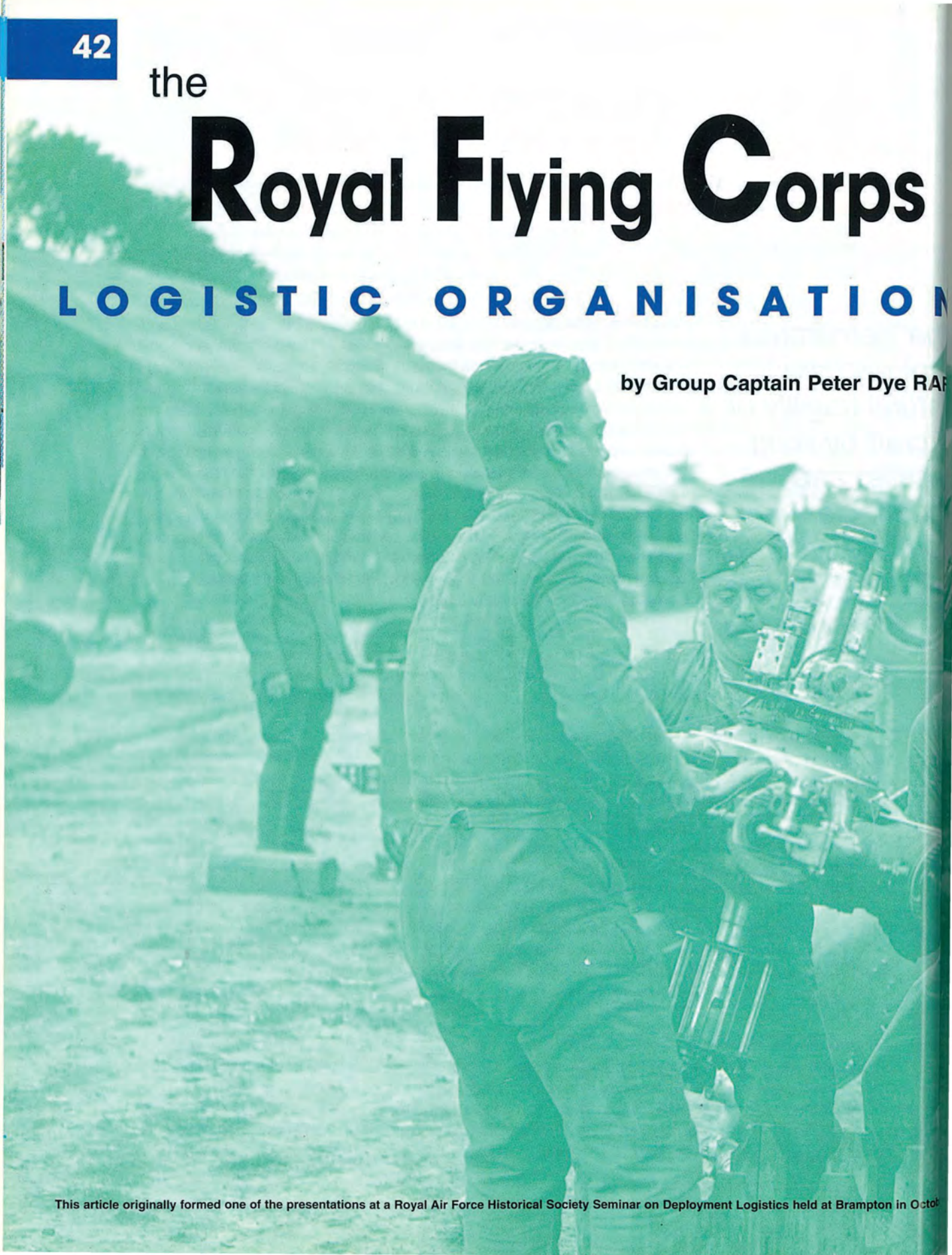
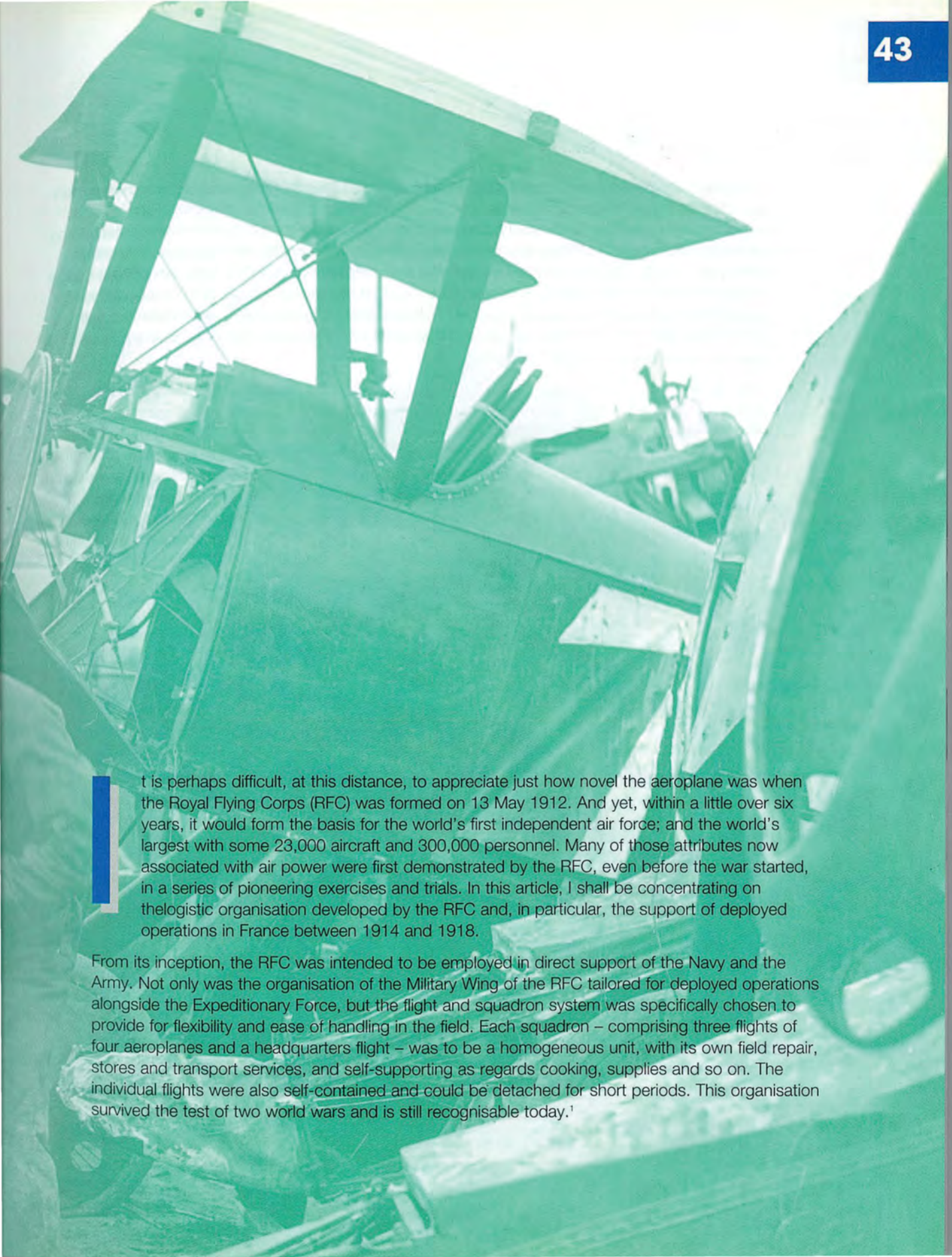
the Royal Flying Corps

