	" "	" "	" "
	July	" "	162,000	23,000
	August	" "	154,000	19,000
	September	157,000	151,300	18,650
	October	146,000	168,000	16,500
	November	150,000	190,000	23,000
	December	Not available	210,000	29,000
1944	January	" "	222,000	33,000
	February	153,000	232,000	43,000
	March	230,000	205,000	40,000
	April	280,000	185,000	57,000
	May	348,000	165,000	65,000
	June	306,000	137,000	82,000
	July	263,000	128,000	95,000
	August	286,000	133,000	108,000
	September	280,000	141,000	124,000
	October	280,000	141,000	124,000
	November	265,562	129,000	125,000
	December	208,000	128,000	125,000
1945	January	233,000	127,250	128,000
	February	252,000	134,000	135,000
	March	332,500	131,000	110,000
	April	239,000	174,000	134,000
	May	171,000	214,500	134,500

(b) DELIVERIES OF BOMBS AND CHEMICAL WEAPONS FROM THE MINISTRY OF AIRCRAFT PRODUCTION FACTORIES FROM 1939 TO 1945

1939	103,400 tons
1940	192,200 "
1941	534,000 "
1942	498,100 "
1943	584,200 "
1944	1,196,400 "
1945	693,600 "

Total .. 3,801,900 tons

Taken from the M.A.P. Statistical Review.

APPENDIX 14

EQUIPMENT STORAGE, NOVEMBER 1941 TO DECEMBER 1944

Statement of Equipment Storage, November 1941

(1) Universal Equipment Depots

							<i>Constructed storage super feet</i>	<i>Hirings super feet</i>
Quedgeley	..	..	..	..	..	..	1,056,000	225,000
Stafford	..	..	..	..	..	..	1,056,000 (a)	47,000 (b)
Heywood	..	..	..	..	..	..	1,056,000	54,000
Carlisle ..	..	..	..	..	..	..	1,056,000	—
Hartlebury	..	..	..	..	..	..	1,000,000	98,000
Handforth	..	..	..	..	..	..	1,144,000	—
Milton ..	..	..	..	..	..	..	800,000	85,000
Totals	..	..	..	..	..	..	7,168,000	509,000

NOTE—(a) Includes 80,000 feet on loan to Admiralty.

(b) Includes 40,000 feet at No. 99 M.U. Derby.

(2) Barrack and Clothing Depots

Wembley	..	..	..	..	..	..	..	969,000
Newport	..	..	..	..	..	..	..	596,000
Dumfries	..	..	..	..	..	..	..	550,000
Glossop..	..	..	..	..	..	..	..	774,000
Nottingham	..	..	..	..	..	..	..	724,000
Total	..	..	..	..	..	..	..	3,613,000

(3) Equipment Dispersal Depots

Under construction at West Linton, Woodcote, Cuckney and Salcey at 250,000 feet each..	1,000,000
---	----	----	----	----	----	----	-----------

(4) Equipment Parks

Inverness, Perth, Holywood and Ballymena each at 20,000 feet	..	..	..	..	..	..	80,000
Contemplated 13 Parks each of 20,000 feet	..	..	..	..	..	..	260,000
Total	..	..	..	..	..	..	340,000

Summary of Storage Position, November 1941

Existing storage space	..	..	U.E.D.s	..	..	..	7,168,000 (c)
			Hirings	..	..	..	509,000 (c)
			B and C Depots..	..	..	..	3,613,000 (c)
			Equipment Parks	..	..	..	80,000
Storage space under construction	..	..	Equipment Dispersal Depots	..	..	..	1,000,000
Storage space under acquisition and earmarked	..	..	Hirings and Equipment Parks	..	..	..	426,000 (d)
Total	..	..	..	..	..	..	12,796,000

NOTE—(c) Of the existing storage space it was estimated that 5 per cent. of the area was vacant and that racks and bins were 85 per cent. full.

(d) Included 260,000 feet for equipment parks, 176,600 feet at High Wycombe, 'E' M.U. and 'S' M.U., and 250,000 feet to be offered shortly.

Statement of Equipment Storage, September 1942
(Including accommodation under acquisition or to be built)

				<i>Constructed sq. feet</i>	<i>Hirings sq. feet</i>	<i>Total sq. feet</i>
Aircraft Equipment Depots						
No. 3 M.U. Milton	..	..	..	800,000	151,700	951,700
No. 7 M.U. Quedgeley	..	..	..	1,063,500	113,500	1,177,000
No. 14 M.U. Carlisle	..	..	..	1,063,500	—	1,063,500
No. 16 M.U. Stafford	..	..	1,063,500			
less U.S.A.A.F. site	..	..	160,000			
				903,500 (a)	71,095	974,595
No. 25 M.U. Hartlebury	..	..	..	1,007,500	123,000	1,130,500
No. 35 M.U. Heywood	..	..	..	1,063,500	224,000	1,287,500
No. 61 M.U. Handforth	..	..	1,144,000			
less U.S.A.A.F. site	..	..	160,000			
less Overseas Bond (201 M.U.)	..	..	160,000			
				824,000	—	824,000
No. 232 M.U. White City						
(less M.T. reception requirements)				—	60,000	60,000
Totals	..	..		6,725,500	743,295	7,468,795

(a) Includes 80,000 sq. feet on loan to the Admiralty.

Ground Equipment Depots

No. 66 M.U. Cuckney	..	..	..	277,500	—	277,500
No. 68 M.U. Hindley Green	..	..	..	—	277,500	277,500
No. 69 M.U. Sandysike	..	..	..	277,500	—	277,500
No. 70 M.U. Woodcote	..	..	..	277,500	—	277,500
No. 72 M.U. Roade	..	..	..	277,500	—	277,500
No. 216 M.U. Sutton Coldfield	..	..	..	120,000		
			completed			
			157,500		—	277,500
			to be			
			constructed			
No. 225 M.U. Warminster	..	..	..	277,500	—	277,500
			to be			
			constructed			
Totals	..	..	..	1,665,000	277,500	1,942,500

Barrack and Clothing Depots

A' M.U. Wembley	..	..	..	—	761,000	—
E' M.U. Newport	..	..	..	—	798,000	—
H' M.U. Dumfries	..	..	..	—	556,100	—
R' M.U. Glossop	..	..	..	—	920,000	—
S' M.U. Nottingham	..	..	..	—	797,145	—
T' M.U. Wakefield	..	..	..	—	860,000	—
Total	..	..	..		4,692,245	

Summary of Storage Position, September 1942

Existing storage space at A.E.D.s and Hirings	—	—	7,468,795
Existing storage space at G.E.D.s and Hirings	—	—	1,942,500
(Including 435,000 sq. feet to be constructed)			
Existing storage at B.C.D.s	..	..	4,692,245
			14,103,540

Statement of Equipment Storage, March 1943

				<i>Constructed, under construction, approved</i>	<i>Hirings</i>	<i>Total</i>
				<i>sq. feet (2)</i>	<i>sq. feet (3)</i>	<i>sq. feet (4)</i>
A.E.D.s						
No. 3 M.U. Milton ..	..	..	..	1,070,000	151,700	1,221,700
No. 7 M.U. Quedgeley ..	..	..	..	1,363,500	147,880	1,511,380
No. 14 M.U. Carlisle ..	..	..	..	1,333,500	50,213	1,383,713
No. 16 M.U. Stafford ..	..	..	..	1,211,500	84,860	1,296,360
No. 25 M.U. Hartlebury ..	..	..	..	1,307,500	101,213	1,408,713
No. 35 M.U. Heywood ..	..	..	..	1,333,500	320,290	1,653,790
No. 61 M.U. Handforth ..	..	..	..	1,094,000	—	1,094,000
No. 232 M.U. White City ..	..	..	..	—	60,000	60,000
Totals ..	..	..	..	8,713,500	916,156	9,629,656
G.E.D.s						
No. 66 M.U. Cuckney ..	..	..	..	322,500	—	322,500
No. 68 M.U. Bolton ..	..	..	..	—	269,400	269,400
No. 69 M.U. Sandysike ..	..	..	..	322,500	—	322,500
No. 70 M.U. Woodcote ..	..	..	..	322,500	—	322,500
No. 72 M.U. Roade ..	..	..	..	292,500	—	292,500
No. 216 M.U. Sutton Coldfield ..	..	..	..	292,500	77,240	369,740
No. 225 M.U. Warminster ..	..	..	..	292,500	—	292,500
Totals ..	..	..	..	1,845,000	346,640	2,191,640
B.C.D.s						
'A' M.U. Wembley ..	..	..	..	—	755,600	—
'E' M.U. Newport ..	..	..	..	—	852,000	—
'H' M.U. Dumfries ..	..	..	..	—	706,990	—
'R' M.U. Salford ..	..	..	..	—	843,540	—
'S' M.U. Nottingham ..	..	..	..	—	1,192,255	—
'T' M.U. Wakefield ..	..	..	..	—	1,095,720	—
Totals ..	..	..	..	—	5,446,105	5,446,105
Grand Totals, March 1943 ..	..	..	..	10,558,500	6,708,901	17,267,401
Target For July 1943 ..	..	..	..	10,550,500	7,055,295	17,605,795

NOTES :—(1) The figures in col. 2 do not include accommodation permanently occupied by U.S. VIII Air Force and by the Admiralty.

(2) Of the totals in col. 2 the following construction was not completed at that date :—

A.E.D.s ..	..	2,100,000 sq. feet
G.E.D.s ..	..	615,000 sq. feet

Statement of Equipment Storage, May 1943

	<i>Storage existing</i>	<i>Total of storage existing and to be constructed or in course of construction</i>	<i>In Hirings</i>	<i>Grand Total</i>
	<i>sq. feet (1)</i>	<i>sq. feet (2)</i>	<i>sq. feet (3)</i>	<i>sq. feet (4)</i>
A.E.D.s				
No. 3 M.U. Milton	815,600	1,085,600	153,700	1,239,300
No. 7 M.U. Quedgeley	1,299,950	1,613,950	413,550	2,027,500
No. 14 M.U. Carlisle	1,216,400	1,486,400	50,210	1,536,610
No. 16 M.U. Stafford	1,102,700	1,522,700	98,860	1,621,560
No. 25 M.U. Hartlebury	1,226,300	1,526,300	166,810	1,693,110
No. 35 M.U. Heywood	1,230,500	1,500,500	470,250	1,970,750
No. 61 M.U. Handforth	960,000	1,237,500	nil	1,237,500
No. 232 M.U. White City	—	nil	60,000	60,000
Totals	<u>7,851,450</u>	<u>9,972,950</u>	<u>1,413,380</u>	<u>11,386,330</u>
G.E.D.s				
No. 66 M.U. Cuckney	270,000	315,000	322,800	315,000
No. 68 M.U. Bolton	—	—	—	322,800
No. 69 M.U. Sandysike	270,000	315,000	—	315,000
No. 70 M.U. Woodcote	270,000	315,000	—	315,000
No. 72 M.U. Roade	270,000	285,000	—	285,000
No. 216 M.U. Sutton Coldfield	120,280	324,280	106,740	431,020
No. 225 M.U. Warminster	—	285,000	—	285,000
Totals	<u>1,200,280</u>	<u>1,839,280</u>	<u>429,540</u>	<u>2,268,820</u>
B.C.D.s				
'A' M.U. Wembley	—	—	786,600	—
'E' M.U. Newport	—	—	904,400	—
'H' M.U. Dumfries	—	—	750,390	—
'R' M.U. Salford	—	—	1,010,090	—
'S' M.U. Nottingham	—	—	1,301,730	—
'T' M.U. Wakefield	—	—	1,149,380	—
Totals	<u>—</u>	<u>—</u>	<u>5,902,590</u>	<u>5,902,590</u>
Forward Holding Units				
No. 17 M.U. Perth	nil	—	5,800	5,800
No. 73 M.U. Okehampton	21,300	—	nil	21,300
No. 74 M.U. Bough Beech	15,000	—	6,000	21,000
No. 79 M.U. Inverness	16,600	—	nil	16,600

Forward Holding Units—contd.

	<i>Storage existing</i>	<i>Total of storage existing and to be constructed or in course of construction</i>	<i>In Hirings</i>	<i>Grand Total</i>
	<i>sq. feet (1)</i>	<i>sq. feet (2)</i>	<i>sq. feet (3)</i>	<i>sq. feet (4)</i>
No. 87 M.U. York	nil	—	32,460	32,460
No. 89 M.U. Barton Mills ..	21,300	—	nil	21,300
No. 203 M.U. Newark ..	6,750	—	19,800	26,550
No. 204 M.U. Rushden ..	7,500	—	13,000	20,500
No. 205 M.U. Edinburgh ..	7,500	—	nil	7,500
No. 207 M.U. Retford ..	7,500	—	16,000	23,500
No. 208 M.U. Golden Grove ..	7,500	—	25,000	32,500
No. 209 M.U. Broughton ..	20,400	—	nil	20,400
No. 210 M.U. Romsey ..	16,500	—	nil	16,500
No. 211 M.U. Bishop's Stortford	7,500	—	nil	7,500
Totals	155,350	155,350	118,060	273,410

Motor Transport Reception Depot

No. 99 M.U. Derby	57,000	57,000	—	57,000
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M.T. Storage Sites

Padiham	7,500	—	—	—
Hermitage	22,500	—	—	—
	30,000	30,000	—	30,000
Totals	9,294,080	12,054,580	7,863,570	19,918,150

NOTE :—The figures in column (2) do not include that on loan, or the 540,000 sq. feet approved for E.D.D. sheds. They do include 2,121,500 sq. feet at A.E.D.s and 630,000 sq. feet at G.E.D.s not yet completed, or approved in detail.

Statement of Equipment Storage, March 1944

	<i>Constructed or under construction</i>	<i>New, Construction Approved</i>	<i>Hirings</i>	<i>Storage at Balloon Centres</i>	<i>Total</i>
	<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>
A.E.D.s					
No. 3 M.U. ..	1,085,600	—	153,700	210,110	1,449,410
No. 7 M.U. ..	1,613,950	75,000	242,350	90,800	2,022,100
No. 14 M.U. ..	1,486,400	90,000	50,210	141,000	1,767,610
No. 16 M.U. ..	1,522,700	90,000	209,910	—	1,822,610
No. 25 M.U. ..	1,526,300	90,000	207,270	128,550	1,952,120
No. 35 M.U. ..	1,500,500	90,000	454,250	118,990	2,163,740
No. 61 M.U. ..	1,237,500	90,000	18,500	—	1,346,000
Totals	9,972,950	525,000	1,336,190	689,450	12,523,590

		<i>Constructed or under construction</i>	<i>New Construction Approved</i>	<i>Hirings</i>	<i>Storage at Balloon Centres</i>	<i>Total</i>
G.E.D.s		<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>
No. 66 M.U.	..	315,000	—	—	—	315,000
No. 68 M.U.	..	—	—	372,440	—	372,440
No. 69 M.U.	..	315,000	—	—	—	315,000
No. 70 M.U.	..	315,000	—	—	—	315,000
No. 72 M.U.	..	285,000	—	—	—	285,000
No. 216 M.U.	..	324,280	—	109,850	—	434,130
No. 225 M.U.	..	285,000	—	165,000	—	450,000
Totals	..	1,839,280	—	647,290	—	2,486,570
B.C.D.s						
No. 212 M.U.	..	—	—	809,910	—	809,910
No. 214 M.U.	..	—	—	906,500	64,000	970,500
No. 220 M.U.	..	—	—	806,960	35,000	841,960
No. 221 M.U.	..	—	—	1,010,090	—	1,010,090
No. 227 M.U.	..	—	—	1,268,390	—	1,268,390
No. 230 M.U.	..	—	—	1,165,890	—	1,165,890
Totals	..	—	—	5,967,740	99,000	6,066,740
Grand Totals		11,812,230	525,000	7,951,220	788,450	21,076,900

Statement of Equipment Storage, 31 December 1944

	<i>Constructed or under construction</i>	<i>Hirings</i>	<i>Redundant Balloon Centres</i>	<i>Redundant R.A.F. Stations</i>	<i>Total</i>
A.E.D.s	<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>	<i>sq. feet</i>
No. 3 M.U.	1,085,600	191,647	82,500	13,000 Oakley 13,000 Little Horwood 196,784 Airfields 101,000 Sawbridgeworth 122,400 Kingston Bagpuize	1,805,931
No. 7 M.U.	1,688,950	232,382	97,150	9,300 MoretonValence	
No. 14 M.U.	1,576,400	50,213	141,000	80,000 Bibury 222,000 Annan	
No. 16 M.U.	1,612,700	301,594	—	129,000 Grangemouth	
No. 25 M.U.	1,616,300	207,713	128,550	110,000 Usworth	
No. 35 M.U.	1,590,500	464,250	98,990	100,000 Marham 100,000 Lakenheath	2,152,563
No. 61 M.U.	1,327,500	49,500	—	80,000 Bowlee 120,000 Catterick	
				90,000 Bircotes	1,467,000
Totals	10,497,950	1,497,299	548,190	1,486,484	14,029,923
G.E.D.s					
No. 66 M.U.	315,000	—	—	—	315,000
No. 68 M.U.	—	396,993	—	—	396,993
No. 69 M.U.	315,000	—	—	—	315,000
No. 70 M.U.	315,000	—	—	—	315,000
No. 72 M.U.	296,000	59,820	—	—	355,820
No. 216 M.U.	324,280	122,450	—	—	446,730
No. 225 M.U.	285,000	165,000	—	—	450,000
Totals	1,850,280	744,263	—	—	2,594,543

B.C.D.s	<i>Constructed or under construction</i> <i>sq. feet</i>	<i>Hirings</i> <i>sq. feet</i>	<i>Redundant Balloon Centres</i> <i>sq. feet</i>	<i>Redundant R.A.F. Stations</i> <i>sq. feet</i>	<i>Total</i> <i>sq. feet</i>
No. 212 M.U.	—	839,770	—	—	839,770
No. 214 M.U.	—	851,384	—	81,000 Rhoose	932,384
No. 220 M.U.	—	847,314	—	—	847,314
No. 221 M.U.	—	991,662	—	—	991,662
No. 227 M.U.	—	1,180,385	—	—	1,180,385
No. 230 M.U.	—	1,068,813	—	—	1,068,813
Totals	—	5,779,328	—	81,000	5,860,328
Grand Totals	12,348,230	8,020,890	548,190	1,567,484	22,484,794

References :— A.M. Files S.53362/39 and S.101315/44.

APPENDIX 15

UNITS OF No. 40 GROUP HEADQUARTERS, ANDOVER, SUB-UNIT, DERBY, SEPTEMBER 1944

The Three (Maintenance) Wings

No. 55 (Maintenance) Wing, Derby

No. 16 M.U. Stafford ..	..	..	..	A.E.D.
No. 25 M.U. Hartlebury ..	..	..	..	A.E.D.
No. 61 M.U. Handforth..	..	..	..	A.E.D.
No. 66 M.U. Cuckney ..	..	..	..	G.E.D.
No. 72 M.U. Roade ..	..	..	..	G.E.D.
*†No. 89 M.U. Barton Mills	..	..	..	E.P.
No. 99 M.U. Derby ..	..	..	..	M.T.S.U.
*†No. 203 M.U. Newark ..	..	..	..	E.P.
*†No. 204 M.U. Rushden ..	..	..	..	E.P.
*†No. 207 M.U. East Retford	..	..	..	E.P.
No. 216 M.U. Sutton Coldfield	..	..	..	G.E.D.
No. 221 M.U. Salford ..	..	..	..	B.C.D.
No. 227 M.U. Nottingham	..	..	..	B.C.D.
No. 236 M.U. Kettering ..	..	..	..	M.T.S.U.
*No. 2 C.C.D. Birmingham	..	..	..	C.C.D.
*No. 3 C.C.D. Manchester	..	..	..	C.C.D.
*M.P.O. Burtonwood ..	..	..	..	M.P.O.

No. 56 (Maintenance) Wing, Annan

No. 14 M.U. Carlisle ..	..	..	..	A.E.D.
†No. 17 M.U. Perth ..	..	..	..	E.P.
No. 35 M.U. Heywood ..	..	..	..	A.E.D.
*No. 62 M.U. Dumbarton	..	..	..	M.C.S.U.
No. 68 M.U. Bolton ..	..	..	..	G.E.D.
No. 69 M.U. Sandysike ..	..	..	..	G.E.D.
*†No. 79 M.U. Inverness ..	..	..	..	E.P.
*†No. 87 M.U. York ..	..	..	..	E.P.
*No. 205 M.U. Edinburgh	..	..	..	E.P.
†No. 209 M.U. Brigg ..	..	..	..	E.P.
No. 217 M.U. Ballymena	..	..	..	E.P.
No. 220 M.U. Dumfries ..	..	..	..	B.C.D.
No. 230 M.U. Wakefield	..	..	..	B.C.D.
No. 239 M.U. Bishopbriggs	..	..	..	M.T.S.U.
No. 241 M.U. Norton ..	..	..	..	M.T.S.U.

No. 57 (Maintenance) Wing, Milton

No. 3 M.U. Milton ..	..	..	..	A.E.D.
No. 7 M.U. Quedgeley ..	..	..	..	A.E.D.
No. 70 M.U. Woodcote ..	..	..	..	G.E.D.
†No. 73 M.U. Okehampton	..	..	..	E.P.
*†No. 74 M.U. Bough Beech	..	..	..	E.P.
*†No. 208 M.U. Llandilo ..	..	..	..	E.P.
†No. 210 M.U. Romsey ..	..	..	..	E.P.
*†No. 211 M.U. Hyde Hall	..	..	..	E.P.
No. 212 M.U. Wembley ..	..	..	..	B.C.D.
No. 225 M.U. Warminster	..	..	..	G.E.D.
†No. 232 M.U. White City	..	..	..	M.T.S.U.
No. 238 M.U. Tewkesbury	..	..	..	M.C.S.U.
*No. 1 C.C.D. Paddington	..	..	..	C.C.D.
No. 214 M.U. Newport ..	..	..	..	B.C.D.
No. 246 M.U. Bicester (December 1944) (previously under No. 85 Group)	..	..	..	Transit Centre for equipment <i>en route</i> to 2nd T.A.F. on the Continent.

Legend

A.E.D.	Aircraft Equipment Depot
B.C.D.	Barrack and Clothing Depot
C.C.D.	Canal Clearing Depot
E.P.	Equipment Park
G.E.D.	Ground Equipment Depot
M.C.S.U.	Marine Craft Storage Unit
M.P.O.	Master Provision Office
M.T.S.U.	Motor Transport Storage Unit

*Stations without parent responsibilities.

†Forward Transit Centres established at these Units.

UNITS OF No. 40 GROUP, NOVEMBER 1944

Unaltered from September 1944 except for the following amendments :—

No. 55 (Maintenance) Wing, Derby

Add No. 241 M.U. Norton. Motor Transport Storage Unit. Delete Nos. 2 and 3 Canal Clearing Depots (disbanded).

No. 56 (Maintenance) Wing, Annan

Delete No. 241 M.U. now in 55 Wing.

No. 57 (Maintenance) Wing, Milton

Delete No. 1 Canal Clearing Depot (disbanded).

APPENDIX 16
DEMAND LOAD AT THE DEPOTS (SINGLE LINE) 1943 AND 1944

Month					A.E.D.s., G.E.D.s, and B.C.D.s.		Equipment Parks		Total	
					1943	1944	1943	1944	1943	1944
January	..	..	..	..	1,005,195	1,101,468	93,298	286,989	1,098,493	1,388,457
February	..	..	..	..	853,499	1,070,708	100,567	301,111	954,066	1,371,819
March	..	..	..	..	1,090,402	1,331,667	140,172	329,831	1,230,574	1,661,498
April	..	..	..	..	1,120,847	1,249,609	156,792	363,533	1,277,639	1,613,142
May	..	..	..	..	1,172,172	1,450,166	179,492	433,767	1,351,664	1,883,933
June	..	..	..	..	1,155,038	1,511,358	202,777	408,103	1,357,815	1,919,461
July	..	..	..	..	1,190,847	1,335,307	239,799	383,452	1,430,646	1,718,759
August	..	..	..	..	1,094,899	1,193,892	243,181	356,943	1,338,080	1,550,835
September	..	..	..	..	1,065,175	1,116,006	271,291	309,182	1,336,466	1,425,188
October	..	..	..	..	1,064,391	1,069,942	288,066	331,128	1,352,457	1,401,070
November	..	..	..	..	1,068,723	1,106,039	271,149	345,967	1,339,872	1,452,006
December	..	..	..	..	968,229	918,964	274,615	296,811	1,242,844	1,215,775
Totals	..	..	..	..	12,849,417	14,455,126	2,461,199	4,146,817	15,310,616	18,601,943

APPENDIX 17
DEVELOPMENT OF No. 40 GROUP
(a) SUMMARY OF PERSONNEL AT No. 40 GROUP
UNITS ON 31 DECEMBER 1944

Unit	Officers	Other Ranks	Civilians	Total
No. 3 M.U. Milton	52	876	2,223	3,151
No. 7 M.U. Quedgeley	60	759	3,097	3,916
No. 14 M.U. Carlisle	70	534	3,329	3,933
No. 16 M.U. Stafford	99	4,564	25	4,688
No. 17 M.U. Perth	2	17	84	103
No. 25 M.U. Hartlebury	62	758	3,188	4,008
No. 35 M.U. Heywood	56	690	3,117	3,863
No. 61 M.U. Handforth	92	4,011	95	4,198
No. 62 M.U. Dumbarton	1	79	—	80
No. 66 M.U. Cuckney	15	39	770	824
No. 68 M.U. Bolton	19	7	1,051	1,077
No. 69 M.U. Sandysike	13	97	673	783
No. 70 M.U. Woodcote	15	165	525	705
No. 72 M.U. Roade	14	111	668	793
No. 73 M.U. Okehampton	4	160	—	164
No. 74 M.U. Bough Beech	5	121	—	126
No. 79 M.U. Inverness	4	128	—	132
No. 87 M.U. York	5	145	—	150
No. 89 M.U. Barton Mills	4	166	—	170
No. 99 M.U. Derby	16	1,107	—	1,123
No. 203 M.U. Newark	4	135	—	139
No. 204 M.U. Rushden	4	149	—	153
No. 205 M.U. Edinburgh	4	104	—	108
No. 207 M.U. East Retford	4	130	—	134
No. 208 M.U. Llandilo	4	121	—	125
No. 209 M.U. Brigg	4	124	—	128
No. 210 M.U. Romsey ¹	4	88	—	92
No. 211 M.U. Hyde Hall	4	112	—	116
No. 212 M.U. Wembley	12	79	853	944
No. 214 M.U. Newport	12	39	886	937
No. 216 M.U. Sutton Coldfield	27	1,062	14	1,103
No. 217 M.U. Ballymena	4	6	211	221
No. 220 M.U. Dumfries	7	—	774	781
No. 221 M.U. Salford	14	—	834	848
No. 225 M.U. Warminster	24	740	116	880
No. 227 M.U. Nottingham	10	—	865	875
No. 230 M.U. Wakefield	11	—	835	846
No. 232 M.U. White City	11	108	442	561
No. 236 M.U. Kettering	4	—	91	95
No. 238 M.U. Tewkesbury	3	51	—	54
No. 239 M.U. Bishopbriggs	15	266	124	405
No. 241 M.U. Norton	12	173	228	413
M.P.O. Burtonwood ²	13	298	—	311
H.Q. No. 40 Group	80	208	60	348
H.Q. No. 55 (M) Wing	22	138	135	295
H.Q. No. 56 (M) Wing	12	22	5	39
H.Q. No. 57 (M) Wing	12	9	2	23
Totals	945	18,696	25,320	44,961

¹ Excludes 49 R.A.F. personnel attached from No. 3 M.U.

² Unlike the nine other M.P.O.s, M.P.O. Burtonwood was established as a separate unit.

NOTE:—No. 246 M.U. Bicester was not transferred to No. 40 Group until 1.1.45.

Summary Showing Growth Since 1939

	1939	1940	1941	1942	1943	1944
Officers	Details not		*350	750	942	945
Other ranks	available		*7,000	10,500	14,106	18,696
Civilians	*13,500	16,672	21,066	25,607	25,937	25,320

*Estimated figures.

(b) STATISTICS FOR THE YEAR 1944

M.T. Vehicles

Total Stock at 31 December 1944—24,000

	1944	Increase or Decrease over 1943
Receipts Normal Storage		
Ex M.O.S. and M.A.P. Contracts	30,350	- 5,390
Ex Home Commands and Formations, C.R.O. and other Services and Governments	25,933	+ 11,850
Incomplete Vehicles ex M.O.S. and M.A.P. Contractors	6,984	- 1,741
Cased M.T. received ex Contractor	3,952	+ 40
Total	67,169	+ 4,259

Issues Ex Normal Storage

To Home Commands and Formations	27,057	+ 8,775
To M.O.S. for disposal	7,000	
Transfers to Admiralty	1,055	
Transfers to U.S.A.A.F.	963	+ 2,568
Transfers to Dominions and other Governments	533	
Transfers to M.A.P.	2,081	
To Contractors for Casing	3,363	- 133
To C.R.O. for Repair	4,850	+ 50
Cased M.T. to Overseas Commands	3,989	+ 230
Incomplete Vehicles to M.O.S., M.A.P. and No. 26 Signals Group	8,626	- 130
Total	59,517	+ 11,360

Special Reserve Storage

Receipts—

Ex Normal Storage	13,166	+ 246
(Not included as turnover)		

Issues—

To 2nd T.A.F. and other Commands operating in N.W. Europe	17,239	+ 11,914
To Contractors for Casing	169	- 82
To Dominion and Foreign Governments	30	- 210
To Overseas Commands (other than N.W. Europe)	178	- 1,290
Total	17,616	+ 10,332

Total Turnover	Normal Receipts ..	67,169	
(Not including S.R. Receipts)	Issues ..	59,517	
	S.R. Issues ..	17,616	
		144,302	+ 25,951

	1944	Increase or Decrease over 1943
Repair Section		
Forms 523 received and actioned to repair	19,771	+ 5,932
Authorisations issued for repair under C.R.O., V.E.R.S.	4,450	- 1,800
Major Components issued—period 1 Jan. 1944– 30 Sept. 1944	6,079	—
Deliveries between M.O.S. and M.A.P. Contractors and No. 26 Group Units	4,300	N.A.
Marine Craft		
Stock at 31 Dec. 1944	182	
Receipts into Storage	305	+ 83
Issues from Storage	251	+ 77
Running Transport No. 40 Group Units		
Allotted from Storage to R.T.	2,609	+ 476
Allotted from R.T. to Storage	511	- 121
Allotted from R.T. to Repair	879	N.A.
Allotted from R.T. to other Commands	142	- 214
Internal Allotments between Units	270	- 162

(c) TOTAL OUTPUT OF AIRCRAFT EQUIPMENT DEPOT
WORKSHOPS, 1943 AND 1944

	1944 Total	1943 Total	Increase or Decrease over 1943
Mechanical Transport—Running			
Vehicles inspected	32,401		
Motor Cycles inspected	4,128		
Trailers inspected	5,694		
Other repairs and modifications	31,157		
	73,380	54,404	+ 18,976
			= + 35%
Stored			
Vehicles tested	54,501		
Vehicles serviced (periodic and issue)	190,589		
Other repairs and modifications	5,426		
	250,516	N.A.	
Safety Equipment			
Parachutes aired, inspected, and repaired	300,007		
Minor repairs and modifications	22,494		
Dinghies inspected and/or tested	86,709		
Minor repairs and modifications	59,169		
	468,379	154,643	+ 313,736
			= + 200%
Gun & Bomb Section			
Guns serviced and modified	45,160		
Category 'C' guns serviced	54,460		
Guns prepared for storage	102,514		
	202,134	80,734	+ 121,400
			= + 150%

		1944	1943	Increase or Decrease over 1943
Turrets Section		<i>Total</i>	<i>Total</i>	
Turrets tested, periodical and issue	21,937			
Turrets modified	816			
	<hr/>	22,753		A new commitment in-
				troduced the latter part
				of 1943

Electrical Section				
Items modified	249,741			
Items serviced	482,006			
	<hr/>	731,747	628,598	+ 103,149
				= + 16%

Instrument Section				
Items modified	228,431			
Ancillary items serviced	56,849			
	<hr/>	285,280	114,270	+ 171,010
				= + 150%

Fabric Section				
Items repaired or modified	36,126	36,126	60,064	- 23,938
Items manufactured	89,900	89,900	73,809	+ 16,091
	<hr/>	126,026	126,026	133,873
				- 7,847
				= - 6%

Sheet Metal Section				
Radiators, Tanks and Oil Coolers, pressure tested	62,463			
Items manufactured and/or modified	55,995			
	<hr/>	118,458	106,163	+ 12,295
				= + 11%

Engine Section				
Engines inhibited	28,008	28,008	23,486	+ 4,522
Engines modified or inspected	8,660			
Engines checked on receipt and for issue	106,605	115,265	98,801	+ 16,464
Aero engine spares modified and prepared for storage	498,057	498,057	151,794	+ 346,263
	<hr/>	641,330	641,330	274,081
				+ 367,249
				= + 134%

Propeller Section				
Propellers modified	1,041	1,041	1,555	- 514
Propellers erected and/or dismantled	8,768	8,768	7,317	+ 1,451
Propellers prepared for storage	31,298	31,298	N.A.	-
Ancillary Equipment serviced/modi- fied	397,831	397,831	N.A.	-
	<hr/>			
				= + 10%

	1944 Total	1943 Total	Increase or Decrease over 1943
General Engineering Section			
Ground Equipment			
Items modified and/or repaired ..	167,122		
Items manufactured ..	178,204		
Items prepared for storage ..	94,975		
	<u>440,301</u>	<u>491,882</u>	- 51,581
			= - 10%

Carpentry Section

Cases manufactured and assembled	541,442		
Cases repaired, miscellaneous wood- working tasks and modifications	232,477		
	<u>773,919</u>	<u>523,943</u>	+ 249,976
			= + 48%

(Cases manufactured by L.P.O. 105,080.)