LOGISTIC ORGANISATION

by Group Captain Peter Dye RAF



This article originally formed one of the presentations at a Royal Air Force Historical Society Seminar on Deployment Logistics held at Brampton in Octob



It is perhaps difficult, at this distance, to appreciate just how novel the aeroplane was when the Royal Flying Corps (RFC) was formed on 13 May 1912. And yet, within a little over six years, it would form the basis for the world's first independent air force; and the world's largest with some 23,000 aircraft and 300,000 personnel. Many of those attributes now associated with air power were first demonstrated by the RFC, even before the war started, in a series of pioneering exercises and trials. In this article, I shall be concentrating on thelogistic organisation developed by the RFC and, in particular, the support of deployed operations in France between 1914 and 1918.

From its inception, the RFC was intended to be employed in direct support of the Navy and the Army. Not only was the organisation of the Military Wing of the RFC tailored for deployed operations alongside the Expeditionary Force, but the flight and squadron system was specifically chosen to provide for flexibility and ease of handling in the field. Each squadron – comprising three flights of four aeroplanes and a headquarters flight – was to be a homogeneous unit, with its own field repair, stores and transport services, and self-supporting as regards cooking, supplies and so on. The individual flights were also self-contained and could be detached for short periods. This organisation survived the test of two world wars and is still recognisable today.[1]

The early aeroplanes were delicate, fragile and unreliable. Their integrity deteriorated rapidly when exposed to the elements such that hangarage was essential to provide protection for both machines and mechanics. The technologies involved were extremely high for the time, demanding skills and equipment that were not readily available. Engine lives were short, requiring thorough overhaul after a comparatively brief period. Effective support was made all the more difficult by the proliferation of aircraft and engine types and the lack of standard components. To enable the squadrons to function effectively in the field the logistic organisation had to be mobile and self-contained, although it was also recognised that, even with these arrangements, only a proportion of aircraft would be available for operations.[2]

The key was motor transport – itself a fledgling technology. By the time of the Military Wing's famous Concentration Camp at Netheravon in June 1914, each squadron had a wartime establishment of 26 lorries and tenders, together with 6 motorcycles and trailers.[3] The need for these vehicles had been clearly demonstrated in successive exercises; but in peacetime affordability was the main issue.[4] A novel scheme was therefore introduced, at the behest of the Treasury, under which up to half of the lorries were provided by subsidy. This operated on the basis of a grant (£50 towards purchase and £20 per annum for maintenance to agreed standards) paid to participating firms with the understanding that, in an emergency, the Army would purchase the vehicle for full-

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time use. When war was declared there were over 1,000 vehicles registered under the scheme, many of which were destined for the RFC and subsequently appeared in France still sporting their commercial colours; including No 5 Sqn's brilliant scarlet lorry, previously operated by Maple's store, advertising *'HP' Sauce – The World's Appetiser.* Not surprisingly, such incongruous sights fostered the belief that the RFC was woefully unprepared for war. In fact, it was evidence of an innovative and pragmatic solution to that perennial problem – matching resources to needs.[5]

Even before the war, it was recognised that squadrons could not support themselves for more than a limited period in the field and that a facility was required – close to the Army's operations – capable of undertaking a greater depth of repair and holding a wide range of spares and equipment. These needs were met by a Line of Communications Workshop which became known as the Flying Depot, and later the Aircraft Park, based at Farnborough and comprising separate stores and workshop sections capable of packing up and moving in 24 hours. On the outbreak of war, the Aircraft Park deployed to France to support the squadrons in the field, arriving at Boulogne on 18 August 1914.[6] The Official History records that, on disembarkation, the port landing officer sent an urgent wire to General Headquarters:

> An unnumbered unit without aeroplanes which calls itself an Aircraft Park has arrived. What are we to do with it?

Despite this initial hiccup, the Aircraft Park proved itself invaluable in sustaining the four deployed RFC squadrons. It was, in effect, their travelling base and as such was constantly on the move. Eventually, at the end of October, after five changes in location, the Aircraft Park found itself at St Omer where it would remain for much of the war.[7]

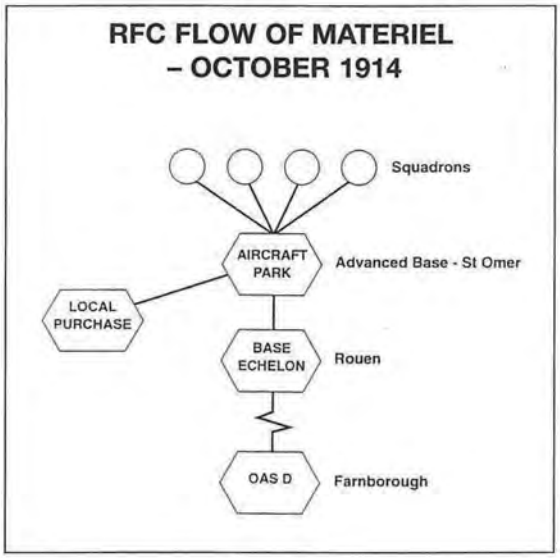

Figure 1

By the end of 1914, the system for the supply of materiel to the squadrons in the field was as depicted as shown at (Figure 1). Two aspects are worthy of note. First, a considerable quantity of materiel was purchased directly in France and delivered to the Aircraft Park for formal acceptance and issue. This included aircraft as well as engines, wireless equipment and a wide range of aeronautical stores. Such was the urgency of the RFC's needs that, in the first 6 months of the war, 100 complete aircraft were purchased from French manufacturers, part of a total of 1,500 airframes of various types purchased in France during the course of the war. The employment of these aircraft and associated equipment, whilst of significant operational benefit, considerably complicated the Aircraft Park's logistic efforts, particularly the interchangeability (or lack of it) between British and French-sourced components.[8]

The second point I would like to make, is that all other stores for the Aircraft Park were issued by the Ordnance Aeronautical Stores Department (OASD), part of the Army Ordnance Department, based at Farnborough. Their supplies were obtained either by direct purchase or from the Royal Aircraft Factory.[9] The increasing range and quantities of material that had to be handled led to the