Airframe Spares

Items modified	66,292		
	219,611		
	<u>285,903</u>	<u>N.A.</u>	

APPENDIX 18

EXTRACTED FROM—A STUDY OF THE SUPPLY ORGANISATION OF THE GERMAN AIR FORCE, 1935-1945

Produced by—Air Division Control Commission for Germany, British
Element, June 1946

The essential difference between the organisation of the German Air Force and the R.A.F. was that the former was organised regionally and the latter both functionally and regionally. The German planners decided in favour of regional control because their military plans were aggressive and they desired their air force to comprise a number of tactical air forces which would work closely with the army in 'lightning' campaigns. The need for an elaborate fighter defence of the Reich and a home-based heavy bomber force was not warranted by their military and political intentions. They expected wars to be won quickly and early but 'war is the last of all things to go according to programme.' The whole German military machine was geared to blitz warfare and this form of strategy was frustrated in the battle for Russia. The Germans were deprived of the initiative in early 1942 but, in spite of this, no efforts were made to alter radically the organisation of the Luftwaffe to accord with the requirements of the new situation.

The pioneers of the G.A.F. were impressed with the mobility of aircraft and their conception of organisation was considerably influenced by the desire to preserve this quality. Each air fleet consisted of operational commands and separate supply and administration commands, the aim being to free the operational formations as far as possible from long-term supply responsibilities and thus to preserve the essential mobility of the fighting force. There was, however, a tendency in practice for the two spheres—flying and supply—to draw so far apart as to prejudice efficiency, especially in a theatre away from the homeland where the battle was constantly fluid. This fact was appreciated by certain commanders who were striving ceaselessly to achieve a compromise that would blend operationally activities more closely with the supply machine without hampering the mobility of the flying staffs. However no general direction was given by the German Air Ministry in this connection and separation continued.

The main factor of importance that emerges from the G.A.F. organisation for supply is the need to distinguish between the home-based air force and the tactical air forces working abroad with mobile armies. In the former case the operational air force should be functional in character and be supplied by a separate supply command which should be divided into functional groups each operating a regional supply system. This method reduces the number of supply installations required, and consequently reduces the amount of material frozen in pipelines and local reserves. Furthermore, strict centralised control over all supply stations can be exercised. In the latter case, i.e. supply to tactical air forces, the policy varies from day to day according to the movements of the battle, which is an imponderable factor. Supply matters, therefore, must be directed from the operational headquarters and supply and operational staffs must work side by side. In addition, the operational headquarters, through the supply staff, should have direct control of its own supply installations, which can then be located and replenished in direct relation to tactical development. The German fear that control of supply installations by an operational headquarters would prejudice the mobility of that formation was disproved by the practical example of Nos. 83 and 84 R.A.F. Groups which supported the British armies in the battle which brought about the final defeat of the Third Reich.

The R.A.F. unquestionably adopted the logical system of supply and made the proper differentiation between home-based and tactical air forces. A similar system, in spite of the different geographical situation, would also have served the German air force more efficiently and more economically than their own organisation. The German mistake may again be attributed to the failure of their original military intentions in 1942 and the subsequent obstinate adherence to an organisation that with the change of strategy became immediately outdated.

Personnel

In the German air force there were no officers equivalent to the equipment and technical officers of the R.A.F. There were three main specialist branches of the G.A.F.—flying, flak and signals—but within those branches there was no further officer specialisation. All G.A.F. officers were given military operational training, which during their careers was supplemented by short courses in technical and supply subjects. All officers were encouraged, therefore, to have a general rather than a particular outlook. Furthermore, it was a German principle that all officers should keep in very close touch with operational activity and consequently officers were not kept in base appointments for more than a maximum of two years at a time. Thus Quartermaster, Technical and Supply appointments were filled by officers who had a very superficial knowledge of their duties.

The system needed some backing of workers who could undertake the detailed work and provide an element of continuity. They were found in the corps of German officials (Beamte) and civilians.

German Opinion on the Question of Officials and Officers

Dr. Winterhoff, a Generalintendant of the German Air Ministry, who was head of the personnel branch dealing with officials, admitted during interrogation that officials would probably not have been introduced into the air force if it had been possible to foresee the estrangement that came to exist between officials and officers. This feeling developed, so he claimed, largely because the officials felt they were constantly at a disadvantage when compared with professional soldiers. Winterhoff agreed that specialisation was essential in order to meet the technical requirements of an air force, but added that it should be undertaken by the officers themselves.

Various General Staff officers interrogated on this subject agreed that the very general training encouraged in the G.A.F. developed a type of officer who had a very superficial knowledge and believed, therefore, that he was able to give judgment on all things whereas, in fact, he was not qualified to judge at all. In the higher and more important positions there were extremely few officers who had sufficient grip of their subject to direct vigorously the supply and technical services. The consequence was that those at the top accepted the opinion of the mass without critical appreciation, and direction suffered accordingly. Although it was agreed that a degree of specialisation was desirable it was stressed that overspecialisation was dangerous, as it meant a limitation of career prospects and tended to produce autonomous sects of narrow-minded people who were out of touch with broad operational principles.

Conclusion

From the foregoing paragraphs it seems clear that German policy for the selection, training and employment of personnel, produced two very serious weaknesses in the organisation of the supply services, which undoubtedly affected the efficiency of those services. They were as follows:—

- (a) By reason of the inadequacy of their training, the officers operating the supply organisation were not sufficiently knowledgeable to do their work efficiently.
- (b) The members of the supply organisation who did possess intimate knowledge of both 'supply mechanics' and equipment, i.e. the Beamte, were separated by a class barrier from the officers directing operations, and also, due to their confinement to relatively subordinate positions, never had the opportunities of learning the wider problems of supply. In consequence they could not bring to bear in the very quarters of the organisation where it was most lacking, the knowledge indispensable to the proper planning of operations.

Before attempting to suggest what lessons may be learned from these observations, it is necessary to determine what basic principles should have been observed in formulating policy, and what mistakes in policy led to their weaknesses.

In the first place it may be said that there are three main aspects to be considered in the employment of a military force :—

- (a) The conduct of operations.
- (b) The means to support the operations, i.e. supply.
- (c) The special services necessary to maintain the means to be employed.

In explanation of the above division it should be said that such apparently separate activities of a service as signals, intelligence, technical maintenance, training and personnel control, are to be regarded as coming under heading (c) as factors determining the conditions in which (a) and (b) are related to each other. Now it is suggested that the Germans' fundamental error in policy was their failure to realise that each of these three main divisions is of equal importance. In consequence they underrated the importance of supply, and neglected to provide the supply organisation with personnel of the right type of training.

With a traditional outlook towards warfare, the Germans regarded the consideration of strategy as the all-important factor. For centuries the military caste had dominated national thought on warfare, and it was this caste which failed to understand the immense influence that the supply of modern arms exercises on the conduct of a war. In the past the mere matter of supply of arms had always been entrusted to the Beamte class. Supply had never been a matter into which an officer need enquire too deeply.

With this traditional outlook it was inevitable that the training of officers should be directed mainly towards making them into efficient General Duties officers, and that little attention should be paid to the task of fitting them for positions in the control of the supply organisation.

Now it has been claimed that the two main weaknesses in the position of personnel for the German supply organisation are traceable to their inability to appreciate correctly the importance of supply in relation to the other activities of the service. It is therefore necessary to suggest what principles should govern the provision of personnel when a correct balance exists between supply and other activities.

In the first place basic specialisation is indispensable, i.e. there should be no attempt to make every officer primarily a General Duties officer, and then impose on him a superficial training that can only make him an indifferent officer in a secondary employment. On entering the service after receiving his basic training each officer should (as is the practice in the R.A.F.) go at once into a particular branch of the service and receive his primary training in that branch, and thereafter practise his 'trade' within the branch until he reaches a standard of proficiency such as will fit him to receive further training of a broader nature to qualify him for higher command.

Incidentally, apart from the reasons deduced above from the weaknesses revealed in the German organisation, there is strong support for the opinion that officers should be placed into specialist branches. It has been shown that one of the greatest mistakes the Germans made was to organise their air force territorially instead of functionally. If this is accepted, then it follows that the part of the organisation devoted specially to supply should be staffed by officers who are supply specialists.

At this stage it is appropriate to consider whether by this system of specialisation all the needs of a service are adequately met. On considering the R.A.F., which has adopted specialisation, it can at once be said that by German standards there is a deficiency of technical knowledge in the junior grades of each branch of the R.A.F. or at least clearly so in the equipment branch. In the Luftwaffe, the Beamte class who filled the majority of junior posts, were trained to a much higher standard than are the equipment officers of the R.A.F. They were not only trained in the 'mechanics' of supply, but also received quite extensive practical training in the engineering firms actually making the equipment they were required to handle. Furthermore, they renewed their contacts with these firms from time to time in order to keep up to date with technical developments. They were thus undeniably more efficient than their counterparts in the R.A.F.—the junior equipment officers.

On the other hand, the more senior officers of the equipment branch in the R.A.F. are more knowledgeable and efficient in purely supply matters than their German counterparts, who were primarily trained as General Duties officers. At the same time, the latter, by reason of their training, possessed a wider knowledge of general service matters, and in particular of operational matters, than the normal R.A.F. equipment officer, and in this respect, therefore, were at an advantage in their dealings with the operational staff.

It is suggested that this German experience clearly indicates the wisdom of establishing full equality amongst officers throughout all branches and also strongly supports the proposal that equipment officers should receive the most extensive training possible.

Viewed from a different angle the position of the Beamte in the German air force also serves to emphasise another disadvantage in which the R.A.F. equipment officer stands in relation to officers in other branches. Whilst the Beamte were admittedly regarded as a race apart they were at least acknowledged as experts in their own limited field and could therefore always hold their own in certain situations of a purely technical nature. The R.A.F. equipment officer, however, lacking the technical knowledge of the Beamte, is at a perpetual disadvantage with his fellow officers with whom he works, all of whom possess their specialist knowledge and training which he does not. He therefore suffers from a double disadvantage in that he is neither the equal of the General Duties officer in general training nor has he adequate standing in his dealing with technical officers. This lack of technical knowledge in the equipment branch therefore not only results in a lower standard of efficiency in the branch but also contributes towards unsatisfactory co-ordination between equipment officers and officers of other branches.

This fact appears to lend considerable support to a suggestion that selected equipment N.C.O.s should receive technical training. The adoption of such a scheme would mean that there would always be in the branch a proportion of N.C.O.s with sound technical training to advise and assist junior officers on technical aspects of their work, and at the same time there would also be a number of officers commissioned from technical N.C.O. rank with direct technical knowledge and experience.

Supply in the Field

The German system of supply in the field provides a clear example of their principle of segregating the 'operational' from the 'administrative' side of their air force. The flying units were freed completely from the normal day-to-day responsibilities of supply, and it is almost undeniable that for the conditions of 'blitz' warfare (for which the German air force was designed) such a system is practicable and efficient for a home-based force. In a war involving little or no territorial expansion, the close link which exists between the operational and administrative sides of the R.A.F. may be desirable, but is not, as far as can be seen, a necessity.

On the other hand, as soon as the character of a war changes to one of rapid movement, it is essential that the closest possible link should be forged between the units conducting the operations and the units bound up with those supplies which render the operations practical. In the G.A.F. the Luttwagen headquarters was usually very many miles behind the fighting forces. It had no visible connection with the early success of the 'operational' air force, and the psychological effect on the members of its staff was unfortunate. They considered themselves overlooked and unappreciated, and developed a tendency to lose interest in operational matters.

The main depots of the G.A.F. are worthy of special consideration, playing as they did an important role in the provisioning system in addition to their normal use as bulk storage installations. The main depots provide a further example of the air force being bound to a system which became out of date immediately the original concept of 'blitz' warfare was proved at fault. They supplied on a 'technical' rather than a 'territorial' basis—that is, they specialised in specific

ranges of equipment, of which they held the total stocks. The advantage of such a system when producing stock figures and consumption data is apparent, but it was a system based on the entirely false premise that the danger of attack by air or land forces was negligible. With the intensification of the Allied air attacks, it became necessary to disperse the main depot holdings over a fantastically wide area, and in due course the overrunning by land forces of certain depots deprived the G.A.F. of its total reserve stocks of whole ranges of equipment.

The air parks—next in the chain of supply—had the advantage of carrying three months' stock of the 'universal' range. Towards the end of the war, however, when Allied air attacks were concentrated on road and rail transport, they were virtually isolated from the main depots, from whom they were expected to obtain replenishments. Due to the 'specialisation' of the main depots the air parks often had to obtain their supplies from depots over 300 miles away. The efficiency of the smaller installations—the equipment issuing stations—was naturally affected by the difficulties besetting the air parks from whom they—the equipment issuing stations—drew their supplies.

It is difficult to draw any positive conclusions regarding the German system of supply in the field beyond the fact that the basic organisation of the G.A.F. rendered it unsatisfactory. The 'operational' and 'administrative' sides of any fighting force cannot remain effective if divorced either geographically or psychologically.

The outstanding defect of the system was that, when called upon to play a role for which it was not originally designed, it lacked the elasticity to adapt itself to changed conditions.

Provisioning and Production

In reviewing the systems of provisioning and production employed in the G.A.F., it is necessary to consider two separate and distinct periods of the war—the first phase, up to 1944, being marked by the complete independence of the air force in controlling its own production, and the second, from 1944 until the end of the war, when responsibility for production was assumed by the Ministry of Armaments and War Production.

The first period was marked by the high standard of quality of the items being produced in sufficient quantities to satisfy the needs of a comparatively small air force. It is scarcely possible, however, to accept this as a merit, when the system was so lacking in elasticity that it was incapable of the required degree of expansion when quantity became a primary consideration. An obvious defect, on the other hand, was the fact that by its insistent isolation the G.A.F. denied itself the benefits of skilled industrial and economic organisation. Its insistence, moreover, in the sphere of raw materials and man-power, on adherence to provisioning programmes unrelated to the total war capacity of the State cannot but have contributed materially to the low output of production for all three Services during the first half of the war.

In the second period the overriding authority of the Speer Ministry in co-ordinating all production, resulted in a greatly increased output of armaments, and the outstanding merits of the system may be summarised as follows :—

- (a) The co-relation to all economic and industrial resources resulted in an improved utilisation of raw materials and ensured a proper degree of allocation between the different Services. It ensured a more economical use of production capacity by eliminating inefficient plants and by preventing the erection of identical or similar plants designed to produce for competing consumers. It resulted in a better use of available man-power by the more specialised employment of technicians and by the opportunities available for the rapid deployment of labour from one plant or area to another.
- (b) It eliminated any element of competition which may have existed between the three fighting Services.

The creation of an autocratic authority with powers to act without relying upon advice or direction from the fighting services presents obvious opportunities for misuse of power. Although it is not suggested (except by certain G.A.F. officers) that Speer did misuse his powers to the positive detriment of the strategic situation, it is evident that,

- (a) no one person or body is competent to deal adequately with all the aspects and ramifications of provisioning and production from both the industrial and military points of view, and
- (b) considerations of expediency in factories may be allowed to over ride strategic necessity, and military requirements may be subordinated to industrial and technical considerations.

APPENDIX 19

THE PLANNING OF AEROPLANE MAINTENANCE¹

Preamble

1. These notes are issued for the guidance of Station Engineer Officers and others concerned with aeroplane maintenance in units of Flying Training Command.
2. Before any problem can properly be understood it first requires to be measured, and in this connection flying training units are fortunately placed as their syllabus flying hours are clearly defined in both magnitude and period.
3. By a method later to be described in this paper, it is possible to arrive at a series of data from which emerges the unit's maintenance task, in respect of which careful planning is called for in fulfilment of the training commitments.

The Maintenance Aim

4. The aim may best be described as follows :—
'To ensure that the unit's state of serviceability is such that the flying training programme is never delayed for want of the requisite number of fully serviceable aeroplanes, and that the ratio of serviceable to unserviceable aeroplanes bears a direct relationship to the syllabus requirements both as regards numbers and intensity of use.'
5. It must always be realised that it is the flying training programme that 'calls the tune' and the maintenance organisation that has to 'play it.'
6. Therefore, a correctly planned maintenance organisation can only be made fully effective by an equally well planned flying training organisation. Thus both activities are interdependent and it follows that part of the flying training aim must be :—
'To ensure that the predetermined quota of serviceable aeroplanes made available to the flying training programme is flown at the planned rate.'

The Maintenance Plan

7. In setting out to ascertain the maintenance task, the vital factors to be taken into account are :—
 - (i) The total flying hour commitments as governed by the syllabus requirements and incidental non-productive flying.
 - (ii) The individual daily flying rate of the aeroplanes in use.
8. These factors dictate the establishment requirements of a unit both for maintenance personnel and aeroplanes. The attachment to this paper serves to illustrate the detailed calculations and the data to be used in arriving at the exact measure of the maintenance task.

The Aids

9. In addition to ensuring that establishments of maintenance personnel and aeroplanes are adequate to meet the needs of individual unit's functions, the following measures have also been introduced to facilitate maintenance and to procure efficiency :—
 - (i) Screening a percentage of maintenance personnel from frequent postings. At present units are authorised to submit nominal rolls of 25%, by ranks and trades, of their maintenance personnel to A.O. i/c Records. This ensures, within practical limits, that those nominated will remain at their unit for at least twelve months.

¹ Flying Training Command File 55436/Eng.

- (ii) Screening of maintenance personnel from mis-employment on routine station duties. To enable this to be effected units' establishments of aircraft hands have been substantially increased.
- (iii) Courses of instruction on airframes, engines and certain ancillary equipment at makers' works.
- (iv) The allocation of servicing representatives of airframe and engine contractors to each unit, or in some cases to serve several units within the district.
- (v) Frequent visits to units by contractors' representatives concerned with ancillary equipment.
- (vi) Routine visits to units by Command Headquarters Engineer Staff Officers every two months and reciprocal visits by Station Engineer Officers to Command Headquarters at similar intervals. This, by staggering, affords monthly contact between the Staff and the unit.
- (vii) Outside aid by contractors' working parties (Civilian Repair Organisation) whenever the work on aeroplane inspections and repairs reaches proportions beyond a unit's capacity.
- (viii) The Deposit Account system which enables a replacement to be automatically allotted for an unserviceable aeroplane due to be inspected or repaired on site by the C.R.O.
- (ix) The introduction of the Wing Maintenance Organisation.

Desiderata for Effective Maintenance

10. Having arrived at the measure of the unit's maintenance commitments and produced for frequent reference a Maintenance Table set out on the lines indicated in the attachment to this paper, it remains for those concerned with the maintenance organisation, and particularly the Station Engineer Officer, vigorously to apply themselves to the task of working to a maximum level consistent with efficiency.

11. The following points, although by no means exhaustive, demand a Station Engineer Officer's constant attention and application, in fact they represent in some measure his very charter :—

- (i) Maintain the closest possible liaison with O.C. Flying and his staff. The progress of the syllabus flying times is as much the concern of the Station Engineer Officer and his subordinates as it is of the flying 'side.'
- (ii) Give all possible assistance to the O.C. Flying and his staff in framing the flying programme so as to achieve the interdependent aims of both interests.
- (iii) Ensure that all the aids set out above are applied to the maximum possible advantage.
- (iv) Never hesitate to seek outside aid (C.R.O.) if the situation warrants. It is obviously bad practice to undertake work in excess of the unit's capacity (as determined by such factors as shortages of personnel, high incidence of petty unserviceability, irregularities in routine inspection, 'staggering' caused by re-equipping with a new type of aeroplane or a big wastage turnover, etc-) if by so doing there is a risk of failure to meet the needs of the flying programme.
- (v) See that the flying hours of aeroplanes are expended in such a way as to create an even flow of inspection arisings. Careful 'staggering' in this respect is of paramount importance.
- (vi) Be prepared to undertake night shifts, especially on minor inspections and minor repair work, in order to catch up with the optimum state of serviceability. Delays in excess of the calculated average time on work

of this nature not only throw out of phase the even flow of work, but the effects become cumulative by increasing the intensity of use of the serviceable balance, which in turn increases the frequency of routine inspections.

- (vii) Aim at keeping the strength of maintenance personnel up to establishment. To this end it is essential that no effort should be spared in letting A.O. i/c Records know of the unit's needs and if necessary calling on Group Headquarters for assistance. In this connection it is to be remembered that aircrafthands are almost, if not entirely, as important to maintenance as are technical tradesmen, since their non-availability necessitates the mis-employment of airmen of the skilled trades on work for which the former are established. It cannot be too strongly emphasised that the practice of units regarding aircrafthands of the maintenance organisation as a source from which to draw for other duties can lead only to a diminution of the maintenance effort. It is expected that an A.M.O. on this subject will shortly be issued, whereby aircrafthands for maintenance will be annotated with a suffix ' S ' to denote ' Servicing.'
- (viii) Encourage *esprit de corps* within the maintenance organisation by all means possible. Let it be known and constantly stressed that, although their task is unspectacular and they are working, as it were, behind the scenes, the flying training effort, and therefore the war effort, is basically dependent on maintenance and the individual efforts of every man.
Occasional talks to N.C.O's, displays of graphical illustrations of the training progress, and even an honours list of ex-pupils of the unit who have been awarded decorations will do much to achieve this object. This is all part of the general subject of welfare, and individual attention to the well-being of maintenance personnel will be reflected in their work. This is particularly pertinent to the Wing Maintenance organisation in which the proportion of officers to men is considerably lower than is normally the case.
- (ix) See that maintenance personnel are given prearranged days off whenever possible and that they realise that this concession is largely dependent on the results of their efforts.
- (x) Keep constantly in mind the need for close liaison with the Station Equipment Officer with a view to achieving the necessary co-ordination of effort to meet requirements in equipment and spare parts.
Frequent reviews of the unit's spare part stock position are essential. Bear in mind that the tally card data will not include those spares known to be required in the future but which have not hitherto been demanded.
- (xi) Ensure that as far as is possible spares requirements for individual aeroplanes, due in the near future for a routine inspection, are anticipated by the A.O.C. Demands.
Do not be discouraged by any general lack of spares, and remember that it is only by a unit raising its ' B ' demands for stock items that the M.P.O. can assess requirements for provisioning action.
- (xi) Make sure that the standard of inspection and repair work is of the highest order.
Quality must never be sacrificed for speed, well carried out periodical inspections will do much to eliminate petty unserviceability of aeroplanes in use, and this is particularly true of the daily inspection.

12. That the ideal state as represented by the unit's maintenance Table will seldom, if ever, be achieved is only to be expected, but diligence and foresight will do much to reduce the divergence between theory and practice.

13. The Royal Air Force flies on its maintenance. At no time let it be said that maintenance has failed to meet the demands of training, unless it be for reasons beyond the control of those responsible for its planning and execution.

**Specimen Maintenance Planning Table, using as an example S.F.T.S.
Figures (Aeroplane Establishment 72 I.E. and 36 I.R.=108)**

Factors	Data	Notes
Pupil Population	200	Due allowance requires to be made for wastage.
Hours per pupil	72	
Length of Course	10 weeks	
Syllabus hours per month ..	5,760	
Incidental flying. (10% of syllabus hours)	576	The statistical figure used by Air Ministry for this type of non-productive flying is 10% of syllabus hours. It is intended to cover weather tests: aeroplane tests after inspection, repair, adjustment or modification; ferrying and communication flights, etc.
Total hours per month of four weeks.	6,336	The four-week month requires to be used since courses are on a weekly basis.
Inspection arisings per four weeks.	Major 26 Minor 132	
(i) Majors	12	(i) & (ii) These figures are arrived at by assuming 10-14 days for a major inspection and one day for a minor, using six working days a week. (iii) This figure is statistical. (iv) All units' establishments reflect these figures in the remarks column of the Maintenance and Servicing Squadrons where allowances for inspections and repairs are quoted as 'gangs.' (v) It is very important to bear in mind that these figures indicate a measure of 'Unit Capacity,' particularly in relation to F.T.C.A.I. Section 'M' procedure as regards 'Crash' categorisation and requests for outside aid on other work.
(ii) Minors	6	
(iii) Repairs	12	
Constant unserviceability		
Total	30	
No. of A/c as a constant 'in-use' figure.	64	It has been established by Air Staff, H.Q.F.T.C., that this number, if constantly available, will meet the normal flying training requirements. The I.E. figure of 72 may, however, be employed whenever it becomes necessary to make good 'below par' flying hours. The serviceable aeroplane figure should therefore never fall below 72, the I.E., or 67% of the total at 108.

Specimen Maintenance Planning Table—contd.

Factors	Data	Notes
Float	14	This figure is the difference between the sum of the 'in-use' and the constantly unserviceable totals and the total establishment. It represents an allowance to cover (i) Shortages of spares, (ii) Delays in wastage, replacements, etc. As, however, unserviceability due to shortages of spares has for some time stood at approximately 10%, a narrow margin of three is all that remains in practice, thus making the aim of keeping the serviceable figure at 67%, although theoretically possible, seldom attainable. A forecast improvement in the spares position will, when realised, naturally improve this 'in-hand' balance.
Flying hours per four weeks 'in-use' aeroplanes.	99	This figure takes as a basis the constant 'in-use' figure of 64 aeroplanes and indicates the intensity of use dictated by the flying training syllabus. The average for 108 (the I.E. plus the I.R.) is 59.
Flying hours per day for 365 days per year for 'in-use' aeroplanes	3-5	A theoretical figure that takes no account of the weather factor. If aimed at it would lead to high peaks of flying intensity after bad weather periods, making it difficult, if not impossible, for maintenance to catch up.
Flying hours per day to be aimed at for 'in-use' aeroplanes—Summer .. Winter ..	4.4 5.8	These figures make allowance for the weather factor. Air Ministry statistics show that in summer 0.8 and in winter 0.6 days should be fit for flying. If this intensity is achieved it should be necessary only to make up for 'above the average' bad weather.

Notes (i) It will be seen from these calculations that the term I.R. is in these days a misnomer and that the allowance it represents is intended to cover unserviceability.

(ii) In making calculations for Civil Operated Units the average times allowed for inspections are :—

Part II One day.
Part III Three days.
Part IV Seven days.

These are statistical figures collected from C.O.U.'s.

APPENDIX 20

LIST OF CONTENTS OF COASTAL COMMAND PUBLICATIONS ON PLANNED FLYING AND PLANNED MAINTENANCE

Part I

General Instructions on Planned Flying and Planned Maintenance and its Application to the Command

- Appendix A. Operational Role and Maintenance Categorisation.
- Appendix B. Scales of Effort—
 - (i) Routine.
 - (ii) Variable Opportunity.
 - (iii) Fleeting Opportunity.
- Appendix C. Weekly Record of Planned Flying. (Forms CCPF/1.)

Part II

Maintenance Instructions

- Appendix D. Specimen Task Chart for Routine Squadron.
- Appendix E. Specimen Task Chart for Routine, Variable and Fleeting Opportunity Squadrons.
- Appendix F. Conspectus Return. Details.
- Appendix G. Diagram of Variable Opportunity.
- Appendix H. Diagram of the effect of bad planning.
- Appendix J. Records required.

Part III

Servicing Wing Organisation

- Appendix K. List of Definitions.
- Appendix L. Diagram of Station Organisation.
- Appendix M. Definition of Duties.
- Appendix N. Relationship between Station and Wing Specialists.
- Appendix O. Disciplinary Control—Daily Servicing Personnel.
- Appendix P. Accounting Instructions.

Part IV

General Instructions on Planned Flying and Planned Maintenance at Operational Training Units

- Appendix S.¹ Task Chart for a Training Unit.
- Appendix T. Weekly Return of Planned Flying. (Form CCPF/T.)
- Appendix U. Aircraft Flying Hours Availability Chart.
- Appendix V. Aircraft Time Sheet.
- Appendix W. Squadron Daily Record.

Part V

The Approach to a System

- Preface. Introduction by the Air Member for Personnel.
- Chapter I. The Reply to a Challenge.
- Chapter II. Statistics, Records and System of Task and Manning Control.
- Chapter III. The Calculation of Flying Tasks and Establishments of Servicing and Specialist Personnel.
- Chapter IV. The Effect of Alteration in Training Flying on the Total Flying Effort of an Operational Squadron.

¹ There were no Appendices I, Q or R.

APPENDIX 21

REPORT BY THE DIRECTORATE OF SERVICING AND MAINTENANCE, AIR MINISTRY, ON THE BENEFITS ACCRUING FROM PLANNED FLYING AND PLANNED SERVICING IN COASTAL COMMAND, DATED 16 APRIL 1944

1. In general, the increase in flying hours per technical man has been achieved by two means: (a) increasing the flying hours per aircraft and leaving the ratio of technical men to aircraft untouched, (b) leaving the flying hours per aircraft the same and reducing the number of technical men per aircraft. Where method (a) has been used it has meant also an increase in flying hours per airfield and in flying hours per non-technical man; in fact, a proportional increase in the return from all the resources of the Command allocated to those squadrons. Where method (b) has been used it has meant that a certain number of technical men have been surrendered.

2. In the greater part of the Command (of the order of 70 per cent.) the saving has been by method (a) and in the remaining 30 per cent. by method (b). Assessment of the saving in man-power has been based on a comparison of flying effort of the operational squadrons in the summer of 1942 (pre-planning) and the summer of 1943 when planning had been introduced. This investigation has presented many difficulties because of the number of variable factors, e.g. strength of manning and squadron role, for which allowances had to be made. Another difficulty has been the incompleteness of data for 1942, when full and essential records were not kept, and to some extent for 1943, and the inherent uncertainties in the situation, such as weather and operational opportunity. The resulting estimate is an approximation expressed as a central value between certain degrees of likely error.

3. On this basis, taking all types of aircraft in all squadrons, the total flying hours achieved in the period June to December 1943 were 200,558, against a calculated achievement for the same period on 1942 standards of 140,380, giving an overall increase of 43 per cent. in flying hours per man. This represents a weighted average for all squadrons. The arithmetic mean of the percentage increases by type of aircraft, which also has some claim to attention as an index of qualitative gain, shows an increase of 61 per cent. in flying hours per man over the 1942 standard. A table of the relevant figures is given as an Annex.

4. The above comparison accepts the actual achievement in 1943 as the test of success, but it is certainly clear that there were more flying hours available than were used, and there is some evidence that the need has lessened. It would appear that the inherent flexibility of the scheme was not called into play for the adjustment of resources to meet the changing tempo of the Atlantic war; nor could it have been so, since manning control was not operative in the Command until last January. If manning control had been in operation, it is reasonable to assume that a greater flying effort would have been achieved. There are also limits to the extent to which Commands can be expected to offer up man-power during a temporary lull without a reasonable expectation of their immediate replacement when needed.

5. Method (b) (applied to some 30 per cent. of the Command) represented an initial surrender to Air Ministry of 1,300 men. In addition to this direct reduction of man-power, and to the saving by increased scale of effort outlined above, there is another factor to be accounted for. This is the saving of 5,000 men, resulting from the establishments review after decentralisation. While it is true that decentralisation of establishments was considered by D.O.Est. independently of the Coastal Command scheme, it must be remembered that such decentralisation is an inherent part of the scheme. This saving of 5,000 men is, therefore, also in some measure due to P.F.P.S.

6. Notwithstanding the difficulties of separating out the methods and organisation of the Command from the whole changing scene in which it operates, there is clear evidence that the scheme is not yet fully working. Coastal Command itself has a long way to go before it reaches its own standards. These standards have been demonstrated to be within the capacity of the technical organisation; the extent to which the operational organisation will be able to improve on its present use of the flying hours available will be awaited with interest.

ANNEX

Aircraft Type	Flying hours per man			Flying hours	
	1942	1943	$\frac{1943}{1942}$	Achieved in 1943	$\frac{\text{Col. 5}}{\text{Col. 4}}$
1	2	3	4	5	6
Beaufighter	2.3	3.0	1.3	21,787	16,750
Catalina	2.9	4.8	1.65	19,629	11,900
Fortress	1.75	2.45	1.4	5,815	4,150
Halifax	—	—	—	9,923	9,923
Hampden	1.8	4.9	2.7	10,404	3,860
Hudson	3.5	6.6	1.87	34,693	18,500
Liberator	2.3	3.2	1.39	30,185	21,700
Sunderland	1.8	2.8	1.51	32,357	20,800
Wellington	3.3	3.6	1.09	35,765	32,800
Common Average			1.61	200,558	140,383

$$\text{Weighted Average } \frac{\text{Col. 5}}{\text{Col. 6}} = 1.43$$

APPENDIX 22

COPY OF LETTER DATED 23 JULY 1945, FROM HEADQUARTERS, FIGHTER COMMAND, ON AIRCRAFT SERVICING¹

Sir,

I have the honour to submit that research into the present-day servicing organisation and a critical analysis of aircraft inspection schedules indicate the need for :—

- (a) More direction on, and understanding of, the servicing organisation.
- (b) Inspection Schedules more in keeping with present and contemplated servicing practices.
- (c) More guidance to Engineer Officers and N.C.O. tradesmen.
- (d) Better tools and workshops lay-out.

Some of the criticisms and suggested remedies are well known but they are included in order to present a coherent picture of the problems waiting to be solved.

2. Present-day methods, and the insistence on progressive decreases in turn-round time, dictate that whenever possible, the exploded and its counterpart, the bay system of servicing will be utilised. The extent of application of this system of servicing depends largely on the number of established aircraft and on the type of servicing required, but certain items are always serviced away from the aircraft. The R.T.P. aircraft servicing schedule does not cater for the 'bay' system and tradesmen, therefore, are called upon to sign for work with which they have had no dealing. Separate bay schedules must be prepared to correct this failing. Further, there are no regulations for the recording of servicing carried out in bays and sections. To meet this last requirement, Fighter Command has produced a Component Servicing Record Book (see Appendix 'A').

3. Inspection Schedules must take the form and substance of a useful guide. The legal tone, the constant repetition, the inclusion of certain items impossible to execute and the array of A.M.O., K.R. and A.P. reference numbers found in the present Schedule confuse a tradesman and have brought it into disrepute. At Appendix 'B' is a set of cards prepared for the Minor/Major Inspection of the Mosquito to overcome these drawbacks. The schedule is written in card form for ease of handling, with due regard to economical gang size, so that each tradesman has his own card. The clauses are brief directives arranged in sequence of operation and include only those items which are carried out *on* the aircraft. Separate cards are prepared for bay servicing.

4. At Appendix 'C' is an outline for a servicing manual in which will be produced all the general and type servicing instructions considered necessary to efficient servicing. The manual must be printed in sufficient quantities to be conveniently available to the working tradesman.

5. The adoption of card schedules and bay servicing result in simpler schedules because inspectional clauses which are common to all types are not repeated continuously as at present, e.g. a card produced for a constant speed unit covers all similar C.S.U.s in the R.A.F. All cross references and instructions now repeated in every schedule appear once in the servicing manual. By these means, the present bogey of amendments is reduced to a minimum. The card tells the tradesman what to do, the manual tells him how to do it.

6. A Fighter Command Engineer Staff Instruction is in the course of preparation to give more guidance to Engineer Officers in technical organisation and administrative matters. Appendix 'D' gives an outline of the intended approach to this problem and is submitted for consideration as an R.A.F. requirement.

7. At Appendices 'E' and 'F' are criticisms of the present organisation with certain recommendations to correct its shortcomings.

¹ Fighter Command File S.37547/Eng.

8. The foregoing, and attached Appendices, make plain the fact that there is a wide field still to be explored before R.A.F. Servicing is placed on economical lines from the man-power and method points of view. The matter and recommendations submitted are not intended to be all-embracing, nor are they submitted as technical documents. They are an attempt to show that a review of the whole servicing system is due.

9. It is known that many servicing problems are under active investigation by Air Ministry, M.A.P. and Commands, but it is considered that if servicing methods and technical organisation are to be efficient they must be subject to a definite policy and removed from the undue influence which can be exerted by Departments, Commands or even individuals in the servicing chain. A large part of the research is concerned with small but important details which can only be explored in direct contact with aircraft. The suggestion, therefore, is to have a central authority to define policy, backed by a servicing development unit, working under R.A.F. conditions, to supply the detail.

I have the honour to be,
Sir,
Your obedient Servant,

Reference:—FC/S.37547/Eng.

Air Vice-Marshal,
Air Officer i/c Administration,
Fighter Command.

A. BAY SERVICING

Card Schedules

1. To meet the needs of bay servicing it is necessary to extract from the aircraft schedule those clauses which cover servicing carried out away from the aircraft and to reproduce them in some other form. As the card schedule has been accepted in principle it is reasonable to suggest that the extracted clauses are also produced in card form. If considered necessary they can be given the number of appropriate A.P. and become Vol. II Part 2 of that publication. The principle can be extended to cover all requirements, but at the present stage it may be better to confine bay schedules to all those items which it is universal practice to service away from the aircraft. C.T.O.s would be advised to extract from the aircraft schedules other clauses to cover any extension of bay servicing practice.

2. These cards, once produced, would be of almost universal application. A card covering generators would apply to all generators whether fitted to single-engined or multi-engined aircraft. The aircraft schedule would detail the frequency of the inspection. A Merlin engine is a Merlin engine in whatever aircraft it is installed so that cards written once for a mark of Merlin engine would suffice for all needs, but again, the aircraft schedule would detail the frequency of the inspection.

Servicing Record Book

3. To record bay servicing it is necessary to introduce a new type of form as it would be clearly impracticable to record such servicing on the Form 700. To meet this need the Fighter Command Component Servicing Record Book has been evolved. It is self-explanatory and is now in use on all Fighter Stations. Aircraft and M.T. components, armament, ground equipment, glider ropes, wireless etc., etc., all come within its scope. To back up the card schedule all bays should hold a copy of the A.P. covering its functions, e.g. a generator bay would hold the appropriate parts of A.P.1095.

4. If a component's life is to be recorded it should be etched or painted on the item and suitable entries in the record book and Form 700 when it is refitted should provide the complete history.

5. A specimen of the F.C. book and servicing bay card schedules are attached.

B. AIRCRAFT SCHEDULES

1. Current practice provides a schedule in book form which is rarely used by the man doing the job. A tradesman will read the schedule in an office, go away and do the inspection and return to the office to sign the Form 700. Certain aircraft schedules have been produced by Commands, in card form, with accompanying slips for recording progress. This is a step in the right direction but it is submitted that R.T.P. should provide this requirement if only to standardise the size and application of the card system and to save the time spent in writing a schedule which eventually has to be re-written.

2. If the suggestions made in Appendix 'A' are adopted a considerable reduction in the size and composition of the aircraft servicing schedule is achieved. If all the present cross-references, legalities and repetitions are also omitted a further reduction takes place. R.T.P. authors would then have the comparatively simple job of writing a schedule for the aircraft and its fixed components and nominating the bay schedule cards, already in being, to cover all the removable equipment. By this means it may be possible to produce the schedule for a new type of aircraft at the same time as the aircraft goes into service.

3. The next step is to get the clauses into the best order for carrying them out, and to arrange them according to the most economical gang size. The cards then fulfil three functions, they tell the tradesman what to do, the best order to do it in and indicate the most economical gang to do the job. Due regard must be paid to staggering 'bottle-neck' groups, e.g. the cockpit groups for the Mosquito should appear as the first item on the instrument repairer's card and the last on the air-frame card.

4. Having extracted all the bay servicing clauses the appropriate clauses of the aircraft schedule for the C.S.U. inspection, for example, would read:—'Remove constant speed unit and refit serviced item.' In short the wording of the clauses now covering sparking plugs would be extended to all removable items.

Use of Inspection Cards, Slips and Progress Cards

5. It is suggested that the card be folded to contain a small slip on which is printed the clause titles in sequence of operation with provision for the tradesman's signature, indication of rectification, the supervisory N.C.O.'s signature and aircraft and inspection details. Should a modification or amendment alter the sequence of operations a new slip only would have to be printed.

6. The card with slip would be issued to the tradesman *to be used on the job*. The tradesman to sign the slip as he completes each clause. A rectification or repair is indicated by a '+' in the rectification column. It is the junior N.C.O.'s (gang-leader) responsibility to check such rectification or repair and to make a suitable entry in the Form 700. The senior N.C.O. to countersign the entry signifying that he has checked the work and is satisfied that it has been properly carried out. The completed slip is to be signed by the junior N.C.O. responsible for the work of the particular tradesman. On completion of the inspection the senior N.C.O.s of each trade concerned in the inspection are to sign the Form 700, and the effect of such signature is, that they have checked the work and the inspections have been satisfactorily carried out. By this means the tradesman stays on the job and the N.C.O.s assume responsibility commensurate with their rank and experience. The present insertion sheet in the Form 700 would be unnecessary.

7. It is suggested that the slips are filed by the C.T.O. and become waste material when the next inspection of increased importance is completed. The Form 700 has the signature of the responsible N.C.O.s. The slips would also be used to assess the need for amendment action to the servicing schedule.

8. In the past little guidance has been given to Engineer Officers or Senior N.C.O.s on methods of progressing inspections. Attachment 'B' is one suggested method. Normally a senior N.C.O. would be given more than one aircraft to supervise and he would then be able to compensate for hold-ups by switching his available manpower. The inspection cards and slips would prevent any likelihood of inspections

being missed or duplicated. The progress cards would be non-consumable and would not become a permanent record. They would give a picture of progress on several inspections and so train N.C.O.s to supervise and organise rationally.

C. SERVICING MANUAL

1. A servicing manual is necessary to provide backing for the card system of inspection and progressing. Its primary purpose is to place technical information necessary to the inspection 'on the job' with the tradesman. It has been found that A.P., A.M.O. and K.R. references in the Inspection Schedule do not convey very much to a tradesman, and that the instructional sheets preceding each of the sections are never read. Further, no allowance in man-hours is made for a series of reference visits to the Unit Library by working tradesmen and which would be necessary if he conformed to the present schedule. The references given in the schedules constitute an amendment requisite to the extent that whenever leaflets or orders are issued, amended or cancelled, the references must receive amendment treatment to bring them up to date. This amendment action is unnecessary and quite impracticable. Material is written into a schedule which not only duplicates the Volume I, A.M.O. and A.P. information, but is repeated again and again in the various sections of the schedules, and in all the schedules produced. It follows of necessity that an amendment to this type of information in its original form is also endlessly and needlessly repeated whenever it appears in all sections of all Inspection Schedules. Further, a trend is apparent that whenever a reference is made in a schedule to certain components or faults, an A.P. or other reference appears automatically. For example, the word 'corrosion' never appears without a reference to A.P.1464 Leaflet D.131, which leaflet contains a long screed giving a large amount of detail on all the varying forms of corrosion; this information should be basic engineering knowledge possessed by all personnel connected with aircraft servicing and as such is ideal material for the suggested manual.

2. The specimen attached is in the nature of a series of extracts from aircraft inspectional schedules, A.M.O.s and A.P.1464, amplified by certain other servicing information. It also attempts to lay down a definite sequence for an inspectional routine. The information is classified as 'General Servicing,' i.e. information applicable to all types of aircraft and 'Specific to Type,' i.e. information explaining the peculiarities of a certain type or a certain mark of aircraft.

3. If material such as that contained in the manual is produced by trades, it will end the unnecessary repetition appearing in all servicing schedules and Volumes I. Certain information could also be included which hitherto has not been available to the men on the job, e.g. details on water soakage. The servicing material in the 'Type' Air Publications should be condensed into this manual. A man should not be called upon to leave his job to refer to an A.P. and therefore the scale of issue of the suggested manual would be based on the number of aircraft on inspection. This is a calculable figure already known and presents no difficulty.

4. The manual constitutes a basis for technical training. It should produce a mechanic capable of engine ground running and general servicing as against the mechanic now produced who is vaguely aware of the range of temper colours and totally unaware of the many basic servicing procedures. This is borne out by the repeated guidance given in the present schedules prohibiting the use of rag for cleaning filters in all sections in any clause containing the word 'filter.' This should be basic knowledge. Further, it is a means of keeping a tradesman abreast of technical instructions and should improve his servicing knowledge. If written in the style of the suggested card, i.e. in simple, direct language, it will be an improvement on the legal wording given to the present schedule.

5. Drawings to assist in servicing should be produced in the Type Servicing Manual, as Appendices.

6. The manual is a step towards the condensation of servicing material common to all types under one cover, and the servicing material peculiar to a type also under one cover. It largely renders the present Volumes I redundant, particularly where a series of volumes are produced for a series of marks of aircraft off the main type. A.P.1464 and remaining parts of the aircraft volumes would be required to carry the type of information which is not required on the job.

D. UNIT ORGANISATION

1. It is obvious that no amount of slide rule calculation in the preparation of establishments is sufficient to ensure full economical employment for established personnel. A calculated establishment gives the minimum number of personnel to be employed with due allowance for certain wastage in man-hours. Method is required to ensure that these personnel give maximum output. A successful Unit owes this fact to the initiative of the man on the spot rather than the direction given by higher authority. To ensure that man-power is employed economically, a directive for a standardised system should be issued. The following is suggested as the minimum directive required as the basis for a servicing organisation so that a C.T.O. administers rather than invents a system.

- (a) *Running Control.* Systems of running control to be laid down for the whole of the servicing carried out on a Unit. That is, a system for the control of Daily Servicing, safety equipment sections, ground equipment bays, instrument sections and electrical sections and all bays functioning. Such system to be a measure of output and a serviceability indicator.
- (b) *Duties and Responsibilities.* Duties and responsibilities of appointments in a servicing organisation to be specifically defined with clear indications as to duties with regard to the maintenance of 'running control.' At the moment a C.T.O. is free to appoint any officer to take charge of any sub-department.
- (c) *Bay Servicing.* All bays and sections to be standard. Drawings of lay-out (to include auxiliary power) to be made available, with details of equipment required within a bay or section. Particular reference to be made to the *amount* of floor space required—this to avoid local 'battles' with W.D. and other claimants to floor space. All non-standardised equipment, tools, rigs, test benches made on a Unit to meet a requirement to be submitted to the higher authority for adoption as required, so that improvements are progressive, assured and based on experience.
- (d) *Aircraft Servicing.* A directive to place all aircraft servicing to Minor and Major inspection standards on the bay system. The hangar to be subdivided into bays, the following to be contained in each bay.
 - (i) Special tools, ground equipment in adequate supply. Scaled to be carried out so that a bay is completely stocked, with particular regard to the requirements of multi-engined aircraft where more than one fitter gang is employed.
 - (ii) Consumable spares (A.G.S. and specific to type).
 - (iii) Serviceable components in the 'removable' category. Spares of these items to be scaled to make this possible.
 - (iv) Racks for cowlings and removable items.
 - (v) Recording desk, this item to carry provision for trade cards, servicing manual, progress card and Form 700 so that recording is centralised on the aircraft.

The adoption of the bay inspection system for aircraft servicing will eliminate much loss of time due to 'fetch and carry' of spares and special tools. At the present time, all stores are centralised, as are most special tools, a tradesman not only leaves the job to go to the stores for a tool or a spare, but is liable to waste considerable time in searching for items which are 'loaned out.' Recording away from the aircraft also wastes time. The key is that all possible accoutrements are mustered on the job.

- (e) *Man-Management.* A guide to be published on the best methods of man-management and general organisation and administration.

2. It may be contended that such direction is unnecessary and expensive but a visit to any well-run factory shows plainly the degree of importance placed on method, and control by civil industry, where competition is keen and efficiency essential if the factory is to continue in production.

E. TOOLS AND EQUIPMENT

1. On every change of station, unit, flight, throughout an airman's career, he has to return his tool kit on departure and draw another on arrival. In times of stress during the past five years it has been necessary on occasions for airmen to take their tool kits with them on posting. It is doubtful if the subsequent voucher action has ever caught up with the airman. The tool box itself is an unwieldy item, containing such unnecessary tools as chisels, fitters' squares, dividers, calipers, etc. It is suggested that each tradesman be issued with a tool roll, at the completion of his training, to be his personal property, but subject to inspection, and with a small upkeep allowance to foster care of tools. By this means any worth-while tradesman would progressively equip himself more ably to do his work and when he leaves the R.A.F. he has the wherewithal to continue his trade. Appeals by discharged airmen to the R.A.F. Benevolent Fund for tools would not occur.

2. In order to quickly carry out certain specialist jobs, the standard tools being inefficient, the tradesman manufactures his own tools. This points to the requirement for more special tools in a tradesman's kit and so eliminate the waste of time occasioned by :—

- (a) borrowing, brought about by niggardly scales ;
- (b) ' making do ' with issued items ;
- (c) local manufacture.

This does not mean that every Fitter E should have a Merlin tool kit but it does mean that small special tools, such as the odd sizes of B.A. box spanners, are made available in ample quantities. An economy in the elaborate and expensive makers' tool kits would more than offset the small expenditure involved.

3. Ladders, steps, trestles at present issued are too ' universal ' to be a success on a particular type. These items should be made for the job in hand. The economy bogey should be dispelled. It is more economical to make an item to suit a job and to control it, than to make thousands of ' make do ' items under largesse issue. A typical example of what can be achieved under the present system is the standard universal platform trestle. M.U.s and stations have a magnificent crop of these useless items. This type of trestle, because of its universal application, must be built to a higher factor of safety and be heavier and carry more fittings than the one ideal for the job. If universal application is required it is suggested that a platform trestle is built of light material on the Meccano principle. It is known that light alloy trestles are being developed. These comments merely stress the need for them.

4. More encouragement should be given to tradesmen to devise tools and improved methods of servicing. This also to include aircraft modification to improve accessibility.

5. Scales of equipment are at present based on U.E. aircraft, without any regard to the amount of servicing. A more elastic scaling is desirable, to be based on gross in-use aircraft and aircraft under repair and inspection. These are calculated figures on which personnel establishments are based and therefore should be used for calculating the *amount* of equipment the tradesmen, so established, will use. A bay, be it a sparking plug bay or minor inspection bay, should be complete. No rigid scale to be laid down so that local requirements and dispersal conditions can be met. Something akin to the equipment which is ' laid on ' in any modern garage should be the aim, i.e. that cleaning, spraying, lubricating and similar operations should be studied, and suitable equipment evolved for high-speed servicing.

General

6. By concentrating all equipment where it is wanted by the tradesman, the waste of time which now occurs in ' fetching and carrying ', searching for tools, recording, etc., etc., would be avoided. It is desired to emphasise that there is nothing in the foregoing which obstructs mobility, the opposite being true if for ' bays ' one reads ' specially equipped vehicles '.

F. MAN-POWER AND FACILITIES—GENERAL RECOMMENDATIONS

Domestic Issues

1. The present domestic organisation on a station is obviously not aware of the high priority of economic employment of servicing personnel. At a very high level a special department computes establishments to fine fractions of a man, and at Unit level misguided persons are wasting the labour potential without restraint. In an accompanying Appendix an attempt was made to prove the requirements to place equipment and tradesmen on an aircraft to be serviced and to keep them there. Obviously, if this is done, the high wastage rate in man-hours caused by domestic arrangements on the stations is justified still less. The whole of a main R. and I. Squadron is technically 'on strike' during the period allotted to pay parade, particularly if a system is used where tradesmen report to the paying centre by alphabetical block. The same argument applies to clothing and sick parades, E.V.T. courses, Backers-Up courses, Tabloid courses, etc., etc. A new outlook is required if maximum output is to be possible; it should be based on the fact that a tradesman is a finely calculated item of equipment who must be kept 'on the job' as much as possible, and not a source of man-power to be used or wasted indiscriminately.

Workshop Facilities

2. Workshops at present are built as permanent buildings with fixed internal sub-divisions. These shops do not lend themselves to adaptations or enlargements dictated by change of equipment, neither do they meet the requirements for bay servicing. Station Workshops should be built with only the outside structure permanent and with partitions capable of being moved to meet the requirement of the particular type of aircraft being serviced. The logical end of bay servicing, is that all removable components are sent to a servicing centre and serviceable items are issued for fitment. Since this requirement embraces engines, power plants, constant speed units, generators, undercarriages, most electrical equipment and instruments, etc., etc., a new style of building is required under new conception, administration and establishment.

APPENDIX 23

THE MONTHLY PERCENTAGE OF SERVICEABLE AIRCRAFT IN BOMBER COMMAND OCTOBER 1940 TO APRIL 1945

Year	Month	Percentage of A/C Serviceable	Year	Month	Percentage of A/C Serviceable
1940	October ..	90.3	1943	January ..	66.6
	November ..	81.9		February ..	61.5
	December ..	81.1		March ..	68.3
1941	January ..	82.1		April ..	76.4
	February ..	82.5		May ..	75.0
	March ..	83.3		June ..	77.1
	April ..	80.8		July ..	78.1
	May ..	79.4		August ..	75.9
	June ..	74.0		September ..	75.4
	July ..	70.6		October ..	78.2
	August ..	73.2		November ..	79.0
	September ..	72.6		December ..	78.4
	October ..	73.4	1944	January ..	78.4
	November ..	73.4		February ..	78.4
	December ..	77.9		March ..	76.0
1942	January ..	75.1		April ..	78.9
	February ..	73.0		May ..	79.8
	March ..	75.9		June ..	82.9
	April ..	65.3		July ..	81.8
	May ..	78.9		August ..	78.8
	June ..	81.7		September ..	80.6
	July ..	83.1		October ..	78.9
	August ..	78.7		November ..	77.0
	September ..	72.8		December ..	76.7
	October ..	73.9	1945	January ..	78.9
	November ..	77.0		February ..	78.5
	December ..	74.1		March ..	78.0
				April ..	81.2

APPENDIX 24

THE COMPOSITION AND DUTIES OF A REPAIR AND SALVAGE UNIT AND BASE DEPOT TO MAINTAIN AN OPERATIONAL AIR FORCE AS DESIGNED BY THE AIR MINISTRY FOR THE MIDDLE EAST IN JUNE 1940

The composition of a Repair and Salvage Unit was to be as follows :—

- (a) Headquarters.
- (b) Inspection and Repair Section for airframes, engines, airscrews, armament, plugs and ancillary equipment.
- (c) General Engineering Section.
- (d) M.T. Section.
- (e) Handling and Despatch Section.
- (f) Mobile Repair Sections (normally 2 per R.S.U.).
- (g) Mobile Salvage Sections (normally 2 per R.S.U.).

The functions of a Repair and Salvage Unit were :—

- (a) To assist squadrons in the repair of damaged aircraft *in situ* or where they forced landed.
- (b) To relieve squadrons of 180-hour inspections of aircraft and engines.
- (c) To assist squadrons with modifications within the working capacity of the R.S.U.
- (d) The salvage of aircraft and M.T. damaged beyond repair *in situ*.
- (e) The sorting of salvaged equipment and components to be :—
 - (i) Retained for further use.
 - (ii) Returned to Base Depot for reconditioning.
 - (iii) Returned to Air Stores Parks for reissue as serviceable equipment or because they were no longer required by the R.S.U.

The Repair and Salvage Units were to be situated on aerodromes so that aircraft could be flown to them for overhaul and modification. If possible, the aerodromes were not to be those used by operational squadrons and it was technically essential that some form of semi-permanent hangar accommodation be provided with hard floors and lighting facilities.

Workshops vehicles (power and plant) were to be provided in order to render the R.S.U.s semi-mobile, and they were to be situated within a reasonable distance of a railhead to facilitate the disposal of salvage and repairable equipment.

The R.S.U.s were to be under the control of a Senior Maintenance Officer established at Advanced Air Headquarters. His duties were mainly :—

- (a) The control of the R.S.U.s.
- (b) To allocate and maintain a steady flow of work between the R.S.U.s, Base Depots and Maintenance Units.
- (c) To maintain liaison between squadrons, R.S.U.s, Base Depots, Maintenance Units and the Senior Repair and Maintenance Officer at Headquarters, R.A.F., Middle East.

The essential function of the Base Depot was to back up the Repair and Salvage Units and to undertake :—

- (a) Limited repairs to airframes, engines, M.T. and ancillary equipment received from R.S.U.s and Depot Salvage Sections. Repairs to be by replacement only.

- (b) Major overhauls of engines and airframes, erection of new aircraft, packing of aircraft for despatch.
- (c) Salvage of aircraft in defined areas and outside those areas which could be reached by the R.S.U.s.
- (d) Repair *in situ* of slightly damaged aircraft in areas defined in (c), whichever was the most economical method.
- (e) Despatch to Maintenance Units of all repairable equipment beyond the capacity of the Base Depot.
- (f) Reduction to scrap of all equipment beyond repair, and the disposal of this scrap.
- (g) Repair of parachutes as carried out at a permanent station.

The individual sections into which the Base Depot was to be divided were :—

- (a) Depot Headquarters.
- (b) Chief Technical Officer.
- (c) Mobile Salvage Section.
- (d) Mobile Repair Section.
- (e) Salvage Handling Section.
- (f) Airframe Repair Section.
- (g) Engine Repair Section.
- (h) Armament Repair Section.
- (i) Photographic Repair Section.
- (j) V.P. Aircrew Repair Section.
- (k) Instrument Repair Section.
- (l) Electrical and W/T Repair Section.
- (m) General Engineering Section, including :—
 - (i) Machine Shop.
 - (ii) Metal Workers' Shop.
 - (iii) Tank and Radiator Shop.
 - (iv) Carpenters' Shop.
- (n) Test and Despatch Flight.
- (o) Aircraft Storage Section.
- (p) Equipment Holding Section.
- (q) M.T. Reserve Pool.

Mobile Repair Parties for repairing aircraft *in situ* were to be provided by the Airframe and Engine Repair Sections.

The Mobile Salvage Section was to be responsible for the collection of crashed aircraft which could not be repaired *in situ* in areas outside those which could be reached by the Salvage Sections of the R.S.U.s.

The Salvage Handling Section's work was to consist of sorting out all salvage returned by the R.S.U.s and the Depot Mobile Repair and Salvage Sections and categorise it into :—

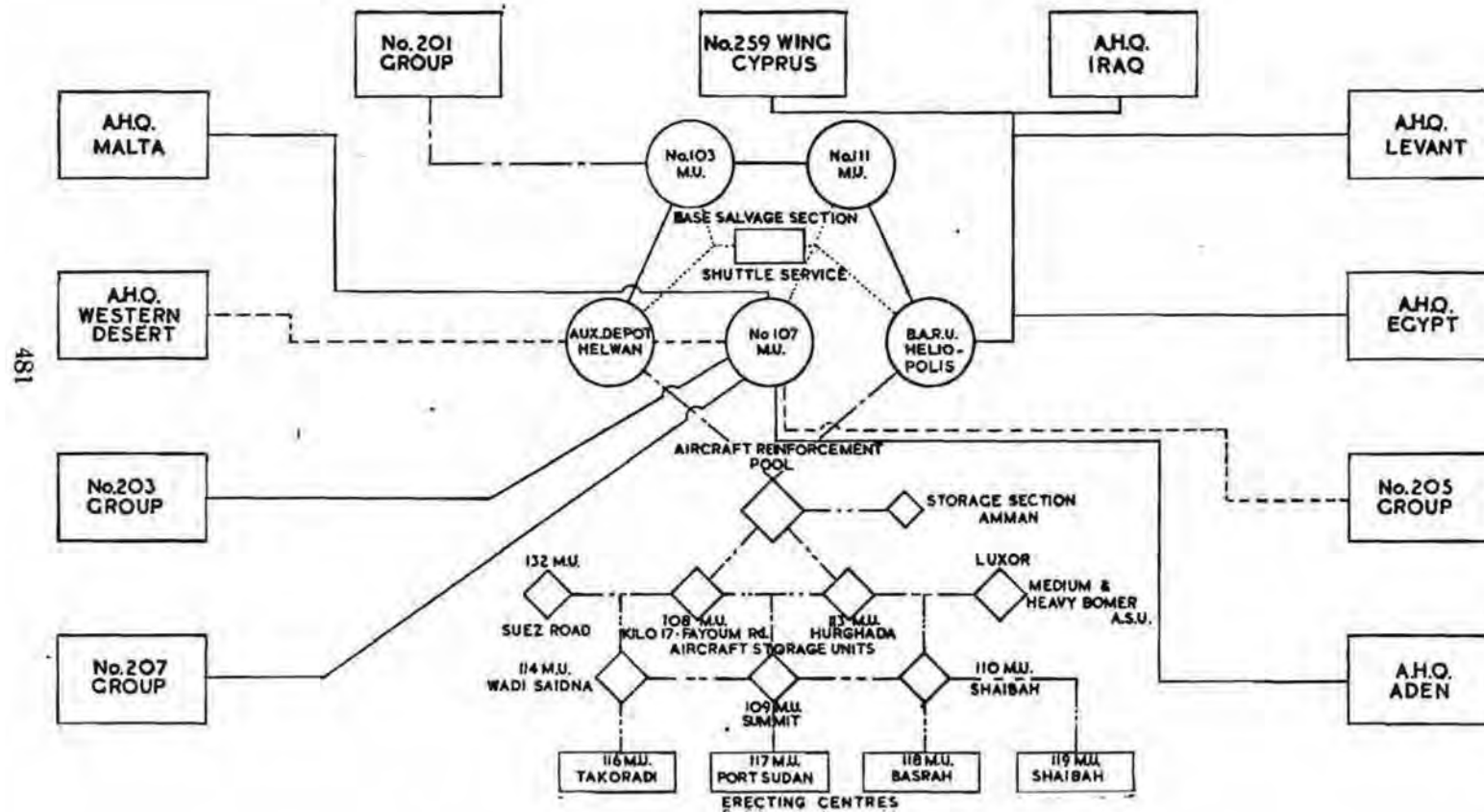
- (a) Provisionally repairable by the Base Depot.
- (b) Provisionally repairable by the Maintenance Units.
- (c) Beyond economical repair.

The remaining shops were to repair or assist in repair by replacement, adjustment or testing of equipment generally.

The duties of the Test and Despatch Flight were to test the aircraft repaired by the Base Depot and to maintain the Depot communication aircraft.

The Base Depot would not be mobile.