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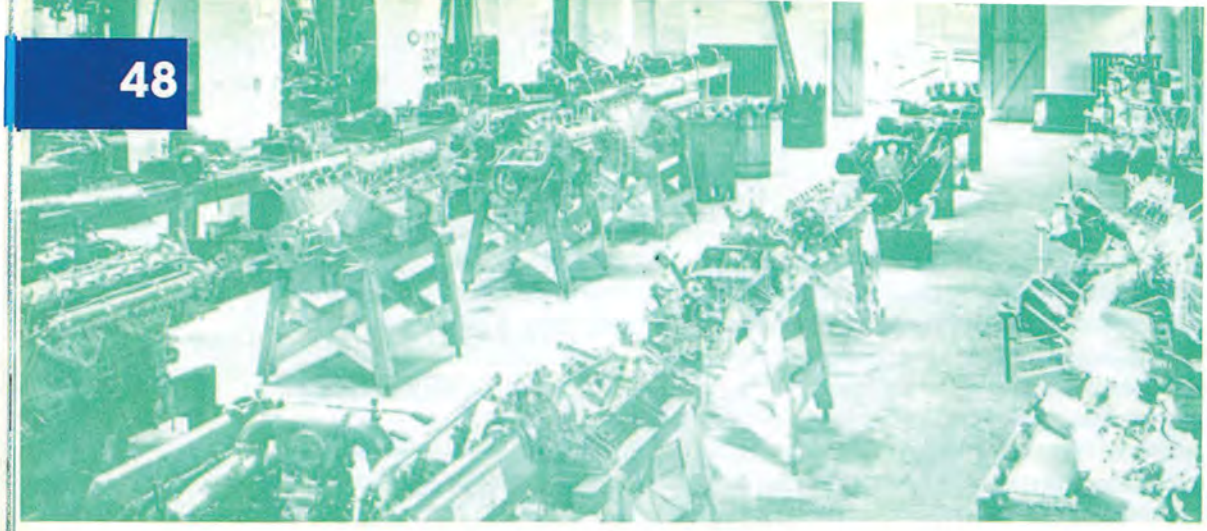
setting up of a dedicated stores depot in October 1914 to hold aircraft, engines, pyrotechnics and all stores special to the RFC. Almost immediately, the buildings at Farnborough proved inadequate to the task and additional stores were established at Greenwich and Didcot; the first elements in a stores distribution system that would ultimately comprise 7 main depots and 10 distributing parks in the United Kingdom alone. I should add that the situation at Farnborough was not made any easier by the requirement that all aircraft purchased for the RFC had to be flown there, or delivered crated and then erected, for inspection and flight testing by the Aeronautical Inspection Department (AID). This potential bottleneck remained until March 1915 when regional delivery centres were opened.[10]

As the war grew in scale and intensity, ever greater human and materiel resources were needed to sustain the RFC in the field

As the war grew in scale and intensity, ever greater human and materiel resources were needed to sustain the RFC in the field. The growth in the number of frontline squadrons, the increasing complexity of aircraft and their supporting equipment and the rapid rise in wastage through accidents or combat losses, placed the existing logistic organisation under considerable strain. The Aircraft Park itself resembled, in the words of its commander, *a gigantic factory and emporium,* repairing everything from aircraft to wireless equipment and vehicles. The range and quantity of spares to be handled created immense difficulties. The stores section alone was responsible for requisitions ranging from complete aircraft to horserakes and lawnmowers for keeping aerodromes trim. As a result, by July 1915, the Aircraft Park had become just too unwieldy to satisfy the demands placed upon it and thus a second park was established at Candas to cater for those squadrons working directly for the newly formed Third Army.[11] Both parks were supplied by rail from separate port depots, based respectively at Boulogne and Rouen, which received all the RFC's stores from England. In due course, the Rounen base became a huge engineering complex that included the RFC's Engine Repair Shops at Pont de l'Arche which, by the summer of 1917, would comprise over 1,700 personnel employed in the overhaul and repair of engines from every squadron on the Western Front.[12] Repairs were also carried out by civilian contractors, but the bulk of arisings were placed in Service repair shops in order to avoid persistent labour and production problems in the United Kingdom.[13]

Engine Repair Shops at Pont de l'Arche which, by the summer of 1917, would comprise over 1,700 personnel employed in the overhaul and repair of engines from every squadron on the Western Front

Even with these changes, it was evident that unless the parks were relieved of some of their heavy repair work and the vast range of stores that they were now required to hold, there was no possibility they could sustain a mobile role. The elegant solution was to create new aircraft parks for each RFC brigade and to convert the original air parks into fixed supply and repair depots. The individual air parks were kept as small as possible, comprising some 150 personnel organised into separate repair, stores and transport sections, and based in the rear of



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the Army area, adjacent to a railhead to enable a rapid move if required. In turn, the depots comprised some 500 to 1,000 personnel, depending upon the number of squadrons to be supported, organised into a wide range of repair and stores sections.[14] Consumables, such as ordnance, petrol, rations, clothing and so on, were provided by a combination of Army supply, specific RFC arrangements and local purchase. In the case of aviation spirit, this was provided in 2 and 4-gallon cans direct from England, using the Army supply system, although the quantities – 600,000 gallons per month – were such that by early 1918 filling arrangements were provided in France.[15]

By June 1916, and the Battle of the Somme, the logistic organisation had expanded to support over 400 aircraft in the field – as shown at (Figure 2) overleaf. The bulk of the operational squadrons were based 6-8 miles from the frontline. The air parks, responsible for day to day support of the squadrons and holding one month's supply of aeronautical stores, were located at railheads some 5-10 miles further back. The parks' stock holdings were strictly controlled to ensure that mobility was not impaired and all stores were packed in specially constructed cases that could be readily

By 1918, the RAF required at least 600,000 gallons per month to sustain operations – all delivered in cans

loaded onto lorries and issued, if necessary, 'on the move'. Minor facilities, for example to conduct wing repairs, were provided but they were first and foremost issuing centres. The parks were supplied in turn by the two main depots, up to 40 miles from the frontline, each with three months' stock of aeronautical and transport stores. The depots also received, and issued direct to the individual squadrons, new aircraft, maintained an attrition reserve and overhauled and rebuilt

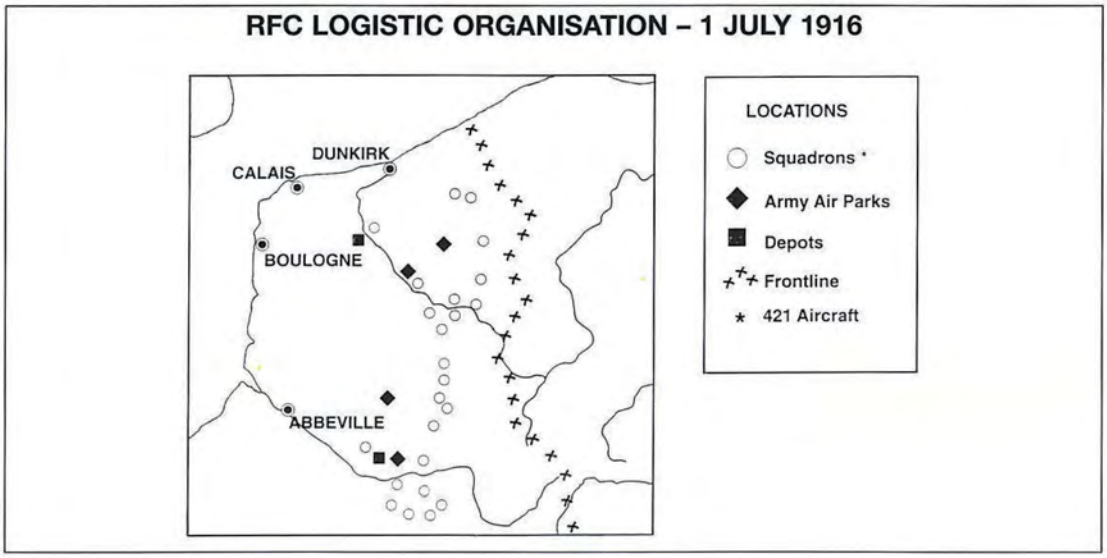


Figure 2

Every aircraft that could be repaired or rebuilt and every component or engine that could be salvaged helped to offset these massive losses and sustain the RFC's operations

aircraft, balloons, transport and associated equipment. All aircraft and engines requiring repair outside squadron capabilities (assessed as in excess of 36 hours) were returned direct to the depots, as were all wrecked aircraft.[16] In theory, because of their size and extensive facilities, the depots were static. But, when the Germans threatened to break through to the Channel ports in 1918, both depots were moved as a precaution – not without difficulty – some 20-30 miles to the west, where they remained until the war was over.

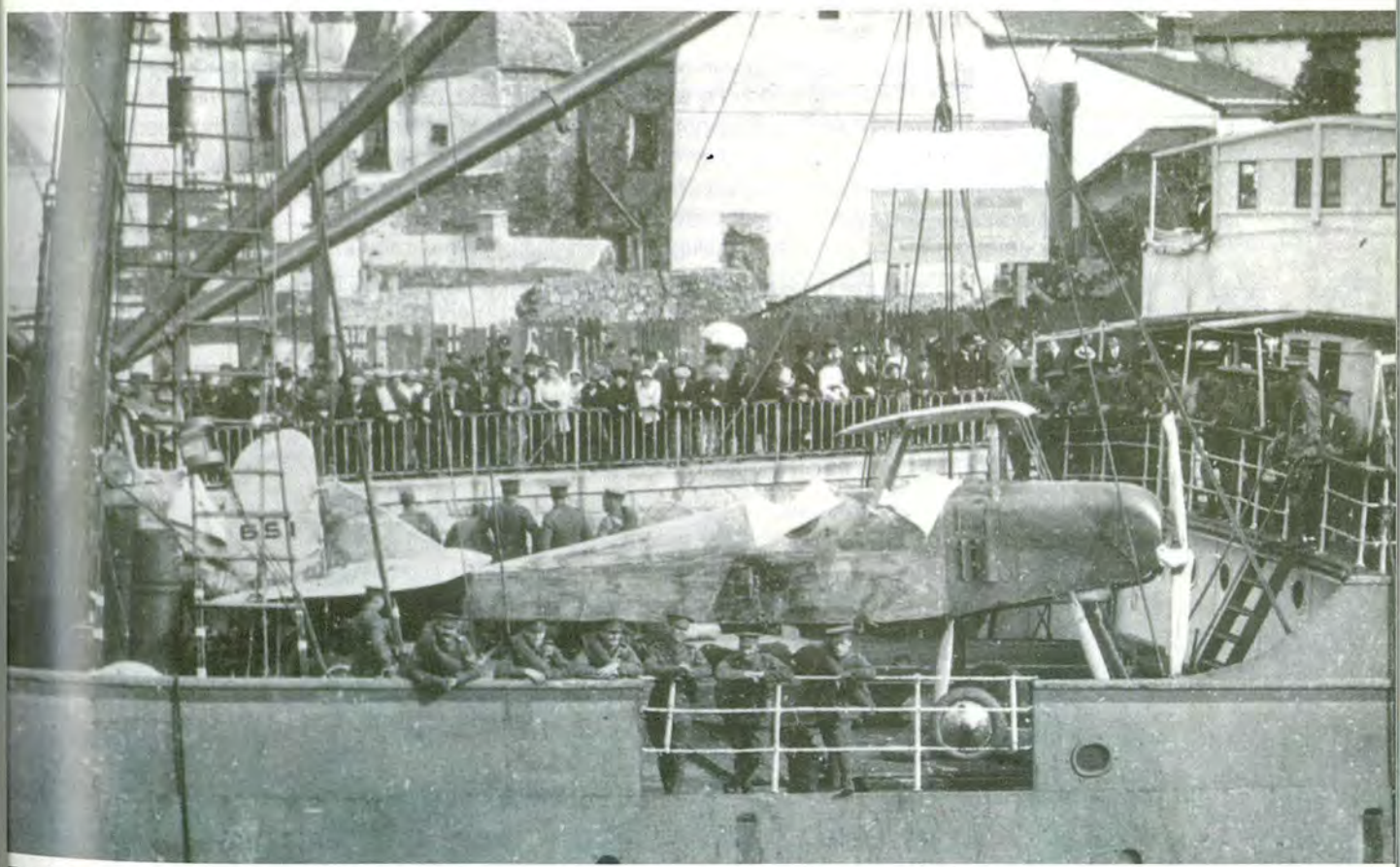
The importance of salvage and repair cannot be exaggerated. Wastage rates at the beginning of the war were relatively low, about 10% per month, however, by June 1916 it had reached 48% per month, rising to a staggering 65% during the course of the Battle of the Somme. In July 1917, it was calculated that to keep 1,800 aircraft in the field (approximately the size of the Royal Air Force in France at the Armistice) 1,500 new aircraft would have to be provided each month.[17] Self-evidently, every aircraft that could be repaired or rebuilt and every component or engine that could be salvaged helped to offset these massive losses and sustain the RFC's operations.[18]

In parallel with these developments, it had become abundantly clear that specialist officers were required to oversee the RFC's technical needs, both to supervise stores and to manage the repair and overhaul of aircraft and equipment. In fact, to find flying officers for such duties, when the lack of trained pilots was a severe constraint on the RFC's expansion plans was simply not possible. As a result, equipment officers had been introduced from early 1915 and by July were to be found in all wings and squadrons in France.[19] Their duties embraced what would now be called the engineer and supply disciplines. The arrival of equipment officers took much of the technical burden off the squadron commander's shoulders giving him more time to concentrate on operational matters. In fact, on some squadrons, such as those employed in Corps duties (army co-operation), there were eventually up to four equipment officers on the establishment.[20] Their overall importance is indicated by the fact that, in a little over a year (that is by July 1916), nearly 400 of the 2,000 officers in the RFC were graded as equipment officers – about 20% of the total strength.