MIDDLE EAST MAINTENANCE ORGANISATION



APPENDIX 25

FIGURE 1

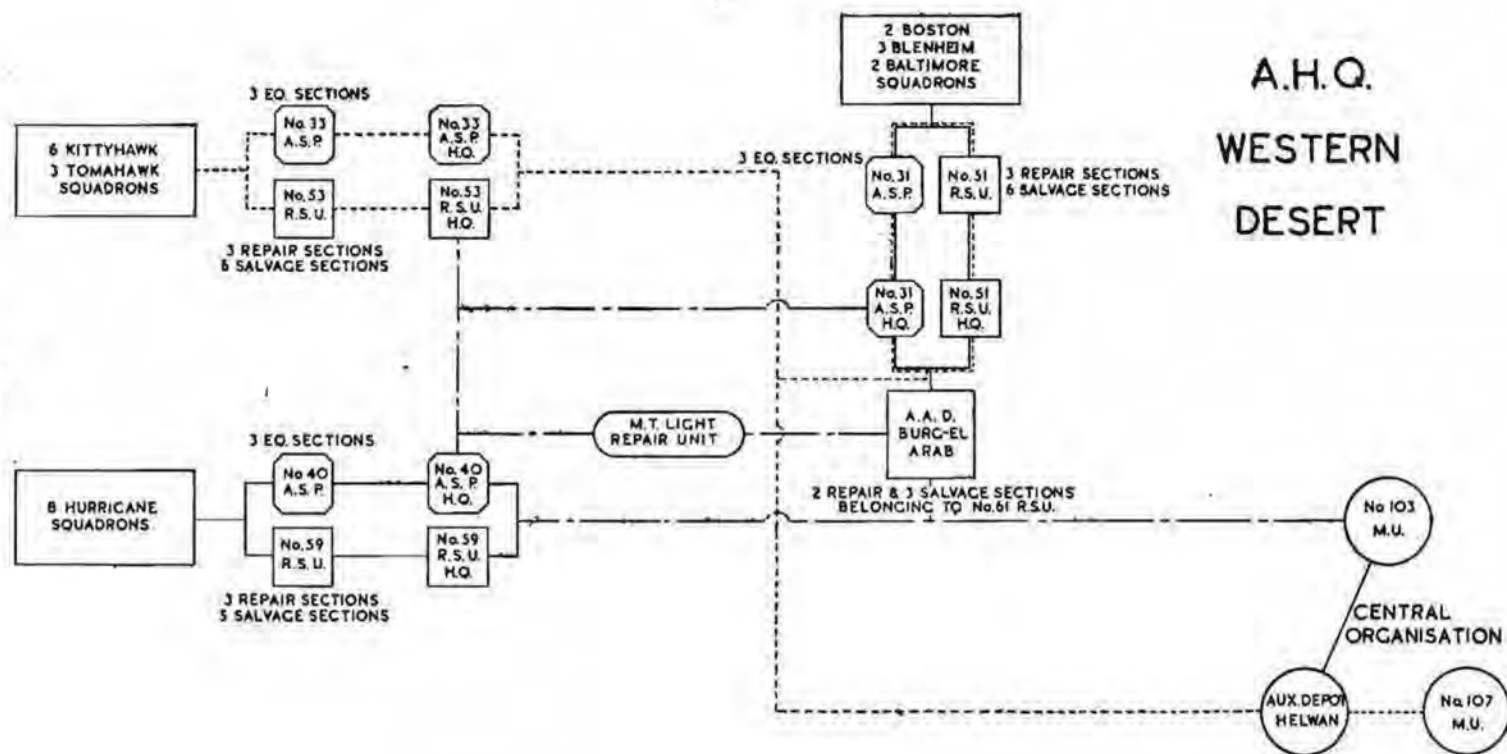


FIGURE 2

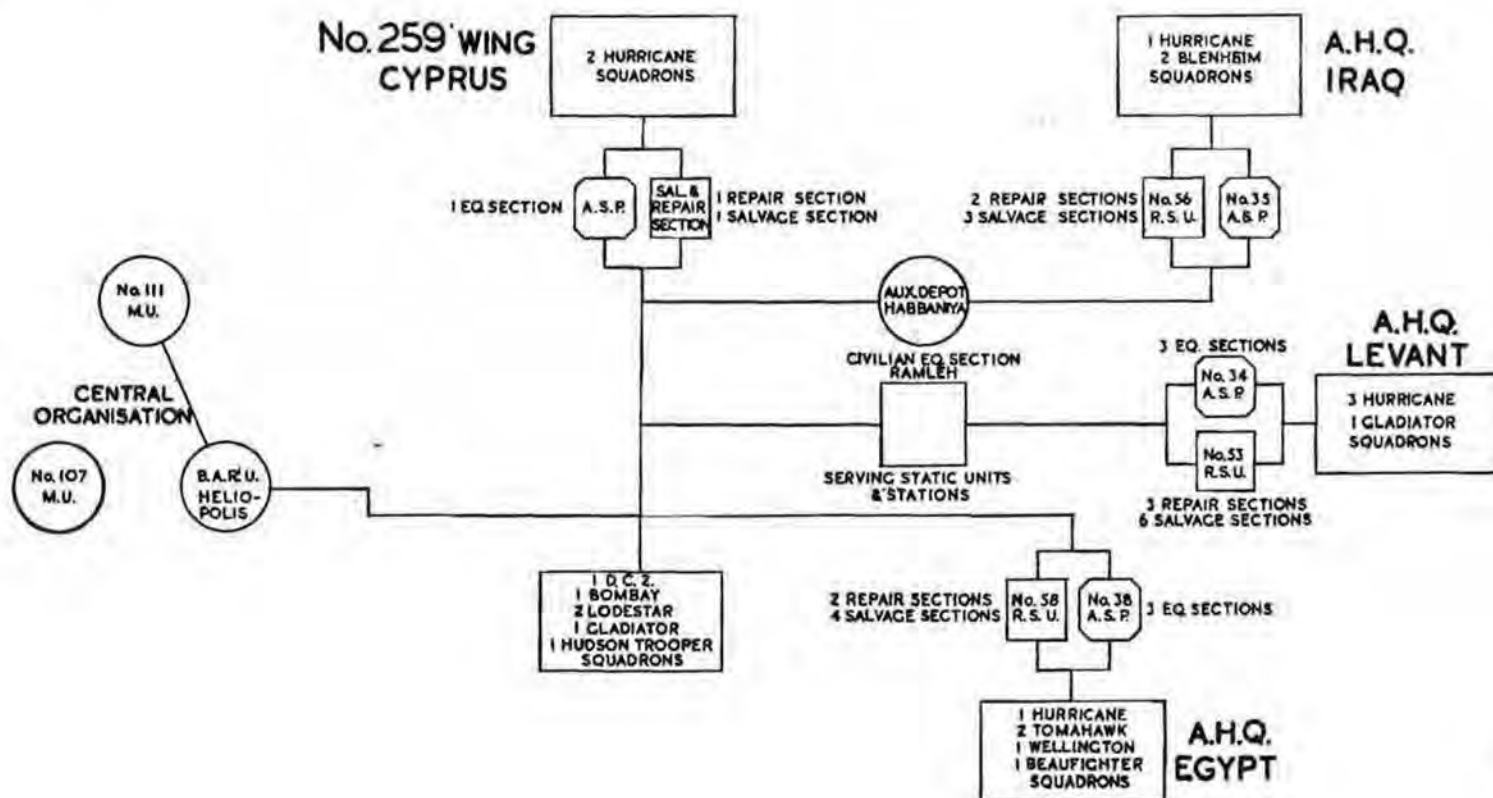


FIGURE 3

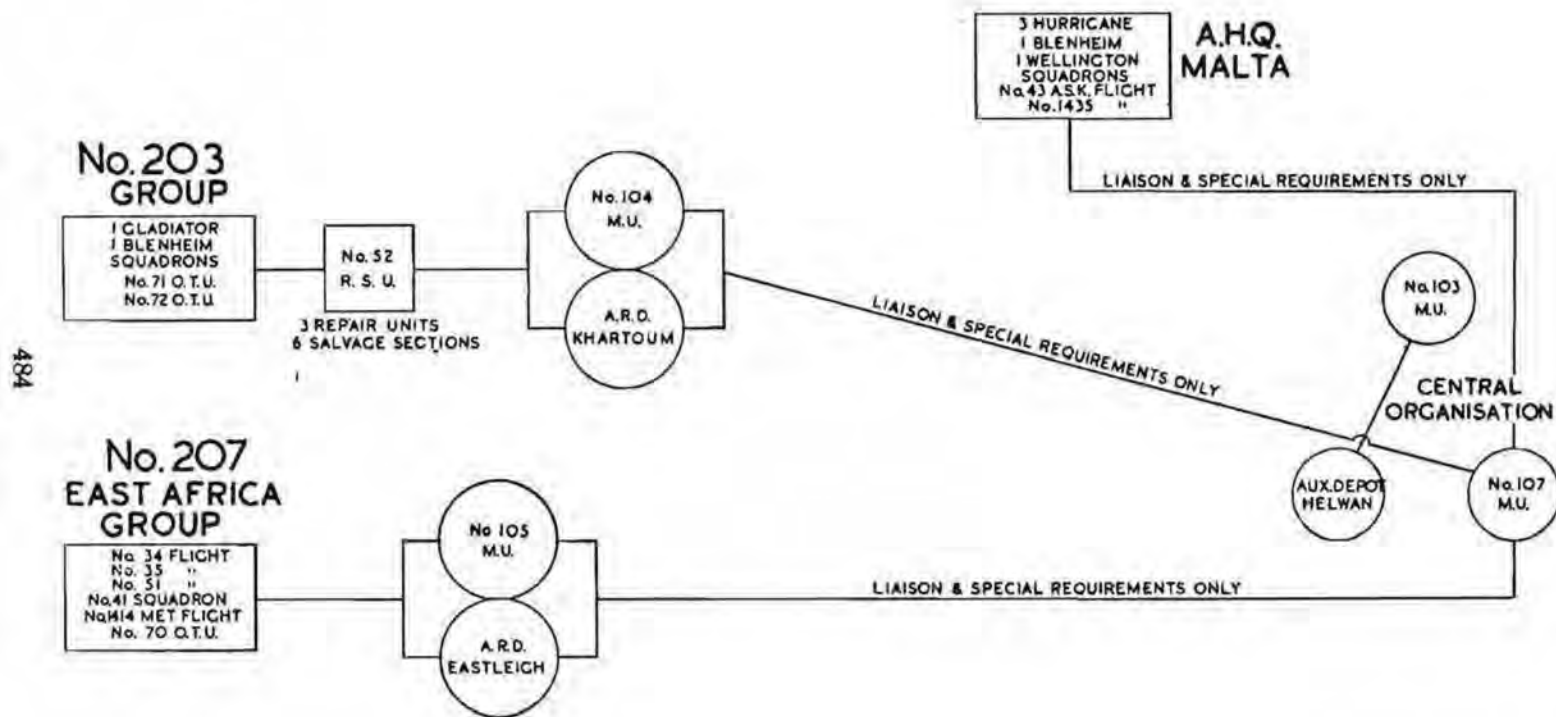


FIGURE 4

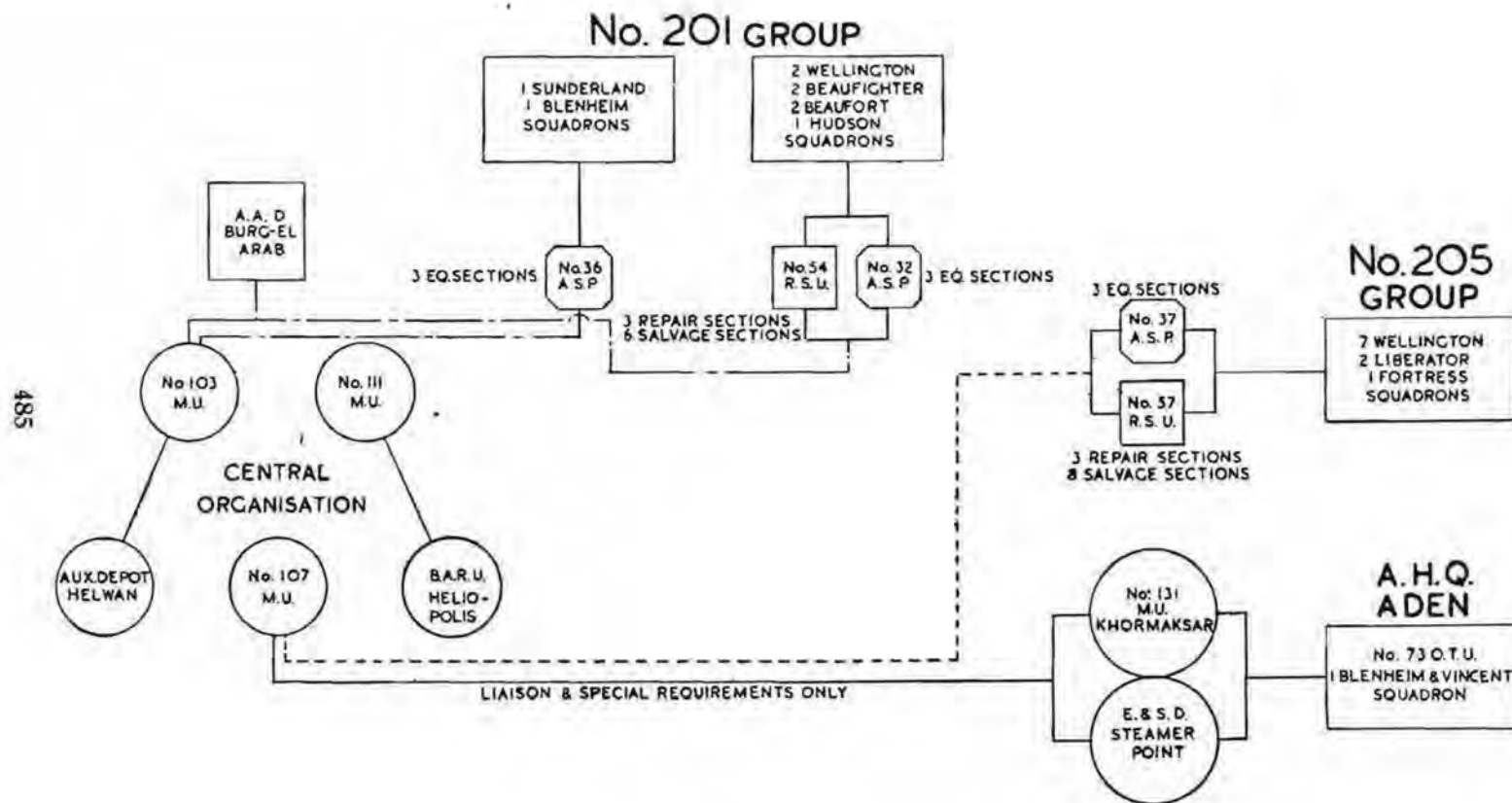


FIGURE 5

APPENDIX 26

EXTRACTS FROM ADMINISTRATIVE PLAN AND MAINTENANCE PROJECT—CRUSADER

Squadrons Comprising the Force

1. The following squadrons will be allocated to A.O.C., Air Headquarters, Western Desert, for the conduct of Crusader operations.

Short-Range Fighters	12 Squadrons at 16 I.E. Aircraft
Long-Range Fighters	1 " at 16 I.E. "
Medium Bombers and G.R.	10 " at 16 I.E. "
Army Co-operation	3 " at 12 I.E. "
Torpedo Bombers	1 " at 16 I.E. "
F.A.A. Bombers (2 Flights of 8 Aircraft)	1 " at 16 I.E. "
Transport Squadron	1 " at 16 I.E. "
' Boston ' Squadron (doubtful)	1 " at 16 I.E. "

* * * *

Phases of the Operations

4. The operations have been divided into four phases as under :—

Phase I. A period of 30 days of preparation (D-35 to D-6 inclusive).

Phase II. A period of five days of concentration (D-5 to D-1 inclusive).

Phase III. A period of 7 days of attack, which embraces the relief of Tobruk (D1 to D7 inclusive).

Phase IV. A period during which Forces are engaged in the pursuit of the enemy. The duration of this period cannot be predetermined. Vital requirements of the Force during this phase are catered for on broad lines in succeeding paragraphs.

Aerodrome Constructional Policy

5. (i) There are adequate landing grounds in the Bir Khamsa area to meet requirements of the Forces located in and operating from that area. Minor work, such as marking these landing grounds, is being undertaken by A.O.C., R.A.F., Western Desert.

(ii) A site in the Maddalena area has been selected for the use of Squadrons which will be required to operate from that area. Action to mark out the landing grounds required is in hand under the direction of A.O.C., A.H.Q., Western Desert.

(iii) A landing ground will be required in the vicinity of the first halt of Southern Column proceeding from Jarabub towards Jalo. The composition of this Column must include a representative of C.R.E. Aerodromes, and sufficient labour and tools to prepare this landing ground for the operation of Fighter Command.

(iv) Once the frontier Cyrenaica/Egypt has been crossed and before enemy aerodromes are brought into use, arrangements must be made by the Army for the de-mining of such aerodromes and for their preparation as operational landing grounds for the R.A.F., i.e. strips up to 1,500 yards in length. Suitable arrangements must therefore be made for aerodrome constructional parties to accompany the Army advancing in this area. It is anticipated that Bir El Gobi and Gabr Saleh will be required for use by the R.A.F. on or about D3.

(v) As the advance into Cyrenaica progresses, more enemy aerodromes will be brought into use. The following aerodromes may be required for use by the R.A.F. between D3 and D7 :—

Gambut, Gasr El Ariyd, Bir El Gobi, Sidi Bu Amed, El Gurb and Tobruk.

(vi) The amount of work involved in making these aerodromes serviceable cannot be stated in advance, but provision must be made for adequate staffs and labour to be available with the advancing columns to repair such damage as has been effected by the enemy and by our own forces.

REQUIREMENTS OF THE FORCE

Dumping Prior to Commencement of Operations

6. (i) Appendices 'E' to 'L' (not included) detail the dumping requirements at each dump. This prior dumping must commence forthwith.

(ii) The policy underlying the provision of requirements for dumping is that supplies will be ordered forward by H.Q., R.A.F., M.E. (through No. 206 Group), from reserves at their disposal and in accordance with the dumping programme detailed in Appendices 'E' to 'L' (not included). In meeting the various requirements detailed in Appendices 'E' to 'L' (not included) No. 206 Group will take into consideration quantities already on rail and on order from No. 121 Maintenance Unit or No. 204 Group up to and including 6 October 1941. The railheads to which individual consignments are to be made are stated at the head of the appropriate Appendix (not included).

(iii) Throughout this dumping period, the closest touch is to be maintained with Army Headquarters through Air Headquarters Western Desert. At the same time, close contact will be maintained with the Movement Control Organisation.

Personnel

7. H.Q., R.A.F., M.E., will post personnel to squadrons and units to fill existing deficiencies in establishments. Such postings will be effected forthwith and are to be completed by D-25. New squadrons and units proceeding to the Western Desert will be complete to establishment in so far as the personnel resources of the Command permit. (See para. 33 below regarding replacement of wastage.)

M.T.

8. (i) All units of the Force, with the exception of Air Headquarters, Western Desert, (HB) squadrons, and F.A.A. squadrons, are established on a fully mobile basis. All units are to raise immediate demands, through A.H.Q., Western Desert, for deficiencies in establishment of load-carrying vehicles. These demands will be forwarded to H.Q., R.A.F., M.E., where action will be taken to supply the requirements. It is stressed that this authority to demand deficiencies in establishment is confined to load-carrying vehicles and is not to include replacements for old but serviceable vehicles. During Phase I all units will concentrate on bringing all vehicles to the highest standard of serviceability and the greatest care is to be exercised to ensure that running of vehicles is reduced to the minimum. Unserviceable vehicles will be put under repair, and equipment which is not available in the units or A.S.P.s will be the subject of urgent demands.

(ii) The Command reserve of technical vehicles is strictly limited and deficiencies in establishments will be made up by H.Q., R.A.F., M.E. (through No. 206 Group), as these vehicles become available. No demands for supply of these vehicles will be rendered.

(iii) In instances where vehicles on the strength of units are beyond repair capacity, a special demand for replacement must be made through A.H.Q., Western Desert, who, in turn, will apply through H.Q., R.A.F., M.E. It is again stressed that demands for replacement will react unfavourably on the reserve situation in the Command and have far-reaching repercussions at a later date. (See para. 34 below regarding 'Wastage'.)

Technical Equipment

9. (i) The policy of holdings is that each squadron and unit consuming technical equipment is to hold 7 days' equipment, packed in an easily transportable condition. Behind this holding, the A.S.P.s will hold one month's estimated requirements for the squadrons and units served.

(ii) Squadrons and units are to raise immediate demands upon their respective A.S.P.s to bring their holdings to the scale authorised above. A.S.P.s will meet such demands, where possible, and demand upon No. 106 Maintenance Unit for inabilities. A.S.P.s will also raise demands to bring their holdings up to the one month's basis stated above. No. 106 Maintenance Unit will treat all demands received from A.S.P.s in the Western Desert with priority. (See under Maintenance Project for further details regarding functions and types of holdings by A.S.P.s.)

Ground Equipment

10. (i) Squadrons will ensure that their ground equipment is in a serviceable condition. Demands for deficiencies are to be raised forthwith on A.S.P.s.

(ii) Particular attention is to be paid to the serviceability of hand refuelling devices. These devices will be carried by all squadrons when they move.

(iii) The requirements for F.A.A. squadrons must be the subject of special demand as soon as deficiencies in their existing equipment are known. Action is to be taken to ascertain these requirements as early as possible.

Aviation Petrol, Aircraft Lubricating Oil and Explosives

11. Requirements for the various phases of the operations are detailed at Appendices 'E' to 'M' (not included). The policy regarding dumping is contained at paras. 6 (i) to (iii) above. The policy and executive action connected with provision of fuel and explosives into the Middle East will be controlled by H.Q., R.A.F., M.E., through No. 206 Group.

P.O.L., Water and Rations

12. The estimated requirements for the Force, phase by phase, are detailed at Appendices 'N' to 'Q' inclusive (not included).

Canteen

13. After Phase I, no Canteen facilities will be available to Forces in the forward area.

Accommodation

14. (i) Squadrons and units will, while located at semi-permanent landing grounds, utilise such amenity buildings as exist, augmented by their tentage, camp and barrack equipment. All other squadrons and units will be accommodated entirely under canvas. Squadrons and units when moving forward will take with them Scale 'A' and 'B' of the Tentage Camp and Barrack Equipment Schedule. Squadrons and units will take immediate action to ensure that their Scale 'A' and 'B' equipment is both up to scale and is in a serviceable condition. Items comprising Scale 'C' of the Tentage Camp and Barrack Equipment Schedule are to be returned to O.C., No. 36 A.S.P., Amiriya. No. 206 Group will issue instructions to O.C., No. 36 A.S.P., regarding action to be taken to condition this equipment and arrange for its storage until required in forward areas at a later date. It is not the intention that the original equipment returned by units should be reissued to that unit, but rather that this equipment should be taken into storage and issued as required to units of the Force when the conditions of the campaign warrant such action.

(ii) Under no circumstances will hutting be moved forward until such action is sanctioned by A.O.C., A.H.Q., Western Desert.

MAINTENANCE PROJECT

General Maintenance Policy

15. (i) The general policy underlying maintenance is that the A.S.P.s shall supply all units of the Force with requirements of technical and non-technical equipment, while the R.S.U.s assist the squadrons in the maintenance of aircraft and M.T. vehicles. The maintenance organisation in the field will, in its turn, be supported by the maintenance organisation in the Base Area (Delta, and other African Depots).

(ii) It is the policy to maintain all squadrons to full I.E. and I.R. establishment. Such wastage as occurs during Phase I and Phase II will be replaced under normal arrangements. It is anticipated that, as the operational intensity during these phases will be at sustained rates, the drain on reserves being built up for possible use during the more intensive phases will not be seriously jeopardised and that the full scale of reserves will be virtually intact.

Distribution of Responsibility of A.S.P.s and R.S.U.s

- | | | |
|---|----|---|
| 16. (i) No. 31 A.S.P. to hold .. | .. | 50% Hurricane equipment (Nos. 1 and 2 Sections).
100% Blenheim equipment (No. 3 Section).
100% Beaufighter equipment (No. 3 Section). |
| (ii) No. 32 A.S.P. (ex Iraq) to hold .. | .. | Equipment for Communication Aircraft. Albacore, Swordfish and Beaufort (No. 1 Section).
Small percentage of Wellington spares. M.T. spares. |
| (iii) No. 33 A.S.P. to hold .. | .. | 50% Hurricane equipment including (AC) Hurricanes (No. 1 Section).
100% American types (No. 2 Section Tomahawks).
(No. 3 Section Maryland and Tomahawks). |
| (iv) No. 51 R.S.U. to cater for .. | .. | 50% Hurricane.
100% Blenheim.
100% Beaufighter. |
| (v) No. 53 R.S.U. to cater for .. | .. | 50% Hurricanes, including (AC) Hurricanes.
100% American types. |
| (vi) No. 54 R.S.U. (ex Iraq) to cater for | | Communication Aircraft.
Albacore and Swordfish.
Beauforts.
Wellingtons (to a minor degree).
M.T. repairs. |

Holdings of Spare Airscrews and Engines

17. Each A.S.P. will hold two spare airscrews for each squadron served. Each R.S.U. will hold two spare engines for each squadron served. These spare engines and airscrews will not be carried forward by Advance Sections, but will be held by the rear parties. As and when spare engines and/or airscrews are required by squadrons at operational landing grounds, these will be sent forward with utmost despatch. The transportation of a considerable number of spare engines and airscrews by Advance Sections of A.S.P.s and R.S.U.s would prove an embarrassment and detract from their mobility.

Oxygen

18. (i) It is estimated that approximately 1,300 cylinders will be required each week. To meet this commitment there will be two mobile oxygen plants in the Western Desert. One plant is already with No. 31 A.S.P., while the second plant is in course of transfer from Iraq with No. 32 A.S.P. On arrival in the Western Desert of No. 32 A.S.P., the mobile oxygen plant will be attached to No. 33 A.S.P.

(ii) The maximum capacity of the two mobile oxygen plants is approximately 2,100 cylinders per week, but this output cannot be relied upon due to the difficulty of maintenance under desert conditions. An average output figure for the two plants is assessed at 1,200 to 1,400 cylinders per week. This output figure will meet the needs of the Force.

(iii) The requirements of cylinders are assessed at 4,200, which allows a turn-round period of one week, allowing one week for filling and one week with the squadron.

Holdings of Glycol by A.S.P.s Serving Squadrons with Merlin and Allison Engines

19. It is assessed that 15 gallons per week per squadron will meet the needs of squadrons equipped with Merlin and Allison engines. Additional, therefore, to 15 gallons carried by each squadron, each A.S.P. will hold 60 gallons for each squadron served.

Movement of A.S.P.s to Conform to the Operational Requirements of Squadrons

20. Although this would be normally detailed in the Movement Plan, it is considered advisable, in the interest of continuity, to include an outline under this section.

(i) Phase I.

No. 32 A.S.P. and No. 54 R.S.U. At Burg el Arab (A.S.P. less 1 Section).

No. 33 A.S.P. and No. 53 R.S.U. At Fuka.

No. 31 A.S.P. and No. 51 R.S.U. At Qasaba.

1 Section No. 32 A.S.P. at Daba with Albacore, Swordfish, Beaufort and M.T. spares.

(ii) Phase II.

1 Section from No. 33 A.S.P. with Tomahawks and Hurricane spares to be located in L.G.74 area.

1 Section from No. 31 A.S.P. with Hurricanes and small percentage of Blenheim spares to be located in L.G.74 area.

Note.—Telephone communication in this area is understood to be feasible.

(iii) Phase III.

Approximately D2, move both Sections, as at Phase II, from L.G.74 area to Dar el Hamra area.

- (iv) Approximately D7, move No. 31 A.S.P. and 2 Sections from Qasaba to Gambut area and 1 Section from Dar el Hamra area to Gambut. Approximately D7, move No. 33 A.S.P. and 2 Sections from Fuka to Sidi Rasegh area and 1 Section from Dar el Hamra to Sidi Rasegh area. No. 32 A.S.P. less 1 section from Burg el Arab to Qasaba, 1 section from Daba to Qasaba.

Movement of R.S.U.s to Conform to the Operational Requirements of Squadrons

21. (i) Phase I.

M.T. Repair Section of No. 54 R.S.U. to move to Daba.

(ii) Phase IV.

No. 51 R.S.U. to Gambut area.

No. 53 R.S.U. to Sidi Rasegh area.

No. 54 R.S.U. to Qasaba area.

Provision of Air Ammunition Parks for the Control of Fuel and Explosives

22. (i) No. 124 M.U. is in course of formation and will comprise a Headquarters and 4 Dump Sections on a similar establishment to No. 121 M.U.

(ii) The locations and disposition of Dump Sections will be as follows :—

No. 124 M.U. Headquarters Fuka. 1 Dump Section each at Fuka, Daba and Bagush. (1 Dump Section unallocated and for transfer to No. 121 M.U.)

No. 121 M.U. Headquarters from D-30 to approximately D-2—Charing Cross, thereafter the Headquarters will be adjacent to Air Headquarters, Western Desert, where Officer Commanding, No. 121 M.U., will be in close contact with the A.O.C. and his Staff to act both in an advisory and executive capacity. Dump Sections of No. 121 M.U. will be allocated as follows :—

φ1 Dump Section	..	No. 1 Forward Base (Army).
φ1 Dump Section	..	No. 2 Forward Base (Army).
1 Dump Section	..	Railhead Dump.
φ1 Dump Section	..	Reserve at No. 2 Forward Base for onwards move to Maddelana area for attachment to Army Dump in that area.
φ1 Dump Section	..	Ex No. 124 M.U. To be held in reserve at Railhead Dump, Charing Cross, for attachment to Army Dump to be formed in Gambut area as and when situation permits.
1 N.C.O. and 2 O.R.s	..	No. 3 Forward Base (Army). To be found under arrangements to be made by Air Headquarters, Western Desert.

(iii) O.C., No. 121 M.U., will withdraw from Dump Sections attached to Army Dumps nine 3-ton lorries and hold them under his control. This decision will result in 4 Dump Sections (marked φ in sub-para. (ii) above) being in a position to release to H.Q., No. 121 M.U., 36 vehicles. The Dump Sections will thus be left with one utility van and one 3-ton lorry, which will suffice for the mobility of the Section. In this connection it is stressed that the R.A.F. Dump Section has no responsibility regarding transportation other than ensuring its own mobility. The 36 vehicles released as above will be used by O.C., No. 121 M.U., to augment his other transport and assist squadrons in obtaining their requirements of fuel and explosives where squadron transport is unable to meet part or all of these requirements.

Responsibility of Army Towards R.A.F. Regarding Movement of Material and Supplies

23. (i) The normal distance over which the R.A.F. can collect material (bombs, ammunition and supplies, including petrol) is 25 to 40 miles. The Army arranges for the conveyance of the material to within this distance of the collecting R.A.F. Unit.

(ii) The present Army dumping programme is confined to the following Dumps :—

No. 1 Forward Base	..	Sidi Barrani area.
No. 2 Forward Base	..	Saffafi area.
No. 3 Forward Base	..	Jarabub area.

(ii) A Railhead Dump at Charing Cross will be formed by the R.A.F. Movement forward of supplies from this dump to within the statutory distance of 25–40 miles of R.A.F. Units will be undertaken by the Army.

(iv) Where Army dumps cover an extensive area, as in the case of No. 2 Forward Base, the allocation of sites for dumping R.A.F. supplies should be in the area nearest to the R.A.F. aerodromes, i.e. Bir Khamsa area.

Stocking of Fuelling Landing Grounds

24. (i) When stocking of dumps has been completed, the laying down of ready-for-use dumps at F.L.G.s must be put in hand. Wing Headquarters concerned

will, upon instructions from A.H.Q., Western Desert, arrange for the attachment of F.L.G. parties to the landing grounds concerned. These parties will be accompanied by their full M.T. vehicle establishment and will collect from the relevant dump two days' requirements for the number of squadrons using the landing ground on a refuelling basis. See Appendices 'E' to 'L' (not included). Wing Headquarters concerned will inform A.H.Q., Western Desert, in instances where the bulk of supplies to be moved under this heading cannot be moved by the F.L.G. party when arrangements will be made to augment the M.T. of the F.L.G. party by attachment of additional vehicles either from the S. and T. Column or from the vehicles at the disposal of No. 121 M.U.

(ii) In connection with the refuelling of aircraft by F.L.G. parties, immediate action is to be taken to ensure that refuelling devices held are adequate and serviceable.

Clearance of Railway Truckage

25. Officers Commanding, Nos. 121 and 124 M.U.s, will use every endeavour to facilitate the rapid clearance of railway truckage. An acute shortage of all classes of trucks exists and it is only by rapid clearance of consignments that the even flow of supplies to railhead can be maintained.

Return of Empty Containers

26. Officers i/c Dumps will exercise particular care in ensuring that empty containers (44/46-gallon drums and special 4-gallon containers) are returned to Shell Coy. of Egypt by the most economical means. Convoys returning empty to railhead and rail trucks returning to the Delta area are to be used to the fullest possible extent for this service. Rapid and careful return of these containers is essential in order that packed reserves can be maintained at the highest possible level.

Re-stocking of Reserve Dumps

27. Consequent upon the denuding of Reserve Dumps at Amiriya, Ikingi Mariut and Gharbaniat, to meet the dumping programme, it will be necessary to re-establish these dumps at the earliest possible date in order to provide a reserve West of the Delta for feeding dumps in the forward area. No. 206 Group will take the necessary action by uplifting certain dumps which are due for turn-over and by orders placed upon Shell Coy.