I have already alluded to the shortfalls in the delivery of equipment, made good by direct purchases in France. In the course of the war, over 55,000 airframes and 41,000 aero-engines were produced by British industry, primarily for use by the RFC and Royal Naval Air Service. This achievement is all the more impressive when one recalls that, at the outbreak of war, there was practically no aero-engine industry and a total of only 8 aircraft contractors. This massive expansion in production inevitably created problems, ranging from dilution of skilled labour to shortages of critical components. Even so, by July 1916 deliveries to the RFC had reached 120 aircraft per month, rising to an average of 1,300 per month in 1917 and 2,700 in 1918. Completed aircraft were sent directly from the manufacturer to a system of Aircraft Acceptance Parks, developed from the regional acceptance centres described earlier, but controlled by the RFC from March 1917 onwards. Ultimately there would be 16 acceptance parks, but it should be emphasised that their existence was largely owed to continuing failures in supply, not only of engines but also of components such as crankshafts, magnetos and ball-bearings. Although, the government took upon itself responsibility for the production and allocation of these critical items, it was found much easier to increase the rate of manufacture of airframes, using a wide range of companies – many of

which had not produced aircraft before. Thus, there was a rapid build-up in stocks of airframes pending availability of, what would now be termed, government furnished equipment. The acceptance parks were therefore established to enable airframes to be accepted formally from the manufacturers, pending completion, so avoiding the possibility of congested factories and production bottlenecks.[21]

In the event, this system worked remarkably well, although it would clearly have been preferable and more efficient to deliver aircraft and equipment direct to the depots. When an airframe was completed by the manufacturer it was inspected by the AID, and once passed, delivered (generally by road) to the appropriate park for completion and onward despatch to the depot. For example, Armstrong Whitworth FK.8 – Ser No B 273 – was passed by the AID, less engine, at Newcastle on June 1917 and despatched to No 8 Aircraft Acceptance Park at Lympne on 25 June. The aircraft was successfully flight tested on 12 July, after installation of its 160 hp Beardmore engine, and delivered to No 1 Aircraft Depot at St Omer on the same day for wireless equipment, guns and other accessories to be fitted. The completed airframe was then transferred to No 2 Aircraft Depot at Candas on 31 July, where it remained in store until issued, as received, to 'A' Flt, No 2 Squadron on 1 September – some 9 weeks after it left the manufacturer.



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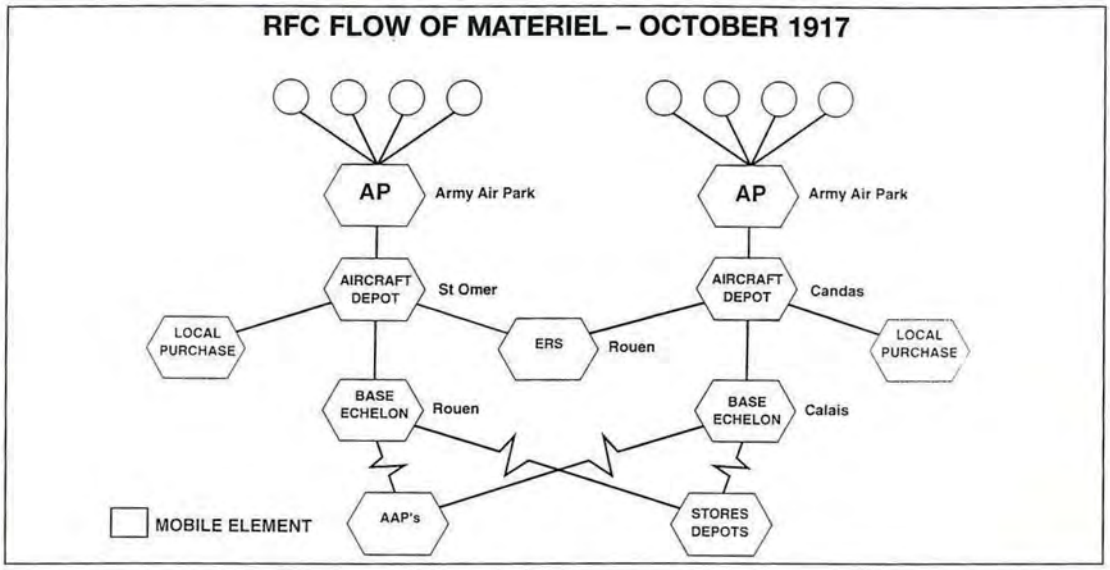

Figure 3

The main elements of the logistic system in place by this stage of the war are illustrated above (Figure 3). The Army Air Parks and flying squadrons comprised the mobile element, while the depots (in theory) were static. It will be noted that the OASD is no longer shown, having been absorbed by the RFC in January 1917 when the latter took responsibility for the supply and storage of all aeronautical materiel. On the ground, the network of parks and squadrons had grown (Figure 4) to support over 800 aircraft – double the RFC's frontline strength in 1916.

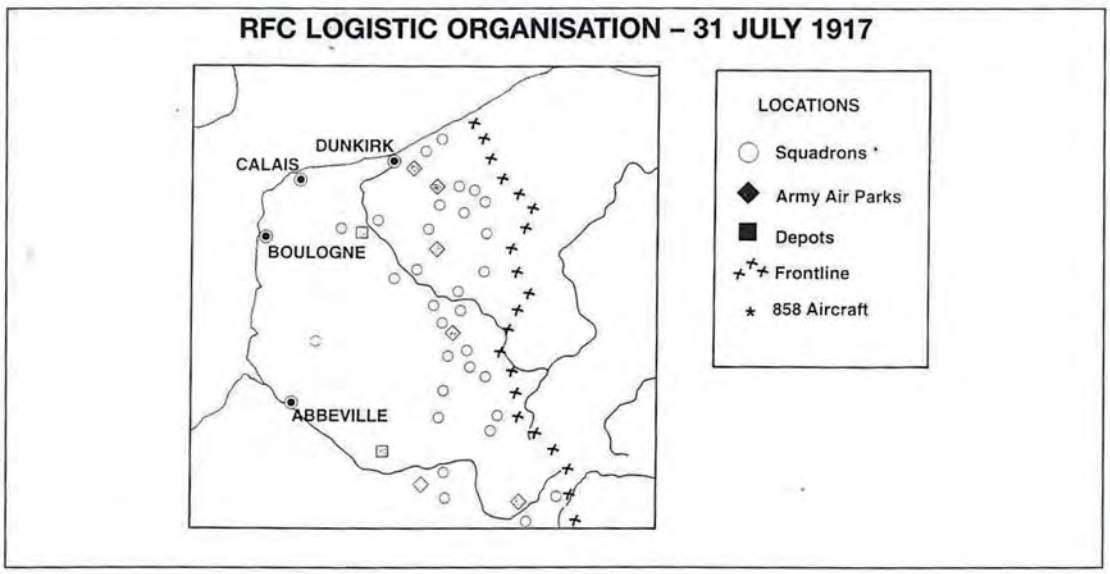

Figure 4

Each flight had its own flight sergeant responsible for some 35 or so mechanics, allocated in small groups to specific aircraft

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The division of work between the various elements of this system was designed to ensure that the flying squadrons could meet their operational task, yet not be encumbered with excessive equipment and personnel that would limit their mobility. Given the common perception that warfare on the Western Front was a rather static affair, this might seem an unnecessary concern, but in fact the RFC's squadrons moved surprisingly regularly – very much as the operational situation dictated. Thus, No 9 Squadron, employed on the Western Front form December 1915 until the Armstice, was based at 20 different airfields in France and Belgium, roughly a move every two months. Some of these deployments were major relocations to a different army area, up to 70 miles away, while others were successive moves to keep in touch with the changing front, as in the last few months of the war. In all cases, the squadron was able to conduct operational sorties within 48 hrs of leaving its previous location – an impressive achievement.

It is perhaps appropriate at this stage to look at the individual squadron logistic organisation in a little more detail. The RFC squadrons in France nominally retained the pre-war establishment of 12 aircraft, but this was usually augmented during active operations; in the case of the Corps squadrons up to a total strength of 21 or even 24 machines. Each flight had its own flight sergeant responsible for some 35 or so mechanics, allocated in small groups to specific aircraft. The flight fitters carried out daily servicing and minor adjustments (such as valve grinding) on their own aircraft while the HQ flight undertook deeper maintenance and rectification (effectively, the equivalent of second line). Together with the inevitable specialist sections (wireless, photographic, armament, stores and so on) and support staff, each squadron needed some 190 ground personnel and 45 vehicles to keep it in

the field.[22] The latter included provision not only for the transportation of tents and hangarage but also for a wide range of mobile facilities, including machine shops, wireless vans, generators, darkrooms and so on. Moving this number of personnel and their specialist equipment safely across the poor roads of the Western Front was a major challenge. That the RFC was able to do so consistently, notwithstanding the lack of prepared airfields and the limited availability of suitable accommodation and other infrastructure, is evidence for the high degree of mobility that was actually achieved.

The flexibility of the overall system was such that it was able to take on additional responsibilities, including the supply of air ammunition from 1917 onwards, as well as greatly expanded salvage, stores and transportation capabilities as the war progressed. This was achieved by the simple expedient of adding individual specialist sections subordinate to the air parks and depots. Thus, in October 1917, when the volume of new aircraft deliveries (then averaging 400 a month) and the quantity of repair and salvage work were beyond the capabilities of the depots, the existing repair sections were separated from their parent depots and expanded into Aeroplane Supply Depots (ASD) responsible solely for aircraft receipt, issues and repairs. This left the depots to concentrate purely on the receipt and issue of aeronautical spares and the reception, repair and issue of Motor Transport.[23] At the same time, it was also decided to create a strategic transport reserve by withdrawing a proportion of each squadron's vehicles to form a Reserve Lorry Park attached to each brigade – arrangements that more than proved their worth during the RFC's desperate but largely successful redeployment in the face of the German March 1918 offensive.[24] These developments marked the last significant changes to the logistic system before it was inherited by the Royal Air Force on 1 April 1918.

By August 1918 (Figure 5), and the final Allied offensives, the Royal Air Force's logistic arrangements were as shown. The notable changes compared to 1917 are the introduction of the Aeroplane Supply Depots and Reserve Lorry Parks, but equally importantly the organisation had expanded (Figure 6), to support almost twice as many aircraft. In the last few months of the war, as the front advanced rapidly, it became necessary to move forward the Issues Sections of the Air Parks to keep in touch with the squadrons. Similarly, advanced sections of the main depots were deployed to railheads close to the advancing armies in order to maintain supplies to the rapidly moving Air Parks. These changes were successful, reflecting once again the basic strength and flexibility of the logistic system established by the RFC.

The RFC was very much the pioneer in this field, providing an example for other air arms including those of France and the United States

To conclude, between 1912 and 1918 the RFC developed a highly sophisticated and extensive logistic system, managed by professional technical and stores officers, that was able to provide effective support for deployed mobile operations, including extended periods of intensive fighting, while coping with an immense increase in numbers and technical complexity. The RFC was very much the pioneer in this field, providing an example for other air arms including those of France and the United States. Indeed, the Air Service of the American Expeditionary Force (AEF) chose to adopt a very similar system, including terminology, when setting up their own supply and technical support arrangements for the Western Front in 1917.[25]