Shipments to Tobruk

28. (i) As stated at Appendix 'L' (not included) shipments to Tobruk will be arranged by H.Q., R.A.F., M.E., in conjunction with Movement Staff G.H.Q., M.E. The dumping programme tabulated at Appendix 'L' must commence with the resumption of shipments during the next moonless period and be carried on until the cessation of shipping prior to commencement of operations. It will be noted that the average daily requirement for fuel and explosives amounts to approximately 48 tons per night. A further 6 tons per night will be involved if oxygen and maintenance stores are included. Although a period of 7 days is indicated as the dumping period, shipments must continue as long as possible to provide not only a reserve for units destined for the Tobruk area but for units in the Gambut area. The larger the reserve which can be accumulated in Tobruk the smaller the call upon the Lifting Column between railhead and Gambut.

(ii) An R.A.F. Embarkation Officer, together with a nucleus Dump Section, is to proceed with the first shipment to Tobruk under arrangements to be made by H.Q., R.A.F., M.E.

(iii) Shipments to Tobruk cannot be relied upon. Under these circumstances firm arrangements will be made by A.H.Q., Western Desert, with Army Headquarters to lift the requirements listed at Appendix 'L' (not included) from railhead to the Gambut/Tobruk area.

Returns to be Rendered by Officers i/c Dump Sections and A.A.P.s

29. (i) Officers i/c Dump Sections will render a daily stock report of both fuel and explosives to their respective A.A.P. Headquarters. The Headquarters of the A.A.P. will consolidate such reports and forward a daily signal to No. 206 Group indicating replenishments required and the destination to which supplies are to be consigned. A duplicate copy of the return rendered by Officers i/c Dumps to Headquarters, A.A.P., will be handed to the Army Officer i/c Forward Base, or other dump, in instances where R.A.F. dumps are located with Army dumps. The daily return rendered to Headquarters, A.A.P., will be despatched direct by Officer i/c Dump Section.

(ii) During the operation envisaged in this Plan, returns rendered will not include a statement of fuel and explosives in aircraft.

Control of R.S.U.s in the Field

30. (i) The Senior Engineer Staff Officer, A.H.Q., Western Desert, will exercise control over the work carried out by R.S.U.s. He will control the forward movement of Advance Repair Sections and Salvage Sections in accordance with the special demands of the Force during the succeeding phases of the operations. The extent to which salvage can be effected cannot be predetermined and must depend upon the report of the Inspecting Officer.

(ii) The M.T. Repair Section attached to No. 54 R.S.U. and detached to the Daba area will be formed by certain personnel from Nos. 51, 53 and 54 R.S.U.s to a provisional establishment to be prepared by H.Q., R.A.F., M.E. The detailed functions of this Section will be precisely stated in a Formation Order to be issued by H.Q., R.A.F., M.E.

S. and T. Columns

31. (i) Nos. 5 and 6 S. and T. Columns will form part of the Force. These two S. and T. Columns will be brought up to full establishment of 4 Sections each, under arrangements being made by H.Q., R.A.F., M.E.

(ii) A.H.Q., Western Desert, will retain control of Nos. 5 and 6 S. and T. Columns throughout and detach such Sections to squadrons and units as necessity dictates. It is not the intention to lay down rigid programmes for their employment, but to retain them as a flexible pool of vehicles capable of being detached to vital centres to render assistance.

Transportation of Equipment from Maintenance Units in Base Area to A.S.P.s

32. (i) Considerable congestion of both rail and road traffic along the Western Desert route from Amiriya area to forward areas during all phases of the operations must be anticipated. To minimise delays in forwarding equipment to A.S.P.s, most of which will be of an urgent nature, H.Q., R.A.F., M.E., will be requested to place a Transport Squadron Flight at the disposal of A.O.C., No. 206 Group, for the sole purpose of transporting equipment to forward areas. It is the intention that this flight of transport aircraft shall be based on Heliopolis from which base its movements will be controlled by No. 206 Group. Requests for the employment of aircraft of this Flight for purposes other than the transport of equipment can only be acceded to provided the needs of the A.S.P.s are not thereby jeopardised.

(ii) The allocation of the Transport Flight to No. 206 Group will not meet the entire needs of the A.S.P.s and recourse to movements by rail and road will have to be resorted to and the delays in delivery accepted. Wherever possible, however, the fullest use is to be made of transport by air, bearing in mind the need for co-ordination of loads between other Maintenance Units to ensure economy in use.

(iii) It will be impossible for A.S.P.s to collect equipment from Maintenance Units with their own transport, in view of their advance locations, and are not therefore to attempt to do so.

REPLACEMENT OF WASTAGE

Aircraft

33. (i) Reserve aircraft will be held under the control of No. 206 Group at Aircraft Storage Units located at No. 108 Maintenance Unit (Fayoum Road), Kilo 8 (Cairo/Suez Road) and at Wadi Natrun. From these A.S.U.s reserve aircraft will be ferried to forward pools located at R.S.U.s in the Western Desert. The pools at R.S.U.s will hold a small percentage of the types of aircraft with which they normally deal. The small percentage referred to will be the estimated wastage, by types, over a period of two days. This reserve holding in the forward pool aims at providing immediate replacement without the necessity for awaiting arrival of an aircraft from the more distant A.S.U.

(ii) Notification of casualties will be made through existing channels and all action to replace the casualty will be undertaken by No. 206 Group. The adequacy of the total reserve of aircraft behind the Force has already been assessed at H.Q., R.A.F., M.E., allowing a high degree of wastage (in excess of the theoretical figures computed in S.D. 98).

(iii) Replacement aircraft will be flown from Aircraft Storage Units to R.S.U.s by ferry pilots under the control of A.R.R.C., H.Q., R.A.F., M.E. Ferrying back of pilots to A.S.U.s will likewise be arranged by A.R.R.C., H.Q., R.A.F., M.E. In order to keep A.R.R.C. informed of the extent to which his pilots will be employed from time to time, all casualty signals will be repeated to A.R.R.C.

(iv) Operational pilots will collect replacements from R.S.U.s. Ferrying of the pilots to R.S.U.s will be effected under squadron arrangements. Operational pilots will ferry back flyable and repairable aircraft lightly loaded.

(v) The degree of completeness of aircraft delivered from Aircraft Storage Units will form the subject of a separate communication.

(vi) All ferry pilots will carry two days' rations when flying aircraft to R.S.U.s. Parachutes taken for the ferry trips will be brought back to A.S.U.s by ferry pilots.

M.T. Vehicles

34. (i) H.Q., R.A.F., M.E., will arrange for two main pools of M.T. load-carrying vehicles to be located, one at Burg el Arab and one at Wadi Natrun. From these pools wastage of vehicles in the field will be met. It is estimated that the degree of wastage which will be incurred will approximate to 12 per cent. per month of the total vehicles with the Force. It is upon this basis that reserves will be held between Burg el Arab and Wadi Natrun. Replacement will be effected through No. 206 Group to whom casualty reports will be rendered. To obviate delay in delivery of replacement to units in the field, A.O.C., No. 206 Group, will form a forward pool at Daba (with M.T. Repair Section) from which immediate replacement can be effected without undue delay.

(ii) A pool of M.T. drivers will be formed under arrangements to be made by H.Q., R.A.F., M.E., whose duty will be to ferry vehicles between the main pools and the forward pool and, if necessary, onwards to the location of units. It is assessed that this pool should consist of 25 per cent. drivers for vehicles held in reserve. It is stressed that this pool of drivers is not formed for the purpose of providing replacements for casualties but for ferrying M.T. vehicles. The Headquarters formation of the unit to which replacement vehicles are delivered will be responsible for the expeditious return of drivers to the pool.

(iii) Drivers of replacement vehicles will be provided with rations on the basis of the estimated time for delivery of the vehicle plus requirements for the return journey.

M.T. Specialist Vehicles

35. Allotment for replacement vehicles from the limited resources available in the Command will be effected by No. 206 Group upon receipt of casualty signals.

Pilot Crews and Ground Personnel

36. Posting of personnel to replace wastage will be controlled by H.Q., R.A.F., M.E., and effected upon receipt of casualty signals.

Movement of Half Hurricane (F) Squadron with Southern Column Requirements

37. The requirements for 7 days under all headings is contained at Appendix 'G' (not included). The requirements of fuel and explosives will be dumped in accordance with the dumping programme and held at Jeriabub against its need for the squadron employed on the role envisaged.

Movement of R.A.F. Requirements with the Column

38. The full requirements for half Hurricane (F) squadron will be transported with the Army Column under arrangements to be made by the Army. The R.A.F. vehicles attached to the Column will only suffice for the transportation of ground equipment, camp and barrack equipment, and personnel. The R.A.F. personnel and vehicles will be reduced to the minimum in order to impose as little administrative strain upon the Column as possible. One empty 3-ton load-carrying vehicle is to accompany the convoy (R.A.F.) as a reserve in case a loaded vehicle breaks down.

P.O.L., Rations and Water

39. This will be supplied and transported by the Army on behalf of the R.A.F.

* * * *

GENERAL

Demolition

43. Unit Commanders will prepare plans for the demolition of fuel and explosives and any equipment which cannot be transported by the unit should evacuation be ordered. These plans will be co-ordinated with the local Army Commander with a view to determining the order of priority of demolition of their respective dumps.

* * * *

Movement Control

48. Air Headquarters, Western Desert, will detail an officer to act as Liaison Officer with M.C.O., Army Headquarters, in all matters connected with movement by sea, rail or road. A movement plan must be prepared setting out in detail all movements of units during the various phases of the operations. This plan is to indicate the various focal points where movement must be controlled and allot periods for the passage of R.A.F. and Army convoys.

* * * *

Aerodromes Vacated by Units

57. A.H.Q., Western Desert, will form a Salvage Organisation whose primary duty is the clearing of aerodromes and landing grounds vacated by squadrons. This Salvage Organisation will include in its duties the return of fuel and explosives to the nearest dump, the return of empty containers and the salvaging of such equipment as is worth the cost of labour involved.

*Admin. Plans,
H.Q., R.A.F., M.E.,
At Maaten Bagush.*

6 October 1941.

HISTORICAL NOTE:—The foregoing Administrative Plan was prepared and produced in Roneo form in 24 hours by two members of the R.A.F., M.E. Admin. Plans Staff. This small cell worked in a dug-out at Maaten Bagush, having brought with them from H.Q., R.A.F., M.E., all necessary maps, office equipment and planning data. Included in the 24-hour period was clearance of the Plan with the appropriate Army authority.

APPENDIX 27

AIRCRAFT REINFORCEMENTS—MIDDLE EAST COMMAND
NOVEMBER 1941 TO DECEMBER 1942

	MIDDLE EAST						MALTA	GIB- RALTAR	GRAND TOTAL
	EX UNITED KINGDOM				EX UNITED STATES	TOTAL	EX U.K. BY SEA	EX U.K. BY SEA	
	BY SEA			BY AIR					
	Via West Africa	Via Aden, Sudan, Suez	Via Misc. Ports	Via Med.					
1941									
November ..	169	17	34	31	43	294	34	4	332
December ..	223	29	19	70	246	587	—	13	600
1942									
January ..	184	13	—	17	158	372	24*	15	411
February ..	134	8	—	105	81	328	—	21	349
March ..	127	42	—	122	154	445	—	24	469
April ..	133	18	—	122	61	334	79	1	414
May	63	42	—	96	98	299	47	41	387
June ..	210	12	—	154	96	472	—	66	538
July	251	84	—	148	57	540	—	38	578
August ..	238	71	—	117	238	664	39	43	746
September ..	315	91	—	64	195	665	110	20	795
October ..	246	18	—	50	83	397	—	—	397
November ..	73	3	—	46	168	290	32	—	322
December ..	217	82	—	80	166	545	—	—	545

* Via Takoradi

APPENDIX 28

REORGANISATION OF S.E. FIGHTER SQUADRONS AND CERTAIN MAINTENANCE UNITS—MIDDLE EAST COMMAND¹

General

1. In view of the experience gained in the Western Desert operations during the last twelve months, in both advance and retirement, the existing organisation of S.E.F. squadrons and certain types of advanced maintenance units has been carefully reviewed with a view to deciding whether they have stood the test of war. As a result certain recommendations have been made and it is intended to implement them throughout the Middle East Command at an early date. They involve a certain amount of reorganisation, the object of which is to obtain greater mobility, combined with increased efficiency.

Fighter Squadrons

2. Single-engined fighter squadrons are to be reduced to approximately 200 personnel, and are to be divided into :—

- (1) 'A' Party
- (2) 'B' Party
- (3) A small Maintenance Party

The provisional establishment for a S.E. Fighter Squadron is at Appendix 'A.'

3. The functions of these three parties are as follows :—

- (a) 'A' and 'B' Parties constitute the operational echelons of the squadron. They will be of approximately equal size and will contain also the administrative elements of the squadron. Each will be able to operate aircraft to the full capacity of the squadron for a short space of time, and, during an advance or retirement, they will 'leap-frog' each other, so that all the squadron aircraft may be operated by whichever party is not on the move. In normal conditions they will be located on the same aerodrome and will share the responsibility for squadron aircraft. Each party will be self-contained and fully mobile.
- (b) The squadron Maintenance Party will be strong enough to undertake a small number of repairs on site, including making aircraft fit for straight 'light-load fly-in' for repairs. The Maintenance Party will be located with either 'A' or 'B' Party as requisite and will be fully mobile.

4. The maximum number of aircraft to be worked upon in the squadron at any time will be 6, and the time limit to work will be 2 days, always provided work on any aircraft can begin at the moment it becomes unserviceable. The squadron will be capable, therefore, of daily inspections, 40-hour inspections, minor repairs and unflyable engine changes. The squadron will hand to the Wing R.S.U. all aircraft which cannot be completed within this time limit of 48 hours, and replacements will immediately be issued from the R.S.U.

5. The B.L.G. Parties as constituted in the Western Desert hitherto will be disbanded under this scheme.

Signals Section—Fighter Squadrons

6. As the four S.E.F. squadrons in a wing will normally be located on the same aerodrome and alongside Wing Headquarters, there is no need to retain large signals sections in squadrons. It is intended, therefore, that signals specialist vehicles with their personnel and cypher officers shall be withdrawn from the squadrons, leaving a senior N.C.O. as technical adviser, together with a sufficient number of mechanics

¹ S.53741/Org.

for daily maintenance of aircraft wireless apparatus on each flight. Personnel withdrawn will be either formed into separate signals units to serve a specified area, or attached to the Wing Headquarters to provide for additional signals load which will be imposed on that unit.

Ground Defence

7. The ground defence organisation is being examined separately. It is intended that all ground gunners in squadrons will be withdrawn and re-formed into the R.A.F. Regiment. R.A.F. Regiment personnel will be allotted to wings, squadrons, aerodromes, etc., on a Command basis.

R.S.U.s and A.S.P.s

8. It is proposed to allot to each S.E. Fighter Wing a Wing R.S.U. and Wing A.S.P. serving a force of 4-5 S.E. fighter squadrons. Appropriate adjustments to the establishments will be made.

Functions of R.S.U.s

9. The salvage role of the Wing R.S.U. is dealt with separately at paras. 21-24 below.

10. Wing R.S.U.s will be responsible for :—

- (a) Receipt and issue of replacement aircraft ;
- (b) 40 Star inspections ;
- (c) Minor repairs up to a maximum of 7 days.

11. No job is to be accepted unless work on it can be completed within 7 days, and normally work must be started immediately. If this is not possible the aircraft will not be held at the Wing R.S.U. but returned either to :—

- (a) The Mobile Aircraft Depot, or
- (b) The Base Maintenance Units or elsewhere as appropriate, dependent upon the type of overhaul or repair required.

Training

12. The final training of replacement crews will be undertaken at the Wing R.S.U.s and a Flt. Lt. (G.D.) will be attached from Wing H.Q. to supervise and control this work. This officer will also act as liaison officer between the Wing H.Q., R.S.U., and squadrons.

13. Each Wing R.S.U. will hold 2 engines for each S.E. type of squadron served by it. All flyable engine changes are to go to M.A.D. or Base Maintenance Units. This will drastically reduce the number of engines in transit to, or being held in the battle area, and render forward units more mobile.

14. It is envisaged in Middle East conditions that normally the Wing R.S.U.s and A.S.P.s will be 100-150 miles behind the front line. They will be fully mobile.

Mobile Aircraft Depot

15. The role of the Mobile Aircraft Depot will be :—

- (a) 40* inspections beyond the capacity of the R.S.U.s
- (b) 40** inspections
- (c) 240-hour inspections
- (d) Fly-in engine changes up to maximum capacity
- (e) Other light repairs within capacity.

16. Work beyond the capacity of M.A.D. is to be flown to Base Maintenance Units.

17. The M.A.D. will be placed under the technical and administrative control of the Command which it serves. H.Q., R.A.F., M.E., will exercise general technical supervision through the senior maintenance officer of the Command.

18. The M.A.D. will consist of a 'double R.S.U.' as shown in existing establishments, but will now be augmented by a number of parties made up to deal with each type of aircraft, and manned by the personnel previously belonging to the Squadron B.L.G. Parties.

19. It is intended to form such a M.A.D. Party for each squadron in the Command or Group, so that when a squadron is transferred from one Command or Group to another the necessary portion of its second line maintenance (the M.A.D. Party) will automatically be moved at the same time and be placed in the M.A.D. or (if no M.A.D. exists) in the Base Maintenance Unit of the new Command. These parties will be posted to the M.A.D. or Base Maintenance Unit. They will be non-mobile and will depend on the Headquarters of the unit to which they are attached for general administration. They will be in direct proportion to the number of squadrons in the Command concerned, i.e. if there are 5 Hurricane squadrons and 8 Kittyhawk squadrons operating, then there will be 5 Hurricane and 8 Kittyhawk Servicing Sections (ex Squadron B.L.G.) in the M.A.D. These parties (ex Squadron B.L.G.) are to be numbered serially and will be known as 'Servicing Sections.' This system is to be applied to all S.E.F. squadrons throughout the Middle East Command.

20. The equipment section of the M.A.D. will have two alternative roles :—

- (a) Where the M.A.D. is located close to the base maintenance organisation, and the front line of its Force is within 300–400 miles of the Delta area, the equipment section of the M.A.D. will act solely as a technical stores for the engineering side of the unit. In these circumstances A.S.P.s will demand their requirements direct from the appropriate base M.U.
- (b) Where the M.A.D. is located 200 miles or over from the base maintenance organisation, the role of the equipment section will be a dual one, holding technical stores for the engineering side and a stores holding unit with 2 months' stocks for the Forces served.

Salvage

21. It has been decided to form a unit for the Western Desert to be called 'H.Q., Salvage Unit.' This will consist of two-thirds of the salvage establishment of the existing R.S.U.s leaving one-third to remain with R.S.U.s for the work in the R.S.U. area. (Vide para. 24 below.) The mobile repair sections and crash inspectors from the R.S.U. will also be absorbed into the 'H.Q., Salvage Unit.'

Role of the Advanced Salvage Unit

22. The role of this Advanced Salvage Unit will be to salvage all aircraft in the forward area, either by fly-away, after repair on the site, or by dismantling and salvage by M.T.

23. The Advanced Salvage Unit will deliver crashes to the nearest focal point on the L. of C. where a dump is formed, and from which a shuttle service operates to the base maintenance organisation.

Salvage in Rear Areas

24. Salvage in rear areas will be undertaken by the R.S.U.s and M.A.D., and will be by types, not by areas, except where only one R.S.U. exists in a large area. Shuttle services will transport all salvaged aircraft to base repair units direct from dumps on the L. of C. or R.S.U.

Servicing of M.T.

25. The repair and salvage of M.T. will be undertaken by an Advanced and Rear M.T.L.R.U.

Advanced M.T.L.R.U.

26. This unit will be established to undertake salvage of M.T. in the forward areas and to render M.T. sufficiently serviceable for running in or towing in, up to a limit of 2 days' work.

27. Vehicles which cannot be worked upon immediately are to be handed to the shuttle service for transfer to Rear M.T.L.R.U.

Rear M.T.L.R.U.

28. The role of this unit is similar to the R.S.U. for aircraft. It will undertake repairs to M.T. up to 7 days. Any job which cannot be worked upon immediately or completed in 7 days, is to be transferred to Base Maintenance Unit by the shuttle service.

29. The M.T.L.R.U. will be the M.T. spares holding unit for the Force.

Move of Squadrons to and from the Command

30. If a squadron is required to move out of the Middle East Command, it will be re-formed on the original Air Ministry establishment under arrangements to be made by S.P.S.O. and B.P.S.O., H.Q., R.A.F., M.E. This re-formation will be accomplished by withdrawing a 'Servicing Section' of the appropriate type (i.e. Hurricane, Spitfire, etc.) from the M.A.D. and posting the personnel to the squadron, together with the signals and defence personnel.

31. Squadrons arriving in this Command will be placed upon the new establishment and organisation before proceeding to their operational station.

G. S. SHAW, G/Capt.
for Air Vice-Marshal.
Air Officer i/c Administration.
Royal Air Force, Middle East.

25 August 1942.

ROYAL AIR FORCE APPENDIX 'A'

TEMPORARY WAR ESTABLISHMENT OF A STANDARD S.E. FIGHTER SQUADRON

Establishment No. LWE/TEMP/2

Date: 9 July 1942

Authority: S.56428/EST.

16 I.E. S.E. FIGHTER

Policy:— BOMBER Squadron:
Hurricanes
Spitfires
Kittyhawks

FULLY MOBILE

Includes for V.H.F.
Maintenance

SUMMARY

Detail	Officers					Airmen & Civilians						
	W/Cdr.	S/Ldr.	F/Lt.	F/O.	Total	W/O	F/Sgt.	Sgt.	Cpl.	A.C.	Civs.	Total
'A' Flight	—	1	3	12	16	1	2	18	14	64	—	99
'B' Flight	—	—	1	—	1	—	2	2	10	53	—	67
Maintenance Party ..	—	—	—	2	2	—	2	4	5	31	—	42
Total Squadron ..	—	1	4	14	19	1	6	24	29	148	—	208

The above establishment is issued in conjunction with the following Middle East establishments:—

LWE/TEMP/3	.. ..	A Standard (S.E.F.) Servicing Section
LWE/TEMP/5	.. ..	A Standard Signals Section Type 'F'
LWE/TEMP/4	.. ..	A Mobile A.A. Flight
LWE/ME/144	.. ..	A Mobile Fighter Wing H.Q.

4 August 1942

Ten Air Stores Parks

No. 31	Air Stores Park	..	..	..	L.G. 207
No. 32	" " "	..	..	..	Qassassin
No. 33	" " "	..	..	..	L.G. 222
No. 34	" " "	..	..	..	Beit Oved
No. 35	" " "	..	..	..	Habbaniya
No. 36	" " "	..	..	..	Aqir
No. 37	" " "	..	..	..	L.G. 216
No. 38	" " "	..	..	..	L.G. 207
No. 40	" " "	..	..	..	L.G. 100
No. 42	" " "	..	..	..	Beit Oved

Sixty Operational Squadrons

Located in the Western Desert, Egypt, Palestine, Iraq, Aden, the Sudan and Kenya.

APPENDIX 30
**DETAILS OF THE TECHNICAL SERVICES IN
 THE MIDDLE EAST IN OCTOBER 1942¹**

Four Erection Centres

No. 116 Maintenance Unit	..	..	..	Takoradi
No. 117	"	"	"	Port Sudan
No. 118	"	"	"	Basrah
No. 119	"	"	"	Shaibah
No. 000	"	"	"	Cape Town, ²
				} combined as one E.C.

Six Aircraft Storage Units

No. 108 Maintenance Unit	..	..	..	Fayoum Road
No. 109	"	"	"	Summit
No. 113	"	"	"	Hurgada
No. 114	"	"	"	Wadi Saidna
No. 132	"	"	"	Khartoum
No. 135	"	"	"	Luxor

One M.T. Base Pool

M.T.B.P.	Heliopolis
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Six Ferry Control Units

No. 1 F.C.U.	L.G. 224, Kilo 26
No. 2	"	"	"	Wadi Saidna
No. 3	"	"	"	Aden
No. 4	"	"	"	Habbaniya
No. 5	"	"	"	Kisumu
No. 6	"	"	"	Lagos

One Ferry Group

No. 216 Group	Heliopolis
---------------	----	----	----	------------

Thirty-four Staging Posts

On the northern and southern Takoradi routes; Khartoum-Cairo route south Arabian route and Palestine-Habbaniya-Persian Gulf route.

Four M.T. Repair Sections

M.T.R.S., Messrs. Thomas Cook	..	..	..	Cairo
No. 1 (ME) M.T.R.S.	..	..	..	Alexandria
No. 4 (ME)	"	"	"	Baghdad
No. 5 (ME)	"	"	"	Ramleh

Fifteen Repair Depots

No. 103 Maintenance Unit—Aircraft Repair, Engine Repair, Signals Repair and General Engineering Sections	Aboukir
No. 107 Maintenance Unit—Ditto	Kasfareet
No. 108 Maintenance Unit—Aircraft Repair	Fayoum Road
No. 111 Maintenance Unit—Engine Repair, Signals Repair and General Engineering Sections	Cairo

¹ This list does not include all the technical units in the Middle East but only those considered to be directly concerned in the maintenance of sixty operational squadrons and four operational training units.

² The Erection Centre at Cape Town was not given a M.U. number.

Fifteen Repair Depots—*contd.*

No. 119 Maintenance Unit—Aircraft Repair, Engine Repair, Signals Repair and General Engineering Sections	Shaibah
No. 131 Maintenance Unit—Aircraft Repair and General Engineering Sections	Aden
No. 133 Maintenance Unit—Aircraft Repair, Engine Repair and General Engineering Sections	Eastleigh
No. 136 Maintenance Unit—Aircraft Repair	Western Desert ¹
No. 138 Maintenance Unit—General Engineering	Teheran
No. 139 Maintenance Unit—Aircraft Repair, Engine Repair and General Engineering Sections	Khartoum
No. 1 (ME) Aircraft Repair Unit	.. .. Helwan
No. 2 (ME) " " " "	.. .. Helwan
No. 3 (ME) " " " "	.. .. Ismailia
No. 4 (ME) " " " "	.. .. Aqir
British Airways Repair Unit	.. .. Heliopolis

(Additional Engine Repair Sections were also located at Heliopolis, Mansourah and Ramleh.)

Base Salvage Section Helwan

Ten Repair and Salvage Units

No. 51 R. and S.U.	.. .. . Abu Sueir
No. 52 " " " "	.. .. . Khartoum
No. 53 " " " "	.. .. . L.G. 200
No. 55 " " " "	.. .. . Ramat David
No. 56 " " " "	.. .. . Habbaniya
No. 57 " " " "	.. .. . Shallufa
No. 58 " " " "	.. .. . Abu Sueir
No. 59 " " " "	.. .. . L.G. 100
No. 61 " " " "	.. .. . Rehoveth
No. 63 " " " "	.. .. . Ismailia

One M.T. Light Repair Unit

In the field in the Western Desert.

Four Operational Training Units

No. 70 O.T.U.	.. .. . Nakuru
No. 71 " " " "	.. .. . Carthago
No. 72 " " " "	.. .. . Nanyuki
No. 74 " " " "	.. .. . Aqir

Sixty Operational Squadrons

In the field in the Western Desert, Palestine, Egypt, Iraq, Aden, Sudan and Kenya.

¹ No. 136 Maintenance Unit did not commence to operate until after we had entered Tripoli in January 1943.

APPENDIX 31

SUMMARY OF AIRCRAFT SERVICEABILITY IN THE MIDDLE EAST FROM NOVEMBER 1941 TO JANUARY 1943¹

<i>Year</i>	<i>Month</i>	<i>Operationally Serviceable Aircraft</i>	<i>Under Repair</i>	<i>Serviceable in 14 days</i>
1941	November (27th) ..	910	458	273
	December (25th) ..	960	457	314
1942	January (30th) ..	865	562	350
	February (27th) ..	815	770	365
	March (26th) ..	674	695	490
	April (30th) ..	840	462	318
	May (28th) ..	770	520	390
	June (25th) ..	767	458	375
	July (30th) ..	943	546	376
	August (27th) ..	939	608	372
	September (24th) ..	1031	680	390
	October (29th) ..	1198	748	344
	November (26th) ..	1235	742	372
	December (31st) ..	1362	790	352
1943	January (28th) ..	1230	750	341

¹ These figures show the position towards the end of each month when returns were rendered. They do not indicate the highest and lowest states of serviceability reached. For instance, the number of operational aircraft serviceable in squadrons at one period in January 1943 was 1,415.

APPENDIX 32

SUMMARY OF AIRFRAME AND ENGINE REPAIR OUTPUT IN THE MIDDLE EAST FROM NOVEMBER 1941 TO JANUARY 1943

<i>Year</i>	<i>Month</i>		<i>Airframes</i>	<i>Engines</i>
1941	November	..	102	160
	December	..	140	214
1942	January ..	..	162	351
	February	..	164	387
	March ..	..	220	467
	April ..	..	247	489
	May ..	..	358	687
	June ..	..	435	709
	July ..	..	414	920
	August ..	..	365	562
	September	..	472	675
	October ..	..	486	823
	November	..	499	820
	December	..	535	709
1943	January ..	..	549	889

APPENDIX 33

OPERATION TORCH

R.A.F. STATION, NORTH FRONT, GIBRALTAR

Foreword

When the plans for this vast operation were first disclosed, it became necessary to prepare the way for the efficient fulfilment by this Station of the considerable tasks allotted to it and which were essential to the ultimate attainment of the vital objects of the whole operation.

In order to arrive at a proper understanding of the whole position it is necessary to describe the geographical peculiarities of the Station which may be unknown in detail to those who have no intimate knowledge of it. The aerodrome is situated directly under the north face of the Rock and consists of a rectangular flat piece of ground bounded on the west by the Bay of Gibraltar, on the east by the Mediterranean and on the north by the frontier road adjoining Spain. The area is approximately 1,000 yards long by 800 yards wide. Prior to March 1942 there was a landing ground 980 yards by 75 yards in the centre of this strip of land, and during that month work was commenced in extending this runway into the sea on the western extremity and continued with such magnificent efforts by the Royal Engineers that by 4 September 1942 this landing ground had been converted into a fully tarmacked runway 1,405 yards long by 100 yards wide. The whole of the administrative buildings, living quarters and dispersal area were also included in this small space as well as a cemetery of over 13 acres, the whole site being no more than could be included within the perimeter track of an ordinary aerodrome at home. The aircraft dispersal areas were alongside the runway on sandy soil and were liable to become waterlogged with any heavy fall of rain, and in consequence it was considered of such vital importance that this dispersal area should be usable whenever required, that it was necessary temporarily to defer the work on the extension to the runway in order to surface as much as possible of this area during the short time which was available before the operation was due to commence. Once again the Royal Engineers are deserving of the highest commendation for the manner in which they adapted themselves to the new tasks allotted to them, and the proof of their labours can be realised that in spite of a rainfall at Gibraltar during November 1942 of 12.48 inches, being approximately double that of the average for the past 25 years, no aircraft failed to take off from Gibraltar during the period owing to bad condition of the ground.

In addition to making provision for aircraft, it also became necessary to prepare for the corresponding increase in both aircrew and ground personnel which would be required to carry through the Station's commitments, and to find space for the erection of fighter aircraft which were to be assembled at Gibraltar prior to taking off for operations in the new theatre of war.

During the major part of November the ground staff of No. 233 Squadron and the Aircraft Transit Squadron were entirely responsible for the servicing and maintenance of two additional operational squadrons in addition to their ordinary commitments, and throughout the period there were no cases of casualties arising from mechanical failure or taxiing accidents.

Aerodrome Construction—Detailed Summary

On 4 September it was decided to cease work on the extension to the runway and to concentrate all efforts on the resurfacing and preparing new dispersal areas. In order to find sufficient space on such a congested area for the number of aircraft involved, namely :—

450 Fighters,
 60 Hudsons,
 36 F.A.A. Aircraft,
 15 P.R.U. Aircraft (Mosquito and Spitfire),
 10 Amphibian Catalinas,
 Communication aircraft consisting of: Fortresses, Liberators, Halifaxes,
 Douglas C.47s,
 M.S.F.U. Met. Flight Hudsons,

it became necessary to clear the north face of the Rock where blasting had previously taken place, remove a minefield, level off an area of the north and south side of the runway extension, build a tarmac road of 700 yards from the face of the Rock to form an entrance and exit for parked aircraft, and to make good a large area on each side of the runway which would otherwise have been unserviceable for heavy aircraft. This work involved the carting, loading and transportation of thousands of tons of stone and provided an additional hardstanding of 112,550 square yards without which the Station's commitments could not have been implemented.