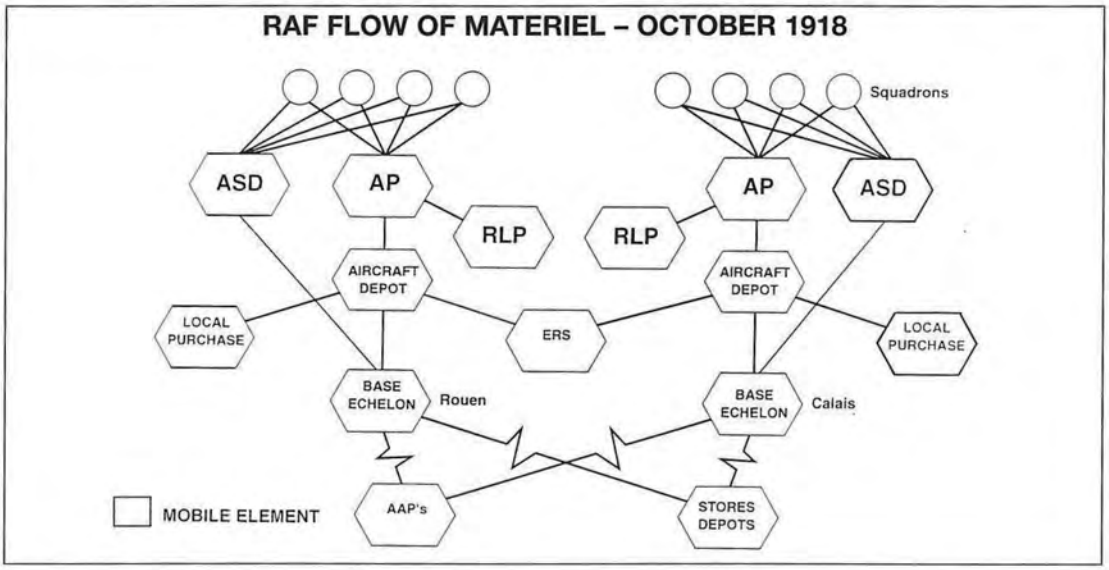


Figure 5

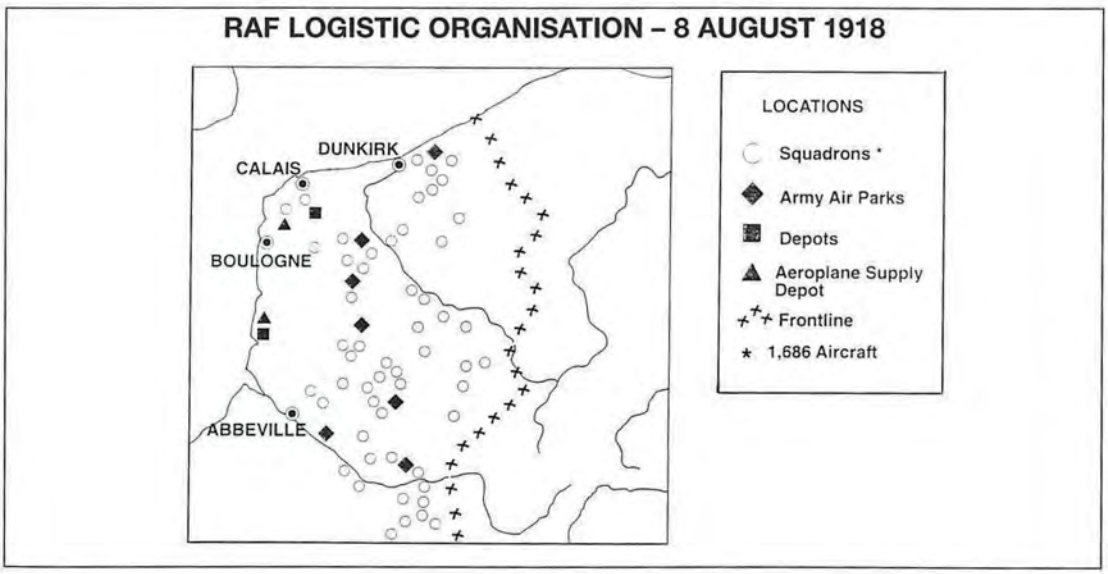


Figure 6

The Royal Air Force never commissioned a 'logistics lessons learned study', but had they done so their experience might have been summarised, as follows:

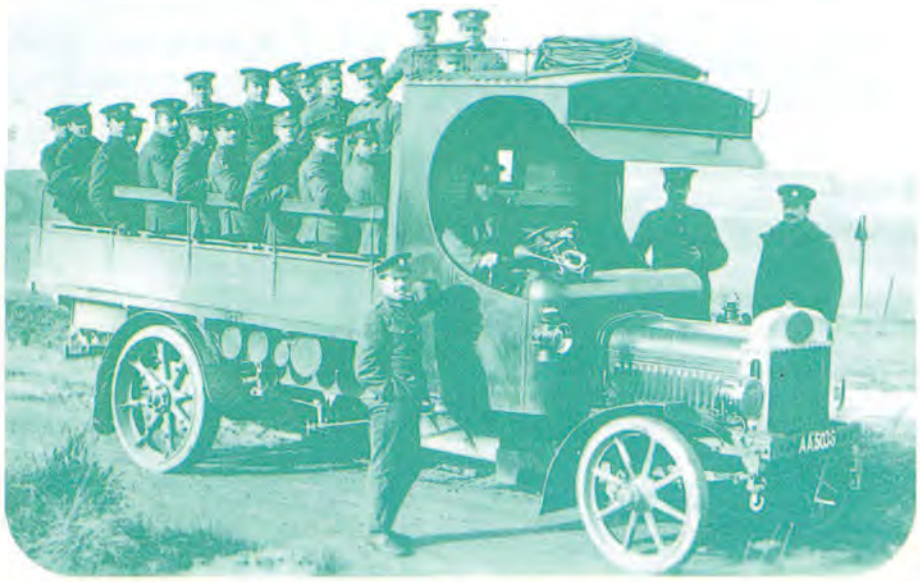
– **Air power was an expensive weapon**. Air expenditure was running at approximately one million pounds a day by the end of the war.

– **Maintaining aircraft away from the home base demanded considerable resources**. The 1,800 aircraft deployed on the Western Front at the end of the war required some 50,000 support personnel in France and Belgium, together with 2,000 aircraft in reserve or at the depots, and an extensive network of supply and repair facilities. In short, the RFC discovered that the 'tail to teeth' ratio for combat aircraft was considerable.

– **Attrition on active operations was extremely high**. By the end of the war, the average monthly aircraft wastage rate was 52%. In the last 10 months of the war, 7,230 aircraft were delivered to the RFC in France just to make good operational losses. In-theatre repair and salvage, although important (particularly in the case of aero-engines), could never make up for this deficit.[26] Only the home base and its industrial capacity could meet such needs.

– **Effective support demanded the readily availability of spares**. At the Armistice, the Expeditionary Force was operating some 20 aircraft types and 23 different engines. Without a wide range of readily available spares, the flying squadrons could not have continued to operate nor could the depots have been able to issue or repair over 900 aircraft each month as well as 500 engines.[27]

– **Rail and motor transport were critical to the supply pipeline**. Without a rapid and effective system to distribute stores and consumables, the RFC could not have sustained the required levels of mobility and operational tempo. The importance of motor transport was such that by April 1918, the Royal Air Force possessed over 8,500 vehicles and motorcycles compared to just 700 in 1915.



Rail and road transport were critical to the supply pipeline

– **Preserving mobility was a constant battle**. It was rapidly discovered that the natural tendency of deployed units was to regularise support arrangements, establishing ever deeper roots and inevitably growing larger with time. Without constant and regular attention to these aspects, mobility rapidly suffered.

– **The essential 'lubricant' was manpower**. Without the determination, flexibility and professionalism of large numbers of skilled tradesmen, on the squadrons and in the depots and parks, there could have been no logistic system.

These are, of course, the results of my own analysis, but they are very similar to the principles established by the AEF, who concluded that, to be effective, the Air Service's supply system had to be:

– Adequate in scope with a margin of capacity to meet unplanned arisings.

– Adaptable to new conditions and resourceful in either manufacturing or securing in the open market any of the manifold commodities it might be called upon to furnish.

– Equipped with extensive material facilities; and manned by adequate numbers of well trained personnel. In this respect, it was stated that;

> there should never be an undue fear of placing with the supply and instruction centres a large proportion of the soldiers of the Air Service. An undermanned service of supply is a vital handicap to the Front.[28]

Eighty years on, these seem to me to remain eminently sound principles for the conduct of logistics support to deployed operations.

It would be misleading to suggest that these lessons were entirely forgotten by the Royal Air Force during the inter-war period but, under the pressure of peace and financial stringency, an organisation that comprised at its peak 24 repair depots at home and overseas, 12 aircraft parks, 16 aircraft acceptance parks, 7 stores depots, 10 stores distributing parks and numerous subsidiary units, was reduced by the 1920s to just six home depots and three overseas.[29] What is more significant, however, is that there was no place in the peacetime organisation for an engineer branch and thus none of the 5,000 technical officers serving at the end of the war were retained by the peacetime air force. In the future, their duties would be undertaken by General Duties officers – I leave it to others to comment on the wisdom and long term impact of this decision.