The Royal Engineers (Aerodrome Construction Coy.) were also called upon to construct two bomb dumps to store a strategic reserve of bombs and depth charges. Total number of Army personnel employed on all these works was approximately 600.

Fuel Storage

Prior to this operation all petrol for use at North Front was stored in the open on the aerodrome in 4 gallon tins, the average stock being between one and two million gallons. It was decided as a measure of safety to remove as much of this reserve as was possible to a site on the eastern beach road about one mile from the aerodrome. In view of the fact that this dispersal might have resulted in a serious delay in refuelling it was further decided to obtain what tanks were available on the Rock, and three 12,000 and fifteen 1,000 gallon tanks were sunk on the aerodrome to serve as an immediate reserve for rush periods. The magnitude of the task of refuelling can best be realised when it is appreciated that 968,500 gallons of petrol were handled between 1 November and 11 December out of 4 gallon tins, all of which was filtered through chamois leathers to prevent any risk of water contamination. The cardboard containers had, in addition, to be carefully baled for reshipping to the U.K. and tins removed for crushing prior to disposal.

Passive Air Defence

In view of the number of aircraft it was proposed to accumulate on the aerodrome on 'D' Day, a passive air defence and fire-fighting scheme, far in excess of that previously envisaged and prepared for, became necessary. Fire-fighting appliances were increased by 2 fire engines and 1 trailer pump, and a static storage well of 514,000 gallons was sunk to provide water at a point on the aerodrome where none was otherwise available. In order to ensure that an adequate fire-fighting system could be put into operation immediately the Station was divided into six sectors, each being permanently manned by an N.C.O. and 9 O.R.s. Each sector was organised as a self-contained unit, having its own fire-fighting appliances, stretchers, etc. Shelters to accommodate the Station, the strength of which had been doubled almost overnight, were constructed by R.A.F. personnel working on night fatigues after completing an abnormal day's work. They also constructed blast-proof pens for fire tenders and ambulances.

Aerodrome Control

In order to ensure efficient control of the aerodrome, having regard to the fact that there is only one runway and no taxiing track, it was decided that the three immediate requirements were:—

- (a) a rigid control of the traffic on the road to Spain (this road crosses the runway at about the middle of its length);
- (b) provision of an elastic means of communication between Flying Control and all aircraft, whether airborne or on the ground, so that exact instructions could be passed for taxiing, taking off and landing;
- (c) instantaneous control of all lighting, including security floodlighting.

Crashes

It was decided that the operation must go through without any hitch or delay, even at the expense of doing irreparable damage to any aircraft which might crash on and form an obstruction to the runway.

The Army were therefore approached and a squad of bulldozers, cranes, grapples, tractors, etc., were made instantly available, day and night, so that obstructions which might delay the operation could be immediately removed, if necessary by simply pushing them clear of the runway.

Fortunately, it was not necessary to resort to this expedient.

Road Traffic Control (1a)

- (i) Adequate control of the road was accomplished, after a good deal of experiment, by means of 'Stop' and 'Go' lights and vertical swinging boom gates installed at either side of the runway, controlled from a sentry box mounted on a stone pillar about five feet high to give a better view.
- (ii) The gates are operated manually, the signal for opening or closing being given by the Traffic Controller, an N.C.O. aircrew, stationed in the sentry box who switches the lights to green or red as required. A telephone system connects the Traffic Controller with the Airfield Controller and the Flying Control Officer.
- (iii) The necessity for this rigid control can be realised when it is appreciated that some 8,000 Spaniards in buses, cars, donkey carts and on foot, cross this road twice a day.

Aerodrome Control (1b)

- (i) Since a large part of the aerodrome cannot be seen from the Control Tower, adequate control was provided by means of a Hillman light van which was equipped with VHF and HF RT, a floodlight and Verrey pistol, cartridges, etc., and aldis lamps.

Control of Lighting (1c)

- (i) The requirement arose from the fact that it was found expedient to keep the aerodrome floodlit throughout the hours of darkness for reasons of security.
- (ii) The flarepath is controlled from the Control Tower and the floodlights had to be controlled at a moment's notice, both for aircraft taking off and landing, and in case of enemy air activity.

An arrangement was made with the Army authorities which control the Rock searchlights, whereby the Flying Control Officer could have the lights put on or off at will, and without delay. At one period during a mass take-off of paratroop-carrying aircraft at night, there being no taxiing tracks, it was necessary to send the aircraft off in batches of 12 and 13, and the crews were briefed to taxi out in a prearranged order. On dowsing the lights, the aircraft took off at very short intervals, and directly the last aircraft of the first batch was airborne, the lights were again ordered on and the next batch taxied out. In this way 37 C.47 aircraft were able to take off in 93 minutes, and the risk of taxiing accidents was reduced to an absolute minimum.

Security

The whole of the aerodrome area, in view of the vital necessity for preventing sabotage, was declared a prohibited area prior to the operation, and beach scaffolding with barbed wire entanglements was erected wherever possible. On account of the ease with which persons could leave the Spanish Road and enter the aerodrome where it crosses the runway, a guard comprising 160 soldiers was continually on duty from dusk to dawn and the aerodrome was also brilliantly illuminated by searchlights.

Internal Communications

To control large numbers of aircraft and persons who were unfamiliar with the geography of the Station, some form of broadcasting was essential. A Tannoy with ten outdoor loudspeakers was flown out from England and was completely installed by R.A.F. labour within seven days of its receipt. This installation involved laying some 4,000 yards of cable, much of which was deeply trenched to avoid damage and interference. This instrument proved to be invaluable, and the success of the operation was to a marked degree due to its efficient working.

Messes

The officers', sergeants' and airmen's messes, built and designed for 100, 180 and 450 respectively, were, during this period, dealing with an average of 300 officers, 450 sergeants and 1,500 airmen. To add to this strain the numbers fluctuated without warning, the officers' mess on one occasion being called upon to serve 80 extra breakfasts and the sergeants' mess on another occasion 200 extra dinners. All this work was carried out without extra staff.

Statistics

- (i) Total aircraft movements for month of November :—4,388 (i.e. almost exactly one every 10 minutes for a month).
- (ii) At peak period, 8 to 14 November inclusive, 1,274 movements (i.e. one every 7 minutes 54 seconds for a week, and this included one bad weather day when there were only 39 take-offs and landings).
- (iii) 37 C.47 aircraft took off at night in 93 minutes.
- (iv) 27 Lightnings landed in 17 minutes.
- (v) 6 Fortresses and 6 Lightnings as escort took off in 6 minutes.
- (vi) 16 Spitfires took off in 4 minutes.
- (vii) 11 C.47s and 9 Spitfires took off in 12 minutes.
- (viii) Petrol consumption 1 November to 11 December, 968,500 gallons ; peak period 13 November to 20 November, 232,484 gallons.
- (ix) Analysis of passengers arriving and departing North Front :—

October ..	..	Arrived 380	Departed 321
November ..	..	466	393
December ..	..	668	395
- (x) On 10 November 38 Douglas C.47s carrying 450 British paratroops arrived and the men were accommodated and fed in the Fortress.
- (xi) Of 67 attacks made on U-boats during November, 63 attacks were made by land-based aircraft.
- (xii) Fighter aircraft assembled—485 to 30.11.42
- (xiii) Transit aircraft movements during November :—1,376
- (xiv) Casualties to home-based aircraft due to mechanical defect, carelessness or taxiing accident—one Spitfire damaged undercarriage—pilot baled out over sea and safe.
- (xv) Strength of Station :—

72 Officers, 202 Senior N.C.O.s and 926 other ranks on 5.10.42
309 Officers, 470 Senior N.C.O.s and 1,400 other ranks on 16.11.42
227 Officers, 321 Senior N.C.O.s and 1,795 other ranks on 14.12.42.

APPENDIX 34
**RELEVANT EXTRACTS OF ADMINISTRATIVE ORDERS AND
INSTRUCTIONS**
No. 333 GROUP

The Nature of the Operation to be Undertaken

The operations which are about to be undertaken involve the launching of an expedition overseas which will consist of British and American land and air forces, the whole being under the supreme command of Allied Force Headquarters.

LAND FORCES

The land forces consist of three Task Forces :—

American

- (i) The Western Task Force.
- (ii) The Centre Task Force.

British

- (iii) The Eastern Task Force.

AIR FORCES

The air forces consist of :—

American

- (i) The Western Air Command.—The 12th Air Force (U.S.) which provides the air component for the Western and Centre U.S. Task Forces.

British

- (ii) The Eastern Air Command.—Royal Air Force which will co-operate with the British Eastern Task Force.

The 12th Air Force (U.S.) and the Eastern Air Force (R.A.F.) have each their specific tasks to perform, but, while operating independently under their respective commanders, are subject to the co-ordination of the Commander-in-Chief, Allied Force Headquarters.

* * * *

MAINTENANCE PROJECT

System of Accounting

14. All units in the Eastern Air Command are to adopt system 'C' for administration of equipment, in accordance with A.P.830, Volume 1, Chapter 36, Section 4.

Responsibility of Army and R.A.F.

15. The Army is responsible for landing, holding and distributing the following stores for R.A.F. units :—

- Engineers stores.
- Petrol, oil and lubricants.
- S.A.A.
- Bombs and pyrotechnics.
- Supplies, water and E.F.I. stores. (To be collected by R.A.F. transport.)
- Medical stores.
- Stationery and maps.

16. The following services will be provided for the R.A.F. by the Army :—

R.E. works.
Survey and postal services.
Signals—laying of land lines, provision of switchboards and telephones and personnel to man them.
Medical—evacuation of casualties and hospitalisation.
Quartering, requisitions and local purchase, hirings and claims, provost, pay and printing.

17. The R.A.F. will be responsible for :—

Provision, holding and distribution of their own reinforcements, vehicles, technical stores and heavy duty dress.
Repair and recovery of aircraft, vehicles and technical equipment.
R.A.F. wireless communications.
Decontamination.

Scales of Equipment and Stores

18. The R.A.F. requirements have been calculated in accordance with the following policy :—

(i) Stores and Equipment

Unit Equipment Each unit will proceed overseas complete with unit and barrack equipment, 50% tentage and 7 days' maintenance.

Air Stores Parks Each park will take 30 days' maintenance for all units which it serves, to be followed approximately 14 days later by a second consignment of 30 days' maintenance for inclusion in Nos. 131, 132, 133, 134 Air Stores Parks.

No. 351 Maintenance Unit 90 days' maintenance for all units.

(ii) S.A.A., Bombs, Petrol, Oil and Lubricants

First 8 days Maximum effort : for each squadron one day's supplies for each day in the country plus 100% reserve up to D plus 7.

Subsequent 30 days Maximum effort.

Thereafter Sustained effort : 90 days' reserve at sustained rates will be built up by stages.

Army Base Depots : Attachments

19. R.A.F. technical personnel to assist in the handling of R.A.F. stocks are attached to Army Fuel and Base Depots and will proceed overseas with these formations.

R.A.F. Embarkation Units

20. Nos. 59, 60 and 61 Embarkation Units will be attached to Q (M) at selected localities to assist in the landing of R.A.F. personnel and stores.

R.A.F. Maintenance Units

21. (i) *No. 351 Maintenance Unit.* This unit will proceed overseas at a later date and will be the main stores holding unit in the theatre of operations. It will contain a small section to hold and issue clothing, equipment and other needs to units not served by Air Stores Parks.

(ii) *Air Stores Parks.* Air Stores Parks are attached to wing formations as set out in the Order of Battle at Annexure I (not included). Each park holds an initial supply of 30 days' maintenance for the squadrons in the wing it is designed to serve. M.T. for Air Stores Parks is included in the establishment of Wing Headquarters formations.

Unit Equipment

22. Squadrons are to take essential equipment and seven days' maintenance spares. All tradesmen are to bring their own tool kits.

REPAIR AND SALVAGE

Squadrons

23. Squadrons are to undertake aircraft minor and major inspections and unit repairs. Unit repairs will be defined as those which can be :—

- (i) Undertaken on the squadron base aerodrome.
- (ii) Completed within a period of 5 days in the case of single-engined aircraft, and 10 days in the case of twin-engined aircraft.

Repair and Salvage Units

24. Each wing has been allotted a Repair and Salvage Unit, which is to undertake salvage, repair on site, and repair at base of aircraft not falling in the category of unit repair. The scope of repair will depend on the availability of spares and tools, the initiative of individuals and the operational conditions. For this reason no minimum or maximum limits may be set but Officers Commanding Repair and Salvage Units are to be guided by the Official Publications in deciding the extent of practicable repairs.

25. Personnel of Repair and Salvage Units may be called upon by the Officer Commanding the wing to which they are attached, to assist squadrons in the major inspections and unit repairs, subject to the approval being obtained from the Chief Maintenance Officer at Air Headquarters.

26. Repair and Salvage Units are to undertake salvage and light repair of M.T.

27. Airframes, engines and ancillary equipment and M.T. damaged beyond repair are to be :—

- (i) Reduced to components, the serviceable items being returned to Air Stores Parks for reissue, or
- (ii) Returned in the complete state to No. 351 Maintenance Unit for return to the United Kingdom.

Mobile Signals Servicing Units

28. Personnel of Mobile Signals Servicing Units are to undertake the servicing and repair of W/T equipment. For administrative purposes these units are attached to Repair and Salvage Units, but attachments will vary in accordance with the movements of the wireless units served.

MECHANICAL TRANSPORT

Establishments

29. M.T. establishments have been prepared to render formations and wings mobile on the lines of Middle East. In the case of certain wings and formations which will not be required to be mobile in the early stages, certain load-carrying vehicles will not be shipped until called for. Those wings and units and the number of vehicles which are retained temporarily in the United Kingdom are as follows :—

<i>Formation or Unit</i>	<i>Vehicles not to be shipped</i>
H.Q., No. 323 (F) Wing	60 three-tonners.
No. 232 (F) Squadron	3 three-tonners.
No. 243 (F) Squadron	3 three-tonners.
No. 106 R.S.U.	11 three-tonners.
H.Q., No. 326 (LB) Wing	38 three-tonners.
No. 18 (LB) Squadron	6 three-tonners.
H.Q., No. 328 (GR) Wing	17 three-tonners.
No. 608 (GR) Squadron	6 three-tonners.

30. Owing to certain limiting factors it is not practicable in some cases to get all unit vehicles into M.T. Ships destined for the same destination. In such cases M.T. vehicles will join their respective formations and wings at the earliest opportunity.

31. M.T. for squadrons and Air Stores Parks is held on the establishment of wing formations. This is sufficient to place units in each wing on a mobile footing.

32. Drivers are established for 'A' category vehicles as shown in the respective establishments. If units are required to move in one lift it will be necessary for them to detail drivers for those vehicles listed in the 'B' category.

33. No. 328 (GR) Wing is established in M.T. on a semi-mobile basis with sufficient vehicles to enable one squadron to operate on detachment.

* * * *

MISCELLANEOUS SUPPLIES

Oxygen

36. Normal source of supply will be by transport cylinders from mobile oxygen plants, one of which is attached to each of the R.S.U.s. An additional reserve plant is attached to No. 131 Air Stores Park. Army requirements will be met in the initial stages from R.A.F. reserves.

37. Empty transport cylinders are to be returned by units to R.S.U.s for filling. They will be exchanged from stocks of full cylinders held at the R.S.U.s.

Glycol, Acid and Distilled Water

38. At the outset glycol, acid and distilled water will be supplied by the Servicing Commandos. Fourteen days' supply is included in each Servicing Commando pack-up. Thereafter units are to demand in the normal way on their Air Stores Parks.

AERODROME CONSTRUCTION GROUPS

39. Two Army Construction Groups are included in the Eastern Task Force Order of Battle. They are provided for the repair of existing and construction of new aerodromes. Advanced elements of these Construction Groups will be available at the outset of the operations.

40. R.A.F. liaison officers are attached to the G.H.Q., Eastern Task Force, and to the Aerodrome Construction Groups as follows :—

G.H.Q. (attached Chief Engineer) ..	..	1 W/Cdr.
No. 3 Aerodrome Construction Group ..	..	1 S/Ldr.
No. 14 Aerodrome Construction Group ..	..	1 S/Ldr.

WORKS SERVICES

41. Works services will be carried out by the Royal Engineers. Application for works services are to be made to the Air or Group Headquarters for approval and transmission to the Chief Engineer. In case of operational urgency, application may be made to the local R.E. officer.

42. Royal Engineers will not be available for defence wiring, digging of trenches, black-out and field hygiene, but assistance will be given in tools and materials where available.

APPENDIX 35

THE EARLY HISTORY OF THE R.A.F. SERVICING COMMANDOS

It was decided in January 1942 to form 3 Servicing Commandos in Fighter Command and instructions to this effect were given by the Director of Organisation on 31 January.¹

The object of these units was to be the occupation of advanced landing grounds, as soon as they had been captured by the Army. The commandos would be disembarked into landing craft and put ashore over the beaches with their equipment and transport. They would then advance to occupy the aerodrome as soon as the Army declared it clear of the enemy. It would not be the duty of Servicing Commandos to fight for landing grounds but in the circumstances under which they would be operating opposition might be encountered and the men would have to be prepared to defend themselves and their aircraft. On reaching the aerodrome they would arrange petrol and ammunition dumps and prepare to receive and service forward support fighter aircraft until the arrival of the squadron servicing echelons, whereupon they would leapfrog forward in their own transport to a more advanced aerodrome. The minimum of essential equipment would be carried, sufficient for refuelling, rearming, between flights and daily inspections, minor repairs and replacements and the necessary gear for aircraft pickets, ground marking, entrenching and cooking. Individual rations would be carried for 48 hours with additional supplies for 10 days. The total strength would be approximately 2 officers and 150 other ranks, all volunteers.²

Immediately following the issue of the Air Ministry authority, volunteers were called for in Fighter Command. Nos. 3201, 3202 and 3203 Commandos were formed and the first battle course was opened at Inveraray on 26 April.

On 6 April the Director of Military Co-operation at Air Ministry was requested by the Air Officer Commanding-in-Chief, Army Co-operation Command, to sanction the formation of 2 further Commandos for the servicing of Army Co-operation aircraft. The request was at first refused since D.M.O. did not consider that the scale of operations in 1942 would call for the employment of such units. The A.O.C.-in-C. pressed his point, however, stressing that the forward operation of reconnaissance aircraft in support of the Army was as necessary as close fighter support. He won his case and approval was given on 19 May. It was considered that smaller units would suffice in Army Co-operation Command and the establishment was fixed at 2 officers and 74 other ranks. Sufficient volunteers had been obtained by 17 July and Nos. 3225 and 3226 Commandos were formed and assembled on 1 August.³

The Fighter Command and Army Co-operation Command Servicing Commandos, though serving similar purposes, had differing establishments and equipment and were trained to service different types of aircraft. It was soon realised that, even though a forward landing ground might be allocated to specific squadrons, it would very likely be necessary to use the same airfield for both fighter and reconnaissance aircraft and even for light bombers, while in an emergency any type of aircraft might land if the aerodrome were suitable. It was, therefore, decided that the Commandos should be known as R.A.F. Servicing Commandos and should all have identical establishments and be able to service aircraft of any squadron likely to use a captured aerodrome. The establishment and training of a Commando would be based on the carrying out of daily and between flights inspections and all repairs and adjustments normally undertaken by flight personnel in a squadron, limited in extent to supporting the equivalent operational effort of 3 fighter

¹ LM/670/DGO.

² AOC/S.182/Air 2A.

³ A.M. File C.S.14196.

squadrons plus 2 light bomber or one medium bomber squadron operating simultaneously throughout the hours of daylight. Technical personnel would come under two groups:—

- (a) Those familiar with all of a list of specified types, the list being subject to periodical amendment, but then including certain marks of Spitfire, Hurricane, Typhoon, Mustang, Blenheim, Boston.
- (b) A limited number of selected experts on each specified type.

Following the completion of No. 5 Beach Course at Inveraray it was considered desirable to organise the Commandos rather more on Army lines. It is beyond doubt that the new organisation had its advantages and the fact that the Commandos were capable of assuming a military role for local defence was a safeguard which the development of the campaigns did not in fact demand to any extent, but which, nevertheless, might under different circumstances have proved invaluable. Under the reorganised scheme the commando was divided into 4 flights and a headquarters flight, each of the five having 3 squads of approximately 12 men.¹

Nos. 3201 and 3202 Servicing Commando Units were used in North Africa.* They disembarked from assault craft at dawn on 8 November 1942 in the vicinity of Algiers and marched 12 miles to Maison Blanche airfield. During the first week the commandos serviced every aircraft that landed at Maison Blanche, including Hurricanes, Spitfires and Lightnings. No. 3203 S.C.U. disembarked at Bône on 10 December and arrived at Blida on the 19th, subsequently joining No. 110 Repair and Salvage Unit at Ghardimaou on 12 February.

In spite of difficulties the units did magnificent work and were required to undertake the maintenance of more squadrons and for a considerably longer period than originally intended, owing to the difficulty in assembling the ground echelons and equipment of the fighter squadrons and moving them to the forward area to join their aircraft.

In the opinion of the Air Officer-in-charge of Administration at H.Q., Eastern Air Command, 'The success achieved by the fighter squadrons during this period was undoubtedly due very largely to the loyal and extremely hard work of the Servicing Commandos who have most certainly proved their value in a campaign of this nature.'²

Moving from Maison Blanche as the campaign developed, the Commandos were subsequently in operation at Djidjelli, Souk el Arba, Bône and other airfields under most difficult conditions. Airfields and road surfaces were bad, the weather was far from ideal, living conditions were at times severe and units had still to contend with supply problems in addition to servicing aircraft. They serviced, during the advance, Spitfires, night-flying Hurricanes, Wellingtons and U.S.A.A.F. Mitchells, frequently under enemy air attack.

At the end of April 1943 Commando personnel moved to a new airfield under construction near Medjez el Bab. They were less than eight miles from the front line but by 3 May the advanced ground was ready for use. It was not actually needed to any extent until 8 May when 184 aircraft were serviced in the one day. This was their last major effort in North Africa, but after a short refresher course near Oran the three units were again ready for action in Sicily by July.

Several further Commando Units were formed early in 1943 for impending operations: No. 3204 was established in Fighter Command in February and in April Nos. 3205 and 3206 were formed in Army Co-operation Command and Nos. 3207, 3208, 3209 and 3210 in Fighter Command.³

By April a revised establishment had been drawn up which incorporated the more important of the recommendations contained in the reports of the Officers Commanding, Nos. 3201 and 3202 Commandos, though the addition of an Officer Adjutant was not allowed. The newly formed units, which were intended for use with No. 83 Group in Europe, were based on the new establishment.

¹ A.M. File S.83764.

² Ref. Admin. Plans 6 Flds. 39/6/1.

³ Ref. EAC/1639/Org. 26.1.43.

⁴ A.M. File S.83764.

APPENDIX 36

THE ROLE AND EQUIPMENT OF THE SERVICING COMMANDOS

Employment¹

The role of the Servicing Commandos was to go in during the early stages of an assault and prepare airfields for the reception of aircraft, which they had to be prepared to service until the arrival of the squadron personnel. The advantages to be gained from their use were :—

- (a) that they allowed for greater flexibility in the Air Plan by enabling squadrons of different types to be put into a new landing ground at short notice, although it was not entirely satisfactory for a Commando to have to cater for more than one type of aircraft, and
- (b) they took the first shock of casualties, thus saving losses among squadron ground personnel who would have been harder to replace.

The number of Commandos required was calculated on the basis of one per four squadrons flying in before their squadron personnel arrived. After the arrival of the latter, Commando personnel were either withdrawn into the personnel transit centre for refitting or distribution among other units, or went ahead with the army to open up further landing grounds. One Commando normally operated one airfield, but could be split to operate two within its capacity of four squadrons. An increment of 50 personnel was made if it was required to service night fighters.

Organisation

The Commando was designed to split into four flights, each of which had 3-ton lorries. Each flight contained 7 aircraft teams of fitter, rigger and armourer. No flight mechanics were included, all tradesmen being Fitters IIA and E. These tradesmen were encouraged to regard themselves as both fitters and riggers when their training and experience could justify it. Each of these flights assumed the responsibility for a squadron and functioned as follows :—

- (a) *Refuelling.* The petrol brought from the beach was dispersed to dumps around the landing ground and from these dumps each flight drew enough petrol for one squadron refuel. One 3-ton lorry contained an empty 44 gallon drum and an A6 refueller, a second an empty drum and two semi-rotary hand pumps. Refuelling was done by pouring the petrol into the drum and pumping it into the aircraft, thus ensuring adequate filtering. No attempt was made to refuel long-range tanks as special attachments were necessary and it was a lengthy process.
- (b) *Rearming.* The third flight lorry collected ammunition from the dumps around the landing ground and transported it to each dispersal for use as required.

As no drivers were held on the establishment, these were drawn from all trades to maintain the balance. All personnel also assisted in refuelling when not actually engaged on other specialist work.

As both officers were engineers and fully occupied with practical work, the paper work was kept to a minimum. The normal system of 'travelling' Forms 700 was used and a sergeant clerk was employed to log aircraft movements. A daily aircraft state was sent in each night at 1800 hours and the beach brick was kept informed of the stocks of petrol, oil, lubricant and explosives available at the landing ground.

One complete Commando was held ready in reserve, to be flown in to replace casualties. In Husky only two airmen were killed by anti-personnel mines and no replacements were necessary.

¹ A.H.B./II JI/193.

Equipment

(a) *Tools.* Every tradesman carried a personal tool-roll of standard tools as laid down in the War Establishment Scales.

(b) *Starter Trolleys.* Starter trolleys equipped with an engine were taken in during Husky at a scale of one per aircraft, but this was found to be excessive as most pilots preferred to start on their internal accumulators rather than wait for the trolley. The number was subsequently reduced to 12 per Commando with the addition of 8 spare internal accumulators.

(c) *Refuellers.* In addition to the 8 semi-rotary hand pumps, 4 American A6 refuellers were carried. These were high-pressure fuel pumps which packed in a box about 3 ft. x 1 ft. 8 ins. x 1 ft. 8 ins., weighed very little and would pump out a 44 gallon drum in one minute. No. 3232 Servicing Commando had in addition a captured German 'Barrel' refueller which was contained in two barrels of normal petrol drum diameter and was 18 ins. high. One held a petrol motor, petrol tank and three stage pump, while the other held sufficient hose and junction pieces to allow three aircraft to be refuelled at once. This proved to be by far the most useful.

(d) *Sheer Legs.* These were considered of little value as they could only lift and not move. A German travelling gantry was acquired with a 3,000 kg. block and tackle from which, at the time of its capture, an Me.109 was suspended. This gantry was constructed of tubular metal, and was mounted on four pressed-steel wheels with interconnected steering. It had two shafts for towing, and could be dismantled into six pieces, each capable of being lifted by one man.

(e) Army type mess tins were used, as R.A.F. mess tins would not accommodate the 48-hour ration.

(f) *Oxygen.* A charging rack and transport cylinders were carried, but this could only be regarded as a temporary measure. A mobile oxygen charging plant should be landed as soon as possible.

(g) Two jeeps were provided for each Commando, as they were essential to officer supervision.

(h) *Spare Tyres and Wheels.* The number of spare tyres and wheels laid down in the War Establishment Scales was found to be inadequate and was accordingly amended to:—

Main wheels and tyres	..	..	..	..	8
Main tyres Spitfire V and IX	..	..	..	..	40
Main tyres Spitfire VIII	..	..	..	..	10
Tail wheels and tyres..	..	..	..	..	12
Tail tyres all Marks	..	..	..	..	20

One gross of new sparking plugs was also carried. These were spark tested, as new sparking plugs were sometimes defective.

(i) *Stores.* These included cases of belted 20 mm. ammunition, water finding paste for checking petrol drums, and ready-mixed glycol engine coolant. At least one Commando in Husky, however, took pure glycol, and had neither distilled water nor tartaric acid for treating ordinary water available; it was therefore compelled to drain the coolant from the radiators of crashed aircraft to top up serviceable aircraft.

APPENDIX 37

RELEVANT EXTRACTS OF ADMINISTRATIVE ORDERS AND INSTRUCTIONS FOR OPERATION HUSKY

Maintenance Instruction No. 1

Preparation and Refitting of Units for Operation Husky

Introduction

These instructions cover the action to be taken by commands and groups with regard to the maintenance aspect of the refitting and general preparation of squadrons and units for Operation Husky. The actual Maintenance Project for 'Finance' and 'Horrid' will be issued separately, the former by H.Q. R.A.F., M.E., and the latter by Force 545 (Air).

2. Responsibility for the refitting and reorganisation of squadrons and units will rest with parent commands as laid down in para. 55 of Administrative Planning Instruction No. 2 dated 19 April 1943.

Establishments

3. Special establishments, which are being issued separately, have been prepared in the case of units destined for 'Horrid.' These establishments are based on light assault scales.

All other units will re-form to normal M.E. establishments current at the time of refitting.

Base Areas

4. There will be two main base areas for refitting and re-equipping, viz., the Delta and Tripoli. Stocks of equipment are being sent to No. 114 M.U., Zavia, for the refitting of units in the Tripoli area. Units in the Delta will submit demands on their usual source of supply, or in accordance with any other special instructions which may be issued.

Units Concerned

5. Units concerned will fall into two categories :

- (a) those destined for 'Horrid' ;
- (b) those moving either to 'Penryn' or 'Finance,' but not due to go forward to 'Horrid.'

At all times priority for refitting and issuing of aircraft, M.T. spares, etc., must be given to (a) above.

Aircraft

6. Commands and groups will ensure that their squadrons are equipped with the number of aircraft for which each squadron is established.

New aircraft will be issued to squadrons to replace unserviceable aircraft which cannot be made serviceable by the squadrons within the time allowed for preparation and refitting. The unserviceable aircraft will be allotted to No. 214 Group for No. 113 M.U., Castel Benito (for all types other than Kittyhawks), or No. 3 A.R.U., Mellaha (for Kittyhawks).

Replacements will be drawn from No. 117 M.U.

A.O.C., No. 214 Group, will be responsible for controlling the issue of aircraft from No. 117 M.U.

Mechanical Transport

7. Commands and groups will ensure that their units are equipped with the number and types of vehicles allowed on establishments. Special M.T. establishments are being issued for units destined for 'Horrid' (see para. 3 above).

Vehicles will be issued to units in the 'Chimpanzee' area from the M.T. Pool attached to No. 114 M.U., and to units in the Delta area from M.T. Base Pool.

As far as units proceeding to 'Horrid' are concerned the aim will be, wherever possible, to supply new F.W.D. vehicles against establishment of load carriers.

Waterproofing is a unit responsibility. Separate instructions are being issued on this subject.

Technical Spares and Unit Equipment

10. (a) Special packs are being issued to the servicing commandos.

(b) Separate instructions are being issued regarding the scale for Spitfire and Kittyhawk squadrons, both as regards unit equipment and range of spares.

(c) Squadrons proceeding to 'Horrid' will move from the refitting area with a 9 days' range of spares which they are to pack in special containers, supplies of which have been despatched to No. 114 M.U. These containers are in two sizes, viz.:

18½ in. × 11½ in. × 8½ in.
24 in. × 18 in. × 11½ in.

The entitlement is 45 containers of each type per squadron. Each container is so designed that upon the removal of four screws it can be opened and used as a stores bin without immediately unpacking all the contents. Before being packed each container is to be lined with waterproof paper, supplies of which are available at No. 114 M.U.

This range of spares (c) above must not be drawn upon until the squadron concerned is in 'Horrid.' Special stocks are being issued to 'Finance' to allow for squadrons in transit to draw on No. 143 M.U., during their stay in 'Finance,' and this will enable the squadrons to keep the 9 days' range of spares intact.

Channels of supply will be as laid down in para. 3 above.

Oxygen

11. When the Western Desert squadrons and units are withdrawn to the 'Chimpanzee' area, the three oxygen plants at present held by Nos. 31, 33 and 40 A.S.P.s will be transferred to the control of No. 214 Group, together with stocks of bottles and cylinders held by those A.S.P.s.

A.O.C., Western Desert, will be responsible for ensuring that all aircraft bottles and transit cylinders held in squadrons surplus to unit equipment scale are handed over to No. 214 Group. This is most important so as to enable the plants to be fully employed filling bottles and cylinders during refitting period.

Squadrons and A.S.P.s will draw their entitlement of filled oxygen bottles/cylinders from No. 114 M.U. prior to leaving the 'Chimpanzee' area.

Air Stores Parks and Repair and Salvage Units.