NOTES

1 A personal account of the rationale behind this system is provided by Sir Frederick Sykes – *From Many Angles*, p 94-95.

2 Major Sefton Brancker, in a lecture reported by Flight dated 12 June 1914, commented that the difficulties of maintenance were sometimes lost sight of – the aeroplane and its engine being both delicate and fragile – necessitating the provision of large quantities of spare parts and portable tents for housing machines. As a result, only a small proportion of aeroplanes in the field would be fit to take to the air at any given moment.

3 Each squadron's war establishment comprised: 1 Crossley touring car for the CO; 6 Crossley light tenders for the conveyance of riggers, men and boxes; 6 heavy tenders for the transport of large spare parts, camp equipment, etc; 3 reserve equipment lorries; 3 shed lorries, 3 flight repair lorries fitted with hand-power tools, electric lighting plant, raw materials, etc; 1 heavy repair lorry fitted with machine tools; 1 lorry carrying spare parts and stores for the mechanical transport; 1 baggage lorry; 1 lorry for POL; 6 motor cycles; and 6 aircraft trailers. By December 1915, the establishment for a Corps squadron had risen to a total of 30 lorries and light tenders with 8 motor cycles & sidecars and 8 aircraft trailers.

4 An analysis of the Army's 1912 manoeuvres showed that 8 steam wagons, 10 heavy lorries, 12 light tenders and 8 motor cars had been required to keep 2 airships and 14 aeroplanes in commission.

5 In this respect, the experience of the Air Service of the American Expeditionary Force (AEF) mirrors the RFC's, although an overall shortage of trucks forced the AEF to centralize the management of all motor transport, much to the chagrin of the Air Service who envied the RFC's independence. Roger G Miller – *What to Do With the Truck?*, Air Force Journal of Logistics, Winter 1997.

6 The mobilisation plan had called for 24 aircraft to be crated, but in the event, the balance was either flown direct to France or used to make up deficiencies on the squadrons.

7 Technically speaking, St Omer was the Aircraft Park's advance base – the base echelon remaining at Rouen.

8 Maurice Baring – *Flying Corps Headquarters 1914-1918*, p 145-146, Heinemann, London 1930, describes the problems faced by the operational squadrons arising from the confusion between English and French spares.

9 The supply of complete machines and vehicles was in the hands of the Director Military Aeronautics at the War Office.

10 The AID had been formed in December 1913 as an inspecting body for aircraft construction and acceptance. Originally under the overall control of the War Office, it was in effect civilianised in March 1917 when control was passed to the Ministry of Munitions and its remit extended to deal with the supply of all aircraft. The AID had grown into an organisation of some 10,600 personnel by the end of the war. For a history of the AID in the First World War, see *Aeroplane Monthly*, November 1993.

11 In August 1914, the Air Park was responsible for just 63 aircraft in the field, but, by May 1915 this had risen to 156. More significantly, 2,260 aircraft engines were on order (*Statistics of the Military Effort Of The British Empire – HMSO, 1922*).

12 The ERS output in August 1916 was roughly 100 engines per month with an establishment of 10 officers and 406 O/Rs. It was agreed to increase this in two stages until, by May 1917, the output reached 400 engines per month with an establishment of 32 officers and 1702 O/Rs – *AIR1/529/16/12/75*. The total output for the last year of the war (10 months) of repaired or rebuilt engines reached 3,196 from an establishment of 4,532 personnel all ranks – *AIR1/686/21/13/2252*.

13 The perceived advantages arising from this policy were: immunity from civilian labour troubles; the training potential to Service in undertaking the work; and the reduced turnround time because of the proximity of Service workshops to the frontline – *History of the Ministry of Munitions, Vol XII, Part 1, Chap III, p 79-81*. However, it was also recognition that industry could not keep pace with repair requirements. In June 1918, for example, there was a total outstanding deficiency of 1,491 repaired engines from civilian firms as compared with the scheduled output.

14 Raleigh & Jones – *War In The Air*. Vol 2, p 188-190.

15 By early 1916, the Army's total petrol consumption had risen to over 2,000,000 gallons a month of which at least 200,000 gallons was aviation spirit. By 1918, the RAF required at least 600,000 gallons per month to sustain operations – *Military Operations In France & Belgium 1916*, p 102-104 refers. Some bulk distribution arrangements were put in hand in 1918 to support the Handley Page bombers of the Independent Force and there were plans to provide each Reserve Lorry Park with dedicated fuel trucks but, for the majority of the war, all aviation fuel for the RFC in France was provided in cans.

16 Raleigh & Jones, *Op cit*, Vol IV, p 358.

17 *Ibid*, Vol VI, p 92-93.

18 *Ibid*, Vol IV, p 202.

19 Two grades of equipment officers were initially established, Equipment Officer (with the rank of Capt) for wings, and Assistant Equipment Officer (with the rank of 2/Lt) for squadrons.

20 For example, in 1917, No 9 Squadron had on its strength one Equipment Officer (Grade 3) Squadron and three Equipment Officers (Grade 3) Wireless.

21 In August 1918, there were more than 4,200 machines in store without engines – *History of the Ministry of Munitions, Vol XII, Part 1, Chap III, p 79*.

22 For fighter squadrons, the formal establishment was smaller, comprising 149 groundcrew and 35 vehicles.

23 The new organisation came into effect on 1 November 1917, comprising No 1 Northern ASD (reception park at Marquise, repair park at St Omer and issue section at Sery) and No 2 Southern ASD (repair park and issue section at Fienvillers). The strength of the former was 92 officers and 2,235 other ranks and the latter, without a reception park, 50 officers and 1,905 other ranks – based on 80 squadrons employed on the Western Front. The strengths of No 1 and No 2 Aircraft Depots were adjusted accordingly, both units comprising 43 officers and 1,697 other ranks – *AIR 1/1084/204/5/1721*.

24 The RLP's were initially established with 30 lorries and 24 trailers, but an additional section of 15 lorries and 12 trailers was authorised in February 1918. Raleigh & Jones, *Op cit*, p 353.

25 The French also organised their aeronautical supply on the RFC system with "Grand Parcs" and "Parcs" matching the roles of the depots and air parks in support of the individual escadrille.

26 In October 1918, some 200 aircraft were repaired or rebuilt from salvage compared to the 3,756 built that month.

27 A total of 131,339 tons of aircraft stores was shipped to the RFC in France over the course of the war, as well as 2,103 aircraft in crates (the large majority of aircraft were delivered by air, however) – *Statistics of the Military Effort of The British Empire*.

28 Report On The Inter-Allied Board of Supply, Chapter XVIII, Section 6 – *AIR2/151/290308/20*.

29 According to the scheme for the permanent organisation of the RAF published on 13 December 1919.