12. Arrangements will be as follows:

- (a) No. 31 A.S.P. and No. 51 R.S.U. will continue to serve the Western Desert Light Bomber Force and will be controlled by the same Headquarters Formation as operates and administers the Western Desert Light Bomber Force.

- (b) No. 33 A.S.P. and No. 53 R.S.U. will be transferred to the control of No. 214 Group.
 Personnel from No. 33 A.S.P. and No. 53 R.S.U. will be required to move into 'Finance' about D minus 30 on the following bases :
- (i) No. 33 A.S.P.—All equipment assistants and drivers M.T. but no equipment or transport. Balance of unit will be attached to No. 114 M.U.
 - (ii) No. 53 R.S.U.—All technicians and drivers M.T., i.e. all personnel other than those purely administrative. In addition, tool kits, three heavy cranes, one light crane and eight articulators (four low loaders and four high loaders) are to be taken. Balance of unit will be attached to No. 113 M.U.
- (c) No. 36 A.S.P. This unit has been transferred from No. 201 Group to No. 214 Group to assist No. 114 M.U.
- (d) No. 40 A.S.P. and No. 59 R.S.U. will be required to move to 'Horried' and separate instructions will be issued by Force 545 concerning these units.
- (e) No. 2 R.S.U. will be transferred to control of No. 214 Group and will work at No. 113 M.U. (Castel Benito).
- (f) No. 3 R.S.U. will be transferred to control of No. 214 Group and will work at No. 3 A.R.U. (Mellaha).

Advanced Salvage Unit

13. The Advanced (or Forward) Salvage Unit will be transferred to control of No. 214 Group and will be required to assist advanced section of base salvage units in the clearance to No. 113 M.U. and No. 3 A.R.U. of accumulations of crashed aircraft in the Western Desert dumps.

M.T. Light Repair Units

14. No. 2 M.T.L.R.U., which will re-form to a new establishment being issued by H.Q., R.A.F., M.E., after consultation with Force 545, will be required to proceed direct from the mainland to 'Horried.' The balance of the unit which will be an increase of the existing advance section will move to 'Finance' from 'Chimpanzee' area about D minus 30.

S. & T. Columns

15. Nos. 5, 6 and 10 S. & T. Columns and Nos. 1 and 2 Bomber Group Maintenance Companies will be transferred to No. 214 Group and will be used by A.O.C., No. 214 Group, to the best advantage.

Air Ammunition Park

16. No. 124 M.U. (A.A.P.) will be transferred to the control of No. 214 Group for the strengthening of No. 141 M.U. However, one dump section will be required in the Kairouan area to support No. 205 Group.

Surplus Equipment and M.T.

17. A.O.C., A.H.Q., Western Desert, and A.O.C. No. 214 Group, will, in the case of units destined for 'Horried,' make arrangements for the disposal, in the 'Chimpanzee' area, of personnel, M.T., and stores surplus to the special assault scale establishments.

In view of the fact that certain personnel belonging to these units will have to stay in the 'Chimpanzee' area, this equipment will be retained by what are, in effect, the rear parties of the units.

16 May 1943

Reference :
 MS.103790/M.Plans

K. L. BOSWELL,
Air Commodore,
 C.M.S.O.,
 H.Q., R.A.F., M.E.

Maintenance Instruction No. 3

Aircraft—Replacement of Wastage—Operation Husky

This instruction is issued to cover the period of Operation Husky and its effective date will be 20 June 1943.

2. Immediately on receipt Air Headquarters and groups are to issue detailed instructions, as necessary, to such of their units as are concerned in the operation of this new procedure.

3. Squadrons of the R.A.F. and 9th U.S.A.A.F. in Malta, Sicily, or in the Middle East Command will be supplied with replacement aircraft from the units shown in Appendix 'A' (not included). This does not apply, however, to medium and heavy bomber squadrons; arrangements for supply of these aircraft are set out in para. 7.

The units to be supplied by, and the types of aircraft to be held at, No. 117 and No. 136 Maintenance Units, at the U.S.A.A.F. Pool at Sorman and at Delta Maintenance Units are shown below, together with details as to the procedure for maintaining the flow of aircraft through maintenance units to squadrons.

4. Maintenance units concerned in the supply of aircraft and the squadrons each will serve are :—

A. No. 117 Maintenance Unit, Azizlia, and U.S.A.A.F. Pool, Sorman

No. 214 Group located in the Tripoli area will be responsible through No. 117 Maintenance Unit and U.S.A.A.F. Pool at Sorman, for supply of aircraft to the following units :—

(i) No. 117 Maintenance Unit

<i>Unit</i>	<i>Type of aircraft</i>
No. 40 (S.A.) Squadron .. ..	.. Spitfire V
No. 73 Squadron .. ..	.. Spitfire V
No. 244 Wing and its Squadrons ..	.. Spitfire V and IX
No. 322 Wing and its Squadrons ..	.. Spitfire V and IX
No. 324 Wing and its Squadrons ..	.. Spitfire V and IX
No. 239 Wing and its Squadrons ..	.. Kittyhawk II and III
No. 7 (S.A.) Wing and its Squadrons ..	.. Kittyhawk I, II and III
No. 1437 Flight .. ..	.. Mustang
No. 3 (S.A.) Wing and its Squadrons ..	.. Boston and Baltimore
No. 232 Wing and its Squadrons ..	.. Baltimore
Malta Squadrons .. ..	.. Spitfire, Mosquito and Beaufighter
A.D.E.M. Squadrons in Tripolitania ..	.. Hurricane and Beaufighter

(Note.—No. 73 Squadron has been temporarily loaned to North African Air Force for employment with North African Coastal Air Force. While so employed it will be maintained by North African Air Force, but as soon as the squadron returns to Middle East Command it will be supplied under Middle East arrangements.)

(ii) U.S.A.A.F. Pool at Sorman

<i>Unit</i>	<i>Type of aircraft</i>
57th Fighter Group .. ..	.. Kittyhawk II (P.40F)
79th Fighter Group .. ..	.. Kittyhawk II (P.40F)

B. No. 136 Maintenance Unit, Berka

No. 212 Group, located in the Martuba area, will be responsible through No. 136 Maintenance Unit for the following :—

- (i) Holding a reserve of aircraft for feeding into No. 117 Maintenance Unit from the east and also to supply the Aircraft Storage Unit, controlled by North African Air Force if H.Q., R.A.F., M.E., is so requested by Mediterranean Air Command.
- (ii) Supplying squadrons operated by Air Defences Western Mediterranean and located in the area Marble Arch to Derna (both included).

C. Maintenance Units in the Delta

Headquarters, Royal Air Force, Middle East, will control, through No. 206 Group and the maintenance units in the Delta, the following commitments :—

- (i) Replenishment of No. 136 Maintenance Unit.
- (ii) Supply of aircraft to squadrons operated by Air Defences Eastern Mediterranean and located in the area Derna (excluded) to Levant.
- (iii) Supply of aircraft to all squadrons operated by No. 201 Group.
- (iv) Supply of aircraft to heavy bomber squadrons (see also para. 7 below).
- (v) Supply of aircraft to operational training units and Middle East Training Schools.
- (vi) Any other special commitment, e.g. aid to Turkey, etc.

5. It is estimated that in order to meet the commitments enumerated in paragraphs 4A and 4B above, the number of aircraft required to be held by No. 117 Maintenance Unit, by the U.S.A.A.F. Pool at Sorman, and by No. 136 Maintenance Unit, will be :—

A. (i) No. 117 Maintenance Unit

<i>Type of aircraft</i>	<i>Qty.</i>	<i>Remarks</i>
Spitfire V	100	
Spitfire IX	25	
Kittyhawk I	10	
Kittyhawk II	12	
Kittyhawk III	20	
Hurricane IIC	10	
Mustang	2	
Mosquito	5	
Beaufighter (Coastal)	5	
Beaufighter (Night)	15	
Baltimore	15	6 of these will be held in No. 51 Repair and Salvage Unit.
Boston	10	4 of these will be held in No. 51 Repair and Salvage Unit.

(ii) U.S.A.A.F. Pool at Sorman

<i>Type of aircraft</i>	<i>Qty.</i>
Kittyhawk II (P.40F)	12-15

B. No. 136 Maintenance Unit

<i>Type of aircraft</i>	<i>Qty.</i>
Spitfire V	40
Kittyhawk I	10
Kittyhawk II	10
Kittyhawk III	20
Hurricane IIC	10
Baltimore	9
Boston	6

6. Method of Replenishment

A. Squadrons

- (i) Existing procedure of repeating casualty signals to the Headquarters Formations responsible for replenishment will continue except for squadrons in Malta and squadrons in Sicily.
- (ii) Headquarters, Malta, will send an immediate signal each day, or more frequently if necessity arises, to Headquarters, No. 214 Group (who will notify Rear Air Headquarters, Western Desert, automatically). This signal will show the number of aircraft required by types to replace Cat. II, Cat. III and 'Fly-in' casualties, also the number of replacement pilots or aircrews and the landing ground(s) to which the aircraft are to be delivered.

- (iii) As far as Sicily is concerned, each wing commander, or his representative will send an immediate signal each day, or more frequently if necessity arises, to No. 214 Group (who will notify Rear Air Headquarters, Western Desert, automatically), stating the number of aircraft required by types to replace Cat. II, Cat. III and 'Fly-in' casualties. The signal will also state the number of replacement pilots or aircrews required and the landing ground(s) to which the aircraft are to be delivered.

B. No. 117 Maintenance Unit and U.S.A.A.F. Pool at Sorman

No. 214 Group will call forward replacement aircraft each day to make good holdings of No. 117 Maintenance Unit and U.S.A.A.F. Pool at Sorman as follows :—

Type of aircraft	From west	From east
Spitfire V	Three-fifths of total requirements	Two-fifths of total requirements
Spitfire IX	All requirements	—
Kittyhawk I and II ..	—	All requirements
Kittyhawk II (P.40F) ..	All requirements for 57th and 79th Fighter Groups	All other requirements
Mustang	All requirements	—
Beaufighter (Night) ..	One-third of total requirements	Two-thirds of total requirements
Beaufighter (Coastal) } Hurricane IIC	—	All requirements
Boston	—	All requirements
Baltimore	—	All requirements
Mosquito	All requirements	—

To call forward aircraft from the west, No. 214 Group will signal requirements to Mediterranean Air Command, endorsed 'For Central Allotments Bureau.'

To call forward aircraft from the east, No. 214 Group will signal its requirements to No. 212 Group.

C. No. 136 Maintenance Unit

No. 212 Group will call up from Headquarters, Royal Air Force, Middle East, the aircraft required to make good holdings of No. 136 Maintenance Unit.

Supply of Medium and Heavy Bomber Aircraft

7. Replacement aircraft for medium and heavy bomber squadrons will continue in accordance with existing procedure :—

- Reinforcement Wellington aircraft from Ras El Ma and repaired aircraft from maintenance units in Delta into No. 205 Group's repair and salvage units direct.
- Halifax aircraft ferried direct from No. 161 Maintenance Unit to the heavy bomber squadrons.
- Heavy bombers for the 9th U.S.A.A.F. are flown into Egypt from U.S. via Khartoum or Marrakesh and are distributed direct to the units concerned under arrangements made by 9th U.S.A.A.F.

Action in Event of Reserves Falling Below Level of Requirements

8. If at any time Air Officer Commanding, No. 214 Group, considers that aircraft reserves under his control are falling below the possible requirements of the various forces which they are designed to support, he will notify Headquarters, Royal Air Force, Middle East, by Immediate signal stating what he has available and what is due in. Headquarters, Royal Air Force, Middle East, will then, if considered necessary, advise Mediterranean Air Command (Central Allotments Bureau) repeating to North African Air Force and North African Tactical Air Force as applicable.

Allotment Forms

9. A. Allotment Forms No. 1012 will be raised as follows :—

<i>Issues from</i>	<i>Responsibility for raising allotment</i>	<i>Distribution of Form 1012</i>
Delta Units	H.Q., R.A.F., M.E.	(1) Consignor M.U. concerned (2) No. 212 Group (3) File
No. 136 M.U.	No. 212 Group	(1) No. 136 Maintenance Unit (2) No. 214 Group for No. 117 M.U., or if local squadron—Consignee unit. (3) File (4) H.Q., R.A.F., M.E.
No. 117 M.U. No. 113 M.U. No. 159 M.U.	No. 214 Group	(1) Consignor M.U. (2) H.Q., E.A.T.F., A.H.Q., Malta, No. 210 Group, No. 51 R.S.U., or consignee unit as applicable (3) File (4) H.Q., R.A.F., M.E.

B. All aircraft flown into No. 117 Maintenance Unit from the west and into Tripoli repair and maintenance units ex Malta and Sicily for engine change, repair, etc., will be covered by No. 214 Group raising a receipt allotment form. Copies of the allotment form will be sent to Headquarters, Royal Air Force, Middle East. In the case of aircraft returned for engine change, repairs, etc., an additional copy will be sent to Air Headquarters, Malta, or Headquarters, Eastern Air Task Force, as applicable.

C. Cat. II and Cat. III aircraft will be advised weekly to Headquarters, Royal Air Force, Middle East, by Headquarters concerned for write-off action.

Returns

10.

<i>Nature of return</i>	<i>Rendered by</i>	<i>Method</i>	<i>To whom rendered</i>
A. Daily State of aircraft in M.U.s	(i) A consolidated return from No. 214 Group for all M.U.s under their control (ii) No. 136 M.U. (iii) All Delta M.U.s	Signal Signal Telephone	H.Q., R.A.F., M.E.
B. Weekly Mayfly	All H.Q. and Group Formations	Signal	H.Q., R.A.F., M.E.
C. Weekly State of aircraft in M.U.s 'S' and 'S' within 7 days	Full particulars given at Appendix 'B' (not included)	Signal	M.A.C. for C.A.B. (R) M.E., H.Q., R.A.F.
D. Monthly Serial Nos. 136 and 139	All H.Q. and Group Formations	Postagram	H.Q., R.A.F., M.E.

11. Air Headquarters, Malta, Air Headquarters, Western Desert, No. 212 Group and No. 214 Group are to acknowledge by signal receipt of this Instruction.

12 June 1943

Reference :
MS.103790/M.Plans

K. L. BOSWELL,
Air Commodore,
C.M.S.O.,
H.Q., R.A.F., M.E.

APPENDIX 38

OUTLINE TABLE SHOWING THE CHAIN OF RESPONSIBILITY FOR
AIRCRAFT SUPPLY

I. Delta Aircraft Storage Units

A. Receipts from :—

- (i) Takoradi, via Central African Reinforcing Route.
- (ii) Erection of aircraft shipped to Egypt in cases.
- (iii) Output of the repair units in the Delta.

B. Issues to :—

- (i) No. 136 Maintenance Unit, Berka.
- (ii) All No. 201 Group Squadrons.
- (iii) Squadrons operated by Air Defences Eastern Mediterranean, Derna (excluded) to Levant.
- (iv) Iraq, Aden, East Africa.
- (v) Operational Training Units, Middle East Training Schools, etc.
- (vi) Special, e.g. Aid to Turkey.

II. No. 136 Maintenance Unit, Berka

A. Receipts from :—

- (i) Delta Maintenance Units.
- (ii) Repair (Internal).

B. Issues to :—

- (i) No. 117 Maintenance Unit, Azizia.
- (ii) Aircraft Storage Unit controlled by North African Air Force.
- (iii) Local squadrons operated by Air Defences Eastern Mediterranean.

III. (a) No. 117 Maintenance Unit, Azizia

A. Receipts from :—

- (i) No. 136 Maintenance Unit, Berka
- (ii) Aircraft Pool controlled by Mediterranean Air Command.
- (iii) Repair (Tripolitania).

B. Issues to :—

- (i) Malta.
- (ii) Sicily.
- (iii) Any fighter squadrons of the Eastern Air Task Force based on the mainland.
- (iv) No. 51 Repair and Salvage Unit.
- (v) Local squadrons operated by Air Defences Eastern Mediterranean.

(b) U.S.A.A.F. Pool at Sorman

A. Receipts from :—

- (i) Aircraft Pool controlled by Mediterranean Air Command.
- (ii) Repair (Tripolitania).

B. Issues to :—

- (i) 57th and 79th Fighter Groups.

APPENDIX 39

HEADQUARTERS, NORTHWEST AFRICAN AIR SERVICE COMMAND

REPLACEMENT OF AIRCRAFT WASTAGE N.A.A.F.

Units Operating on the Mainland, Including Lampedusa and the 31st Fighter Group

The following instructions with regard to aircraft replacement during Operation Husky are based on Headquarters, Mediterranean Air Command letter MAC/S/7100 dated 30 May 1943 and cover arrangements for :—

- (i) The replacement of aircraft in Northwest African Air Forces' squadrons (R.A.F. and U.S.A.A.F.) operating from airfields on the mainland, including Lampedusa and the 31st Fighter Group.
- (ii) The replacement of aircraft in Northwest African Air Forces' squadrons (R.A.F. and U.S.A.A.F.) operating from airfields in Malta, Sicily or other overseas bases.

Allocation of Replacement Aircraft

Headquarters, Mediterranean Air Command—Central Allotments Bureau

2. The general allocation of replacement aircraft to Northwest African Air Forces is controlled by the Central Allotments Bureau at Headquarters, Mediterranean Air Command. This organisation has at its disposal British aircraft of all types, either erected at No. 145 M.U., Casablanca, or flown into North Africa from the United Kingdom. These aircraft are held, pending allocation by the Central Allotments Bureau, at No. 163 Maintenance Unit, Ras El Ma. Replacement aircraft of U.S. types erected at Casablanca (No. 3 Depot), Oran (No. 1 Depot) and Maison Blanche (No. 2 Depot) are also controlled by the Central Allotments Bureau.

Twin-engined and heavy bombers of the U.S.A.A.F. are flown from the United States to Marrakesh from whence they are distributed as required.

Headquarters, Northwest African Air Forces

3. The detailed distribution of replacement aircraft to units and squadrons of the Northwest African Air Forces operating on the mainland, including Lampedusa and the 31st Fighter Group, is carried out by Headquarters Northwest African Air Forces through Headquarters, Northwest African Air Service Command, in the case of Royal Air Force units and the Northwest African Training Command in the case of U.S. units, with the exception of 31st and 52nd Fighter Groups (U.S.) which are included with the Royal Air Force units.

Replacement Policy—Husky

4. The replacement policy for N.A.A.F. units operating in Malta and Sicily, except 31st Fighter Group, will be in accordance with M.E. Maintenance Instruction No. 3 dated 12 June 1943.

General Replacement Plan—N.A.A.F. Units Operating on the Mainland

5. The general plan for the replacement of aircraft wastage in Northwest African Air Forces' units and squadrons is as follows, including Lampedusa and 31st Fighter Group :—

British types

- (i) S.E. and T.E. aircraft of British types operating with British or U.S.A.A.F. squadrons, for Northwest African Air Forces' units will be ferried by No. 216 Group from No. 163 Maintenance Unit, Ras El Ma, to No. 162 Maintenance Unit, Sétif. No. 162 Maintenance Unit, Sétif, supplies replacements of British types for Northwest African Air Forces' squadrons operating from airfields on the mainland.

American types

- (ii) S.E. and T.E. fighters of U.S. types will be ferried to their destinations from the erecting depots at Casablanca, Oran, and Algiers by the Northwest African Training Command as directed by Headquarters, Northwest African Air Forces.
- (iii) T.E. and heavy bombers of U.S. types operated by British or U.S.A.A.F. squadrons on arrival at Marrakesh from the U.S. will be ferried to their destinations by Northwest African Training Command under Headquarters, Northwest African Air Forces, direction.

NOTE.—This does not include Boston or Hudson aircraft.

No. 162 Maintenance Unit, Sétif

6. No. 162 M.U., Sétif, is under the technical and administrative control of Headquarters, Northwest African Air Service, and is established to hold British S.E. fighters, T.E. bombers of light and medium types, and G.R. aircraft. The formations and units to be supplied with replacements from No. 162 M.U. will be as follows :—

(i) *Northwest African Tactical Air Force*

No. 326 (L.B.) Wing and its Squadrons	..	Bostons
No. 225 (Tac. R) Squadron	..	Spitfire V
No. 241 (Tac. R) Squadron	..	Hurribomber
*No. 600 (N.F.) Squadron	..	Beaufighter
31st Fighter Group	..	Spitfire V, VIII and IX
No. 2 S.A.A.F. Squadron	..	Spitfire V
No. 4 S.A.A.F. Squadron	..	Spitfire V

*Operating from Malta but reinforced from No. 162 M.U.

(ii) *Northwest African Coastal Air Force*

No. 323 (F) Wing and its Squadrons, including the 52nd (U.S.) Fighter Group and No. 255 (N.F.) Squadron	..	Spitfire V and IX Beaufighter
No. 328 (G.R.) Wing and its Squadrons	..	T.B. Beaufighter T.B. Wellington
Bône Sector	..	Hurricane Beaufighter
R.A.F. Station, Tafaroui	..	Hudson Bisley
R.A.F. Station, Blida	..	Hudson Bisley T.B. Wellington
R.A.F. Station, Bône	..	Hudson
R.A.F. Station, Maison Blanche	..	Beaufighter

(iii) *Northwest African Strategical Air Forces*

Wellingtons for the squadrons of Nos. 330 and 331 Wings will be flown direct to Kairouan in accordance with M.E. Maintenance Instruction No. 3 dated 12 June 1943.

(iv) *Northwest African Photographic Reconnaissance Wing*

No. 682 Squadron	..	Spitfire (P.R.)
------------------	----	-----------------

Ferrying Arrangements—Fighter Aircraft only

7. The Advanced Flying Unit at Sétif is to provide ferry pilots for No. 162 M.U. When pilots for ferrying duties are required the O.C., No. 162 M.U., is to call upon the C.O., Advanced Flying Unit, to make the requisite number available. Not less than 25 pilots are to be held ready for ferrying duties at all times.

8. The C.O., Advanced Flying Unit, is responsible for briefing arrangements in conjunction with the O.C., No. 162 M.U.

Transport Aircraft

9. Headquarters, Northwest African Air Service Command, will arrange the return of ferry pilots to Sétif after having delivered replacement aircraft to their destinations.

12th Air Support Command Pool, Korba North

10. This replacement aircraft pool will receive fighter aircraft ferried from No. 162 M.U., Sétif, and U.S. fighter types ferried by the Northwest African Training Command from rearward depots, for units of the 12th Air Support Command in Malta, Sicily and other bases. These units will be :—

<i>Formation or Unit</i>				<i>Type of aircraft</i>
324th Fighter Group	..	..	..	P.40
33rd Fighter Group	..	..	..	P.40
27th Fighter Group	..	..	..	P.36
86th Fighter Group	..	..	..	A.36
No. 111 Observation Squadron	..	..	..	P.51 and P.39

11. It will be the responsibility of Northwest African Training Command that this 12th Air Support Command Pool is supplied with replacements as required for delivery to the combat units, with the exception of Spitfire aircraft for 31st Fighter Group, which will be sent forward by N.A.A.S.C. on receipt of Daily States from Headquarters, N.A.T.A.F.

No. 117 Maintenance Unit, Sorman

12. See M.E. Maintenance Instruction No. 3 dated 12 June 1943.

Allocation of Repaired Aircraft

13. All S.E. aircraft from repair at N.A.A.S.C. Depots will be flown to No. 162 M.U., Sétif, and form part of that pool.

Method of Obtaining Replacement Aircraft

14. (i) *Single-engined Fighters (British types)*

Squadron reinforcing pools are located at :—

No. 110 R.S.U. for N.A.C.A.F.

No. 109 R.S.U. for N.A.T.A.F.

Korba North for N.A.T.A.F. for 31st Fighter Group (U.S.)

These pools are to hold the following immediate reserve aircraft :—

Coastal Air Force

Spitfire VB and C

.. 15

Spitfire IX

.. 6

Hurricane

.. 9

Coastal Air Force are responsible for reinforcing 52nd Fighter Group from their pool and this commitment has been covered in the strength laid down.

Tactical Air Force

Spitfire V

.. 7

Hurricane

.. 3

Held at No. 109 R.S.U.

Spitfire V

.. 7

Spitfire VIII or IX

.. 3

Held at Korba North for 31st Fighter Group.

Aircraft state reports from squadrons are to be repeated to commands as appropriate, who are responsible for allocation of aircraft from their own immediate reserve to squadrons.

Headquarters, Coastal Air Force, and Headquarters, Tactical Air Force, are to report to N.A.A.S.C. by telephone or teleprinter each night the state of their pool, by aircraft types, using code letters as under :—

Spitfire V	--	JB V
Spitfire IX	--	JB IX
Hurricane	--	OC 2

- A. Total serviceable.
- B. Total serviceable in 48 hours.
- C. Aircraft waiting to be flown in to No. 144 M.U.

A duty Royal Air Force clerk will be available at all times during the night to take the return on Ozark (Extension No. 133). Each morning, on receipt of above report, N.A.A.S.C. will issue allotments from No. 162 Maintenance Unit to bring aircraft pools up to strength. Aircraft reported under Category C above are to be flown in to No. 162 M.U. by ferry pilots who flew up new aircraft.

(ii) *Twin-engined British types, including also Boston and Hudson aircraft*

Headquarters, Coastal and Tactical Commands, are to report losses to N.A.A.S.C. who will allot and ferry replacement aircraft direct to squadron concerned as and when aircraft become available. Boston aircraft will be ferried to No. 109 R.S.U. for onward delivery to squadrons under N.A.T.A.F. instructions. Wellington aircraft for Strategical Air Force will be flown direct to Kairouan (see paragraph 6 (iii)).

15. No. 162 M.U. is to render a state report nightly to N.A.A.S.C., who are responsible for obtaining aircraft to cover their commitments.

Allotment Forms

16. All movements of aircraft are to be reported on Form 1623 to N.A.A.S.C. in the normal manner. These forms must be rendered by No. 162 M.U., command pools, and squadrons.

Returns

17. All existing returns are to be continued with the addition of those called for in paragraph 14 above.

Reference :
Z/II/E
27 June 1943

For the Commanding General.
E. L. RIDLEY, *Air Commodore*,
DEPUTY COMMANDER, N.A.A.S.C.

APPENDIX 40

EXTRACTS FROM MAINTENANCE INSTRUCTION No. 4 ORGANISATION IN 'FINANCE' (i.e. Malta)

General Policy

For Operation Husky the maintenance policy with regard to 'Finance' is as follows :—

- (a) *Supply.* To build up, prior to D minus 21, stocks of equipment of all kinds to cover the known increased commitments which will be placed on 'Finance' during Operation Husky.
- (b) *Repair.* To restrict the amount of repair work to be done in 'Finance' wherever possible and to use the maximum facilities existing on the mainland. This is necessary because of the limited repair capacity of 'Finance' in relation to the number of squadrons involved and the difficulty of moving both serviceable and unserviceable equipment, especially such items as aero-engines, into and out of 'Finance.'

Supply

Channels of Supply

2. The general policy for Operation Husky shows no change in the existing procedure of 'Finance' being supplied from the Middle East.

Aircraft Aero-Engines

3. A small stock of aero-engines has been built up in 'Finance.' However, the immediate reserve, both of aircraft and aero-engines, will be held in the 'Chimpanzee' area—aircraft at No. 117 M.U. and aero-engines at No. 114 M.U. The balance of the reserves will be held in the Delta.

Replacement aircraft will be ferried across from No. 117 M.U. and method of replacement will be as set out in Headquarters, Royal Air Force, M.E., Maintenance Instruction No. 3 dated 12 June 1943.

Mechanical Transport

4. Reserves of mechanical transport have been pre-dumped in 'Finance.' In addition, reinforcing squadrons and units will proceed complete with mechanical transport. In-transit units will confine their use of vehicles to a minimum.

Stores

5. Equipment has been issued to No. 143 M.U. to allow for reinforcing and in-transit units to draw on 'Finance's' stocks, thus leaving intact the range of stores which each unit will take to 'Finance.'

Supplies of long-range tanks for Kittyhawk and Spitfire aircraft have been pre-dumped in 'Finance' in accordance with assessments calculated by Force 545.

Explosives and Aviation Fuels

6. Stocks of explosives and aviation fuels have been pre-dumped on a scale more than sufficient to meet the requirements of 'Finance' for Operation Husky.

Oxygen

7. Four oxygen plants are being put into 'Finance' to meet the requirements of 'Finance' and 'Horried' until such time as sufficient plants are established in 'Horried' to make the latter place self-sufficient in oxygen. In addition to the four plants mentioned above the Navy has guaranteed to fill, for the Royal Air Force, up to 50 transit cylinders per week from their own static plant.

Stocks of oxygen bottles and cylinders are being sent to 'Finance' to make this supply responsibility a practical proposition for 'Finance.'

'Finance' will have to arrange the servicing of the plants in such a way that all four plants are in operation during the critical period D plus 2 to D plus 7.

Repair

Chain of Technical Maintenance (External)

8. (a) Aircraft requiring engine changes and repairs in excess of seven days will be flown to the mainland where possible. Procedure will be as follows :—

(i) Aircraft other than Kittyhawks to No. 113 M.U. (Castel Benito).

(ii) Kittyhawk aircraft to No. 159 M.U. (Mellaha).

No. 214 Group will be responsible for these aircraft on arrival at No. 113 M.U. or No. 159 M.U. and replacements will be issued to 'Finance.'

(b) Aircraft which cannot be flown will be transported to the mainland by air or sea at the first opportunity. Convoys for the Delta, 'Chimpanzee' and North Africa are to be used for the return of such aircraft. Spitfire IX and Mosquito unflyable Cat. II and Cat. III aircraft will be shipped to North Africa ports only.

Chain of Technical Maintenance (Internal)

9. The functions of the Maintenance Organisation in 'Finance' will be limited to :—

- | | | |
|--|---|-----------------------------|
| (a) Daily maintenance, servicing of aircraft and M.T. and repairs up to 48 hours. | } | In squadrons. |
| (b) Repairs of aircraft up to 7 days on site, including minor inspections and engine changes. | } | Maintenance Wing, 'Finance' |
| (c) Salvage and despatch of airframes, engines and accessories beyond 7 days. | } | Maintenance Wing, 'Finance' |
| (d) Complete overhaul of engines will not be undertaken, but changing of engine components and check test loading will be done in 'Finance.' | | |
| (e) M.T. repairs by M.T.R.S., Maintenance Wing, 'Finance.' | | |

Reference :
MS.103790/M.Plans
20 June 1943.

K. L. BOSWELL,
Air Commodore,
C.M.S.O.,
H.Q., R.A.F., M.E.

APPENDIX 41

PLAN FOR THE MOVEMENT OF NORTHWEST AFRICAN AIR FORCES INTO ITALIAN TERRITORY

Annexure—Total movement requirements during each phase, based on planned build-up of all air forces, plus maintenance commitment.

Intention

1. (a) To move the whole of the Tactical Air Force, the whole of the Strategic Air Force, elements of Coastal Air Force, the Photographic Reconnaissance Wing, and the Troop Carrier Command, together with most of the Service Command and other supporting services, on to the Italian mainland. Planned to be completed by the end of 1943, in phases.

(b) To move elements of Coastal Air Force into Sardinia and into Corsica at the earliest possible date, with supporting services.

(c) To move elements of Coastal Air Force into Sicily, with supporting services, to replace units moved from Sicily to the mainland and to Sardinia.

(d) To move Headquarters, Northwest African Air Forces, to a suitable location on the mainland as soon as the necessary accommodation and communications are established.

Planned Location of Air Forces

Tactical Air Force

2. Initially the Tactical Air Force will build up in the Naples area and in the Heel. The 12th Air Support Command will be located in the Naples area and the Desert Air Force in the Heel. Elements of the Tactical Bomber Force will be moved to Naples area or to the Heel, depending on the tactical situation. In general, the Tactical Bomber Force will be moved to the Naples area in preference to the Heel, but if the tactical situation does not permit early movement into the Naples area, the bomber forces will be moved initially into the Heel.

3. As the tactical situation allows, the elements of the Tactical Air Force in the Heel will move northward and before the end of the year the Tactical Air Force will be located as far north as possible.

Strategic Air Force

4. It is intended to locate the Strategic Air Force in the Foggia area as soon as possible. If the situation does not permit early movement direct into the Foggia area, movement of the Strategic Air Force into the Heel will commence as soon as airfield accommodation is available, units being moved on to the Foggia area as soon as conditions permit and accommodation becomes available.

5. Provision must be made for the rearming and refuelling of heavy bombers operating from the U.K. on a shuttle basis.

Coastal Air Force

6. Fighter Sectors will be formed :—

- (a) In the Naples area.
- (b) In the Foggia/Heel area.
- (c) In Sicily.
- (d) In Sardinia and Corsica.

7. Anti-shipping and anti-submarine units will be located in the Naples area and in Sardinia.

8. The location of Air/Sea Rescue units will be adjusted as the situation requires.
9. Readjustment of Coastal Air Force units in Northwest Africa will be made to suit the change in strategic position.

Troop Carrier Command

10. Units of the Troop Carrier Command will not be moved to the mainland of Italy until the movement of Tactical, Coastal and Strategic units has been completed. Individual troop carrier units may, however, be moved to the mainland or to Sardinia as required.

Training Command

11. The Training Command will remain in Northwest Africa, the location of its units being adjusted as advisable. It is the intention to move this Command into Tunisia as soon as the Strategic Air Force has moved from the area.

Northwest African Air Service Command

12. Elements of N.A.A.S.C. will move to the Italian mainland, to Sardinia, Corsica and Sicily to meet the requirements of the air forces in these localities. Command organisation will be adjusted to meet the changed distribution of Northwest African Air Forces, and the Command Headquarters will move to the mainland when the general situation and the provision of communications permit.

Northwest African Photographic Reconnaissance Wing

13. This Wing will be moved to the Italian mainland in stages as necessary, and will eventually be located adjacent to the Air Command Post.

Aviation Engineers

14. In view of the importance of providing all-weather airfields on the mainland of Italy, aviation engineers and engineer supplies will be moved to that area as soon as possible. Some commitments remain in Northwest Africa and there will be certain commitments in Sardinia, Corsica and Sicily. The effective operation of the Strategic, Tactical and Coastal Air Forces from the mainland of Italy during the winter months, however, depends to a large extent upon the provision of all-weather airfields. It is therefore intended that the bulk of the airfield construction effort during the next six months will be exerted on the Italian mainland, and particularly in the Foggia area.

Phasing of Movements to New Localities

15. The dates and order in which units of the various air forces and commands will move to their new bases must be determined to a large extent by :—

- (a) The general military situation, particularly in regard to the occupation of new areas.
- (b) The availability of airfields.
- (c) The allocation of shipping both for the movement and for the subsequent supply of the air forces.

For purposes of planning, the movement of the operational air forces will be phased as follows :—

Tactical Air Force

16. Movement into the Naples area has already commenced in accordance with the planned Avalanche build-up. It is, however, behind the planned schedule. Movement into the Heel area has also commenced. It is intended that the whole of the Tactical Air Force be located on the mainland of Italy by 15 October. If the availability of airfields in the Naples area slows up the build-up in this area, the build-up in the Heel will be increased, units moving forward as soon as circumstances allow.

Strategic Air Force

17. It is planned that Strategic Air Force should commence to move to the mainland approximately 15 October, the move to be completed by 1 December. If this is not possible, units will be moved initially into the Heel area, subsequently advancing to the Foggia area. It may be decided, if movement to the mainland is slow, to utilise advanced landing grounds in Sardinia during the interim period to extend the range of the Strategic Air Force, and particularly the medium day bombers, from Northwest Africa. Decision on this point will depend upon the general situation and the position in Sardinia. In order that this course can be adopted if required, it is intended to place into Sardinia as soon as possible sufficient supplies to enable the medium bombers, two groups of P-38s, and one group of P-40s to operate at 50 per cent. sustained effort for one month.

Coastal Air Force

18. The movement of Coastal Air Force units into the Naples area, into the Heel, into Sardinia and Corsica and into Sicily, will depend upon the development of the general situation in each area. For planning, the following is the general movements plan.

(a) Into the Naples area

No. 242 R.A.F. Group, controlling :—

No. 323 Wing.

(Nos. 253, 73 and 32 Spitfire Squadrons and No. 255 Night Fighter (Beaufighter) Squadron.)

No. 325 G.R. Wing

(No. 608 (Hudson) and No. 52 (Baltimore) Squadrons.)

Movement to be completed by 15 October.

(b) Into the Taranto/Foggia area

No. 287 Wing.

Three R.A.F. S.E. fighter squadrons (Spitfires).

One U.S. night fighter squadron (Beaufighters).

The night fighter squadron (No. 416) is due to move in almost immediately ; the remaining units to move in as soon as the tactical situation allows. It is planned that this movement should be completed not later than the end of October.

(c) Into Sardinia

62nd U.S. Air Defense Wing.

52nd U.S. Group (three Spitfire squadrons).

No. 328 R.A.F. Wing

(No. 14 Squadron (Marauders), No. 458 Squadron (ASV Wellingtons),

No. 39 Squadron (Torpedo Beaufighters), No. 47 Squadron (Torpedo Beaufighters).)

It is planned that movement of these units be completed within fourteen days of the island being ready to receive air forces. Half of No. 608 Squadron may be moved from Naples to Sardinia at a later date.

(d) Into Corsica

Two fighter squadrons (probably French Spitfires) are likely to be moved into this island as soon as circumstances permit, operating under the 62nd U.S. Air Defense Wing.

(e) Into Sicily

As units move from Sicily to other locations, it will probably be necessary to move in certain Coastal Air Force units from Northwest Africa. No. 87 A.F. Squadron (Hurricane) should move to Sicily as soon as facilities become available, and one other Hurricane squadron is likely to be required. Two Coastal Beaufighter squadrons are also likely to remain in Sicily for some time. Two sub-sectors will be formed to

control these units. No specified date can be given for the completion of these movements as they will depend upon the movements from Sicily to Sardinia and to the mainland. The readjustment, however, should be completed by the end of October.

Note.—Should progress in the Naples area continue to be slow and events in the Heel and in Sardinia move fast, it may be necessary to make adjustments at short notice in the Coastal Air Force movement programme.

Troop Carrier Command

19. Troop Carrier Command will continue to operate from advanced bases in Sicily and may gradually transfer its main bases to that island. Movement to the mainland is not expected to commence until after 1 December.

Aviation Engineer Battalions

20. Five aviation engineer battalions are expected to be moved into the mainland by 8 October. Additional battalions to bring the total up to nine are planned to move in by early November. Facilities will be available to undertake a limited amount of airfield improvement in Sardinia.

Units Remaining in Northwest Africa

21. The readjustment of locations of air force units remaining in Northwest Africa will be the subject of a separate memorandum.

Movement and Supply Requirements

22. Based on the above general programme, the total requirements during each phase based on the planned build-up periods for each air force, command, etc., are given in the Annexure.

In the case of the Strategic Air Force, the requirements include an assessed commitment for the refuelling and rearming of heavy bombers operating from the U.K. The requirements of airfield construction materials, based on the provision of all-weather airfields at the maximum rate probable with the aviation engineer battalions available, are also included.

23. Requirements of each air force and for airfield construction are shown separately so that adjustments can readily be made if circumstances call for a revision of the planned rate of build-up of each air force. Detailed lists of priorities for the movement of units will be compiled separately. There will be certain additional requirements, particularly for signals units and service commando units and materials, which have not been included in the assessments. These assessments do, however, form a reasonable basis for planning.

By command of Lieutenant-General Spaatz.

E. P. CURTIS,
Brigadier-General,
Chief of Staff.

15 September, 1943.

ANNEXURE
SUMMARY OF MOVEMENT REQUIREMENTS BASED ON
PLANNED BUILD-UP OF ALL AIR FORCES, PLUS
MAINTENANCE COMMITMENT

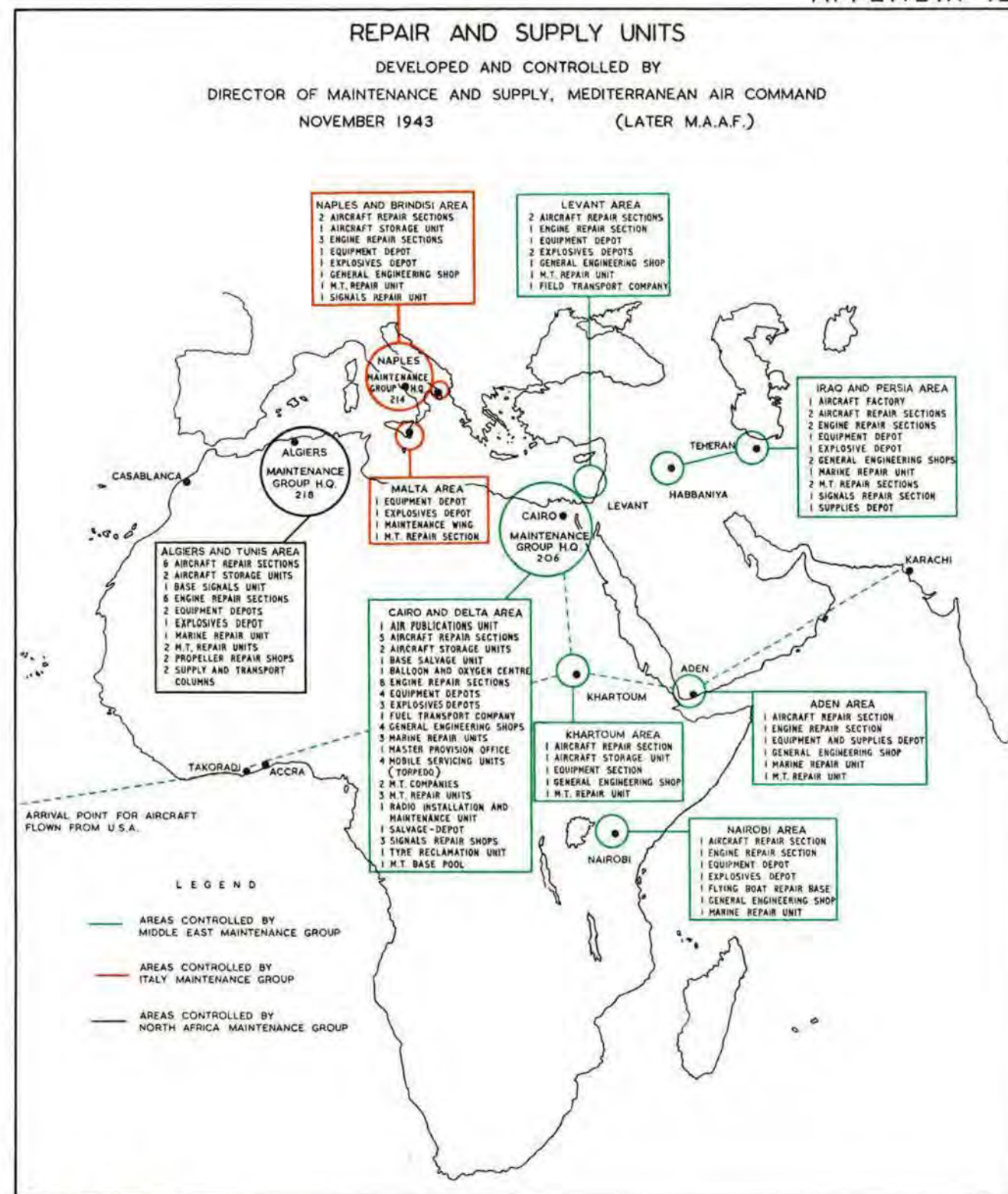
Movements	Personnel	Vehicles	TBA D/Wt.	Daily Main- tenance D/Wt.
<i>Tactical Air Force to Italy</i>			tons	tons
9-25 Sept.	12,022	2,404	1,845	381
26 Sept.-5 Oct.	9,758	2,030	680	357
6-15 Oct.	11,445	2,400	930	520
	33,225	6,834	3,455	1,258
<i>Strategic Air Force to Italy</i>				
15-25 Oct.	13,440	3,450	2,900	550
26 Oct.-5 Nov.	7,226	1,150	1,280	440
6-15 Nov.	13,780	2,330	2,800	800
16-30 Nov.	7,820	1,160	300	430
1 Dec. onwards (approx.) ..	5,400	825	—	545
	47,666	8,915	7,280	2,765
<i>Coastal Air Force</i>				
<i>By 15 October</i>				
To Italy (Naples area) ..	4,573	810	790	109
To Italy (Heel area) ..	3,650	646	1,278	71
<i>Dates as required</i>				
To Sardinia	6,090	1,238	1,444	161
To Corsica	462	62	—	16
<i>By 31 October</i>				
To Sicily	1,752	272	40	59
	16,527	3,028	3,552	416
<i>Troop Carrier Command</i>				
<i>Dates as required</i>				
To Italy	11,742	2,787	2,272	302
<i>Aviation Engineers to Italy</i>			Con- struction materials	
9 Sept.-October	2,995	690	23,000	135
During October	1,338	352	21,000	70
During November	3,534	1,035	30,000	206
During December	—	—	30,000	—
	7,867	2,077	104,000	411
<i>Totals</i>				
Tactical Air Force	33,225	6,834	3,455	1,258
Strategic Air Force	47,666	8,915	7,280	2,765
Coastal Air Force	16,527	3,028	3,552	416
Troop Carrier Command	11,742	2,787	2,272	302
Aviation Engineers	7,867	2,077	104,000	411
	117,027	23,641	120,559	5,152

ANNEXURE—continued.

MAINTENANCE TONNAGE REQUIREMENTS FOR EACH PHASE—15 SEPTEMBER TO 31 DECEMBER

	15-30 Sept.	1-15 Oct.	16-31 Oct.	1-15 Nov.	16-30 Nov.	1-15 Dec.	16-31 Dec.	Total
Tactical Air Force.. ..	7,515	16,315	20,176	18,915	18,915	18,915	20,176	120,927
Strategic Air Force	—	—	11,440	22,850	33,300	41,475	44,240	153,305
Coastal Air Force	1,350	2,025	2,880	2,700	2,700	2,700	2,880	17,235
Troop Carrier Command	—	—	—	—	—	4,530	4,832	9,362
Aviation Engineers	2,025	3,075	3,280	6,165	6,165	6,165	6,576	33,451
Total Italy	10,890	21,415	37,776	50,630	61,080	73,785	78,704	334,280
<i>Movements to Sardinia</i>								
Coastal Air Force	—	—	2,576	2,415	2,415	2,415	2,576	12,397
<i>Movements to Corsica</i>								
Coastal Air Force	—	—	—	240	240	240	256	976
Grand Total	10,890	21,415	40,352	53,285	63,735	76,440	81,536	347,653
Average daily maintenance tonnage during each phase*	726	1,428	2,521	3,552	4,249	5,096	4,971	—

* In addition to the average daily maintenance tonnage there is a commitment averaging 972 tons per day for airfield construction materials.



APPENDIX 43

M.A.A.F. AND M.E. REPAIR ORGANISATION
AIRFRAMES, ENGINES AND PROPELLERS
APRIL 1944

Command	Headquarters	M.U. No.	Location	Airframe
M.A.A.F.	No. 214 Gp. (Italy)	110	Brindisi ..	Principally Spitfire fly-ins ; also Austers, etc. Planned for 60 British S.E. and 20 British T.E. per month.
		113	Naples ..	Nil.
		159	Brindisi ..	Principally Kittyhawks ; also Bostons, Baltimores, etc. Planned for 35/40 American S.E. and T.E. per month.
M.A.A.F.	No. 218 Gp. (North Africa)	144	Maison Blanche	Planned for 60 Spitfires, 10 Kittyhawks, 5 Dakotas, 8 Halifaxes and 6 Liberators per month.
		185	Sétif ..	Beaufighters, 50 per month, Baltimores, 10 per month, Bostons, 10 per month.
		156	Blida ..	Wellingtons, Hudsons, Blenheims, Marauders and Warwicks. Planned for 60 per month. Final assembly of Mosquitos from F.T.L.U. Boufarik.
		167	Bizerta ..	Wellington M.I.s, 10 per month.
		F.T.L.U.	Blida ..	Spitfires, 60 per month.
		"	Boufarik ..	All Mosquitos from Nos. 214 and 218 Groups, 3 per month.
		Fr. C.R.R.A.	Casablanca	Spitfire jig repairs, 50 per month. All Hurricanes from Nos. 214 and 218 Groups.
M.A.A.F.	A.H.Q., Malta	137	Malta ..	Certain types based in Malta.
		118	Catania (Sicily)	Advanced R.D. up to 21 days. Spitfires, etc.
M.E.	No. 206 Gp.	103	Aboukir (Egypt)	Principally Spitfires, also Hurricanes, Ansons, Walruses, etc.
		107	Kasfareet (Egypt)	Baltimores and Venturas.
		109	Boulac (Egypt)	Nil.
		111	Tura (Egypt)	Nil.
	H.Q., M.E.	139	Khartoum (Sudan)	Miscellaneous local arisings.

M.A.A.F. AND M.E. REPAIR ORGANISATION—*contd.*

Command	Headquarters	M.U. No.	Location	Airframe
M.E.	No. 206 Gp.	157	Helwan (Egypt)	Baltimores only.
		158	Helwan (Egypt)	Hurricanes only.
		168	Heliopolis (Egypt)	Beaufighters, Hudsons, Harvards, Kittyhawks, Wellingtons and Liberators.
		5 E.R.S.	Mansourah (Egypt)	Nil.
M.E.	A.H.Q., E. Med.	136	Berka (Cyrenaica)	Advanced R.D. for types in area.
M.E.	H.Q., British Forces, Aden	131	Khormaksar (Aden)	Blenheims
M.E.	A.H.Q., Levant	160	Aqir ..	Wellingtons, Hurricanes, etc., from O.T.U.s.
		166	Nicosia (Cyprus)	Beaufighters, Hurricanes, etc.
		6 E.R.S.	Ramleh (Levant)	Nil.
M.E.	A.H.Q., Iraq and Persia	134	Habbaniya	Miscellaneous local arisings.
		138	Teheran (Iran)	Audaxes, Hinds and Tiger Moths from Iranian Air Force.
M.E.	A.H.Q., East Africa	133	Eastleigh (Kenya)	Miscellaneous local arisings.
		F.B. Base	Kisumu (Kenya)	Catalinas.

Aircraft Erection

S.M.1(b)/7/2/6.

Command	Headquarters	M.U. No.	Location	Function
M.A.A.F.	No. 214 Gp.	110	Brindisi ..	Erection of Austers.
	No. 218 Gp.	114	Maison Blanche	Erection of Austers, Argus.
M.E.	No. 206 Gp.	145	Casablanca	A.A.U. Spitfires, 100 p.m.
		103	Aboukir ..	Erection of Ansons
		108	Kasfareet ..	Erection of Kittyhawks and non-operational aircraft.
	A.H.Q., Iraq	119	Shaibah ..	A.A.U. Hurricanes.

M.A.A.F. AND M.E. REPAIR ORGANISATION—*contd.*

Aircraft Storage

Command	Headquarters	M.U. No.	Location	Function
M.A.A.F.	No. 214 Gp.	117	Bari ..	A.S.U. for 60 S.E. and 50 T.E.
	No. 218 Gp.	162	Sétif ..	A.S.U. for 200 S.E. and 200 T.E.
		163	Oujda ..	A.S.U. for 150 S.E.
	A.H.A., Malta	118	Catania ..	Stores 80 S.E.F.
M.E.	No. 206 Gp.	108	Kasfareet ..	A.S.U. for trainers, etc.
		132	Helwan ..	A.S.U. for Hurricanes, Spitfires.
		135	Gebel Hamzi	A.S.U. for all types.
	H.Q., M.E.	139	Khartoum	A.S.U.
	A.H.Q., Levant	104	Aleppo ..	Reserve aircraft pool.

Transport Repair

M.A.A.F.	No. 218 Gp.	1	Maison	Transport and reinforcement
		T.A.R.U.	Blanche	aircraft.
M.E.	No. 206 Gp.	2	Kabrit ..	" "
		T.A.R.U.		
	A.H.Q., Iraq	3	Habbaniya	" "
		T.A.R.U.		

Repair of Aircraft Ancillaries

Command	M.U.	Location	Elec. Accs.	Guns	Tur- rets	Radio	Radar	Insts.	Safety Eq.
M.A.A.F.	No. 110	Brindisi	x	—	—	x	x	x	—
	No. 113	Naples ..	x	x	x	—	—	x	x
	No. 159	Brindisi	x	x	—	—	—	x	—
	No. 144	Maison Blanche	x	x	—	x	x	x	x
	No. 155	Sétif ..	—	x	—	x	x	—	—
	No. 156	Blida ..	x	x	—	x	x	x	—
	No. 167	Bizerta	—	—	x	—	—	—	—
	F.T.L.U.	Blida ..	x	x	—	x	x	x	—
	No. 137	Malta ..	—	x	—	—	—	—	—
M.E.	No. 103	Aboukir	x	—	—	x	x	x	x
	No. 107	Kasfareet	x	x	—	x	x	x	x
	No. 109	Boulac ..	—	x	x	—	—	—	—
	No. 111	Tura ..	x	—	—	x	—	—	x
	No. 160	Aqir ..	x	x	x	x	x	x	x

NOTE—Nos. 131, 133, 134, 136 and 139 M.U.s in M.E. dealt with local arisings only of certain aircraft ancillaries.

APPENDIX 44

THE LOCATION OF THE PRINCIPAL UNITS OF No. 214 GROUP IN ITALY¹ 9 JUNE 1944

<i>Unit</i>	<i>Location</i>	<i>Remarks</i>
Groups		
No. 214 Group H.Q.	Naples	
No. 214 Group (Rear Detachment)	Bari	Co-ordination of No. 214 Group units in East Italy.
Base Areas		
No. 2 R.A.F. Base Area ..	Rome	
No. 3 R.A.F. Base Area ..	Portici	Closed down 7 June.
Wings		
No. 276 Wing	Conversano	Admin. control of ten field units—Algiers, Corsica, etc.
No. 334 Wing	Brindisi	Admin. control of two squadrons.
No. 336 (P.R.) Wing	San Severo	Admin. control of three squadrons.
No. 249 Wing	Portici	Admin.
No. 1320 R.A.F. Regiment Wg. (Advanced H.Q.)	Pastinelle	Three field squadrons and one L.A.A. squadron.
No. 1320 (Rear H.Q.)	Villino Blum	
Rest and Leave Camps		
No. 2 Rest and Leave camp ..	Sorrento	
No. 4 " " " " ..	San Spirito (Bari)	
No. 15 " " " " ..	Sorrento	
Maintenance Units		
No. 110 M.U. H.Q.	Brindisi	
No. 110 " 'A' Det.	Foggia	
No. 110 " 'B' Det.	Vasto	
No. 113 " H.Q.	Capodichino	
No. 113 " (No. 1 Echelon)	Capodichino	
No. 113 " (No. 2 Echelon)	Castellammare	
No. 114 " H.Q.	Naples	
No. 114 " (M.T.S.U.)	Kilo 12, Foggia/Lucera Road	
No. 117 " H.Q.	Bari	
No. 124 " H.Q.	San Severo	
No. 124 " (No. 1 Sub-Park)	14 miles North Foggia	
No. 124 " (No. 2 Sub-Park)	6 miles North Cerignola	
No. 141 " H.Q.	Caserta	
No. 141 " ('B' Park)	San Nicandio (Bari)	
No. 159 " H.Q.	Capodichino	

¹ No. 214 Group O.R.B. Appendices.

<i>Unit</i>	<i>Location</i>	<i>Remarks</i>
Transit Centres		
No. 3 Base Personnel Depot ..	Portici	
R.A.F. Transit Camp	Taranto	
Officers' and N.C.O.s' Transit Mess	Naples	
Supply and Transport Columns		
No. 6 S. and T.C.	2 miles from Bari	Nos. 13, 15 M.T.L.R.U.s
No. 8	Saviano	and No. 54 M.T. Com-
No. 9	Naples	pany forming.
Signals Units		
Seven Signals Units	Italy	
Bomb Disposal Units		
H.Q., No. 5136 B.D. Squadron	Naples	Fourteen detachments scattered throughout Italy.
Film Production Units		
No. 2 F.P.U. H.Q.	Naples	
Embarkation Units		
Nos. 61, 67, 90, 91 and 92 ..	Italian Ports	
Medical Units		
Nos. 1, 4 and 31	Naples, Foggia, Bari	
Parachute Units		
Three	Italy	
Concealment and Decoy		
No. 5	Naples	
Base Salvage Units		
One (Advanced Section) ..	2 miles from Foggia	
Oxygen Production Centres		
No. 2 O.P.C.	Naples	
Detachment		
Schools		
R.A.F. Gas School	Foggia	Attached to 5 C.M.L (U.S.A.A.F.).
Miscellaneous Units		
Seven	Naples	

APPENDIX 45
STATISTICS
BASE AIR FORCES SOUTH EAST ASIA
OCTOBER 1943 TO AUGUST 1945
MECHANICAL TRANSPORT—REPAIRS

Month (1)	Input (2)	Productive Output (3)	Balance held at month end (4)
1944			
January	4,022	3,732	1,756
February	3,505	3,470	1,791
March	3,822	4,245	1,368
April	3,718	3,683	1,403
May	4,849	4,548	1,704
June	4,406	4,262	1,848
July	4,050	4,287	2,044
August	4,836	4,805	2,075
September	4,528	4,334	2,269
October	4,829	4,669	2,429
November	5,623	5,087	2,965
December	4,731	4,754	2,942
1945			
January	5,536	5,445	3,033
February	5,335	4,907	3,194
March	6,281	5,856	3,511
April	5,591	5,758	3,344
May	5,834	5,387	3,791
June	4,887	5,178	3,500
July	Returns incomplete		
August			

AERO-ENGINES REPAIRED IN BASE DEPOTS

Month (1)	Input (2)	Productive Output (3)	Balance held at month end (4)
1943			
November ..	221	282	1,131
December ..	226	235	1,122
1944			
January	212	248	1,086
February	211	209	1,088
March	240	220	1,108
April	363	226	1,245
May	257	251	1,251
June	543	319	1,475
July	229	270	1,434
August	431	384	1,481
September ..	434	303	1,612
October	504	417	1,224 ^φ
November ..	503	613	911 ^φ
December ..	268	289	890
1945			
January	369	303	956
February	313	296	973
March	704	429	1,248
April	492	377	1,363
May	459	457	1,365
June	439	323	1,481
July	369	325	1,525
August	391	367	1,549

^φ Figures adjusted to allow for obsolete engines struck off charge.

**MONTHLY INPUT AND OUTPUT OF AIRCRAFT STORAGE UNITS
AND RESERVE AIRCRAFT POOLS**

Month (1)	A.S.U.s		R.A.P.s		Total	
	In (2)	Out (3)	In (4)	Out (5)	In (6)	Out (7)
1943						
December ..	275	248	141	90	416	338
1944						
January ..	388	284	94	113	482	397
February ..	468	312	122	160	590	472
March ..	433	411	215	202	648	613
April ..	512	378	180	207	692	585
May ..	356	314	146	161	502	475
June ..	244	250	96	133	340	383
July ..	380	272	84	106	464	378
August ..	367	299	114	114	481	413
September ..	280	482	112	96	392	579
October ..	497	387	162	152	659	519
November ..	389	462	108	149	497	611
December ..	291	392	157	147	448	539
1945						
January ..	442	522	155	183	597	705
February ..	434	368	106	118	540	486
March ..	484	508	99	126	583	634
April ..	248	267	79	77	327	344
May ..	103	210	155	111	258	321
June ..	239	258	52	70	291	328
July ..	158	190	51	65	209	255
August ..	247	256	59	50	306	306

NOTE—A.S.U.s=Aircraft Storage Units. R.A.P.s=Reserve Aircraft Pools.
Flying-boats are not included.

AIRFRAMES REPAIRED IN BASE REPAIR DEPOTS

Month (1)	Input (2)	Productive Output (3)	Balance held at month end (4)
1943			
October ..	—	—	—
November ..	76	93	464
December ..	107	74	497
1944			
January ..	190	85	602
February ..	207	148	661
March ..	187	141	707
April ..	192	124	775
May ..	287	215	847
June ..	283	202	928
July ..	164	123	969
August ..	281	193	599
September ..	114	163	550
October ..	107	110	547
November ..	290	196	641
December ..	164	124	681
1945			
January ..	66	134	613
February ..	183	159	637
March ..	274	220	691
April ..	74	172	593
May ..	30	161	462
June ..	37	98	401
July ..	140	120	421
August ..	89	169	341

AIRCRAFT RECEIVED AND TAKEN ON CHARGE

Month (1)	Cased/Deck Cargo (2)	Fly-ins (3)	Receipts from Misc. Sources (4)	Total (5)
1943				
October	170	87	81	338
November	217	155	3	375
December	223	150	—	373
1944				
January	407	174	—	581
February	219	139	—	358
March	339	153	—	492
April	140	200	1	341
May	241	188	—	429
June	237	150	4	391
July	340	110	—	450
August	163	128	—	291
September	121	131	—	252
October	181	164	—	345
November	196	194	—	390
December	127	95	—	222
1945				
January	141	102	—	243
February	84	112	1	197
March	129	135	—	264
April	68	113	7	188
May	101	138	14	253
June	97	122	—	219
July	87	112	—	199
August	145	139	3	287

AIRFRAMES REPAIRED IN FIELD UNITS (R.S.U.s, Etc.)

Month (1)	Input (2)	Productive Output (3)	Balance held at month end (4)
1943			
November ..	81	60	249
December ..	205	153	301
1944			
January ..	98	99	300
February ..	200	156	344
March ..	229	197	376
April ..	270	208	438
May ..	527	554	411
June ..	419	405	425
July ..	194	261	358
August ..	139	182	315
September ..	229	195	349
October ..	248	225	372
November ..	514	368	518
December ..	359	257	620
1945			
January ..	293	291	622
February ..	305	327	600
March ..	309	447	662
April ..	263	332	593
May ..	313	379	527
June ..	214	204	537
July ..	140	205	472
August ..	160	218	414

CASED AIRCRAFT ERECTED

Month (1)	Input (2)	Productive Output (3)	Balance held at month end (4)
1943			
October	178	304	496
November	188	218	466
December	185	212	439
1944			
January	409	336	512
February	245	247	510
March	263	269	504
April	207	234	477
May	269	207	539
June	176	191	524
July	287	132	679
August	198	124	753
September	160	234	652
October	137	169	615
November	188	187	695
December	196	161	634
1945			
January	125	146	608
February	104	164	539
March	123	212	446
April	67	132	373
May	100	115	351
June	97	77	367
July	87	48	406
August	145	168	383

NOTE—Col. 4 adjusted to exclude any aircraft written off/struck off charge.

DISPOSITION OF COMMAND HOLDING OF AIRCRAFT

Month	Flying Units			Maintenance Units			A.S.O.	Command Total
	Opn'l	Non-Opn'l	Total	In Erection A.S.U.s, R.A.P.s and Transit etc.	In Repair Units	Total		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1943								
October ..	840	683	1,523	—	—	2,011	—	3,534
November ..	935	721	1,656	1,480	713	2,193	—	3,849
December ..	1,014	793	1,807	1,511	798	2,309	—	4,116
1944								
January ..	1,031	832	1,863	1,849	902	2,751	—	4,614
February ..	1,029	869	1,898	2,016	1,005	3,021	—	4,919
March ..	1,122	941	2,063	1,942	1,083	3,025	—	5,088
April ..	1,110	960	2,070	2,073	1,213	3,286	—	5,356
May ..	1,170	967	2,137	2,242	1,258	3,500	—	5,637
June ..	1,177	1,069	2,246	2,278	1,353	3,631	—	5,877
July ..	1,194	1,049	2,243	2,414	1,327	3,741	—	5,984
August ..	1,170	1,098	2,268	2,580	914	3,494	166	5,928
September ..	1,185	1,066	2,251	2,409	899	3,308	266	5,825
October ..	1,245	1,053	2,298	2,267	919	3,186	348	5,832
November ..	1,201	1,006	2,207	2,165	1,159	3,324	105	5,636
December ..	1,246	1,035	2,281	2,037	1,301	3,338	203	5,822
1945								
January ..	1,257	1,154	2,411	2,032	1,235	3,267	85	5,763
February ..	1,343	1,108	2,451	2,040	1,237	3,277	70	5,798
March ..	1,360	1,115	2,475	1,819	1,353	3,172	232	5,879
April ..	1,391	1,165	2,556	1,689	1,186	2,875	158	5,589
May ..	1,363	1,183	2,546	1,649	989	2,638	143	5,327
June ..	1,338	1,084	2,422	1,526	938	2,464	246	5,132
July ..	1,358	1,080	2,438	1,485	893	2,378	209	5,025
August ..	1,315	1,122	2,437	1,611	755	2,366	186	4,989

