

# **Royal Air Force Logistics During the Second World War: Transformation, Sustainment and Flexibility**

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## Abstract

Research into air power history has grown in popularity, but much of this scholarship centres on operational activities with little study into matters of support, especially logistics; this paucity of research is particularly evident with regards to the British Royal Air Force (RAF). This thesis examines RAF logistics during the Second World War through five research questions, under the generic themes of Transformation, Sustainment and Flexibility. Its research methodology is innovative in that it uses an inter-disciplinary approach through the use of a management science model to conduct an historical study. First, it considers how the RAF's logistics organisation came into being and how it was shaped by the Royal Flying Corps' experience during the First World War. The inter-war years are then examined with particular emphasis on how the Expansion Programme of the mid to late 1930s shaped the logistics organisation, up to the outbreak of the Second World War in September 1939. The thesis then takes a detailed look at how RAF logistics was organised and how it operated its supply chain throughout the war including: manning, command and control, procurement, warehousing and transport. The final part of the thesis examines how logistic services were provided to the front line, both at home and overseas.

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## Glossary of Abbreviations & Terms

AA	Anti-Aircraft
AAF	Auxiliary Air Force
AAP	Army Aircraft Park (First World War)
AAP	Air Ammunition Park (Second World War)
AASF	Advanced Air Striking Force
ACH	Aircraft Hand
AD	Ammunition Depot
AE	Aircraft Establishment
AED	Aircraft Equipment Depot
AEO	Assistant Equipment Officer
AGS	Aircraft General Spares
AEAF	Allied Expeditionary Air Force
AHB	Air Historical Branch
AM	Air Ministry
AMDP	Air Member for Development and Production
AMO	Air Ministry Order
AMSO	Air Member for Supply and Organisation
AMSR	Air Member for Supply and Research
AMWO	Air Ministry Weekly Order
AOC	Air Officer Commanding
AOCinC	Air Officer Commanding in Chief
AOG	Aircraft-on-Ground
AP	Air Publication
ASP	Air Stores Park
ATS	Auxiliary Territorial Service
BAC	British Air Commission
BCD	Barrack and Clothing Depot
BEF	British Expeditionary Force
CAS	Chief of the Air Staff
CCD	Canal Clearing Depot
CinC	Commander in Chief

CGE	Controller General of Equipment
CO	Commanding Officer
CTC	Civilian Technical Corps
DAE	Directorate of Aircraft and Equipment
DAP	Directorate of Aeronautical Production
DAQS	Directorate of Air Quartermaster Services
DD	Deputy Director or Deputy Directorate
DDGE	Deputy Directorate General of Equipment
DE	Directorate of Equipment
DE&S	Defence Equipment and Support
DGE	Directorate General of Equipment
DGRD	Directorate General of Research and Development
DH	De Havilland
DLO	Defence Logistics Organisation
DofE	Director or Directorate of Equipment
DSO	Distinguished Service Order
DWAAF	Director Women's Auxiliary Air Force
EO	Equipment Officer
ETS	Equipment Training School
FAD	Forward Ammunition Depot
GD	General Duties
GED	Ground Equipment Depot
GS	General Service
HE	High Explosive
HMS	His Majesty's Ship
HQ	Headquarters
IAF	Indian Air Force (until March 1944)
IP	Initial Provisioning
IWM	Imperial War Museum

KGr	Kampfgruppe (Luftwaffe Bomber Group)
LPO	Local Purchase Order
MA	Military Aeronautics
MAP	Ministry of Aircraft Production
MC	Military Cross
MPO	Master Provisioning Office
MPSCO	Master Provision and Stock Control Office
MT	Motor Transport
MU	Maintenance Unit
NATO	North Atlantic Treaty Organisation
NCO	Non-Commissioned Officer
NW	North West
OASD	Ordnance Aeronautical Stores Department
OC	Officer Commanding
OKL	Oberkommando der Luftwaffe (Luftwaffe High Command)
OKW	Oberkommando der Wehrmacht (Supreme Command of the Wehrmacht)
OR	Other Ranks
ORB	Operational Record Book
POL	Petroleum, Oils and Lubricants
QM	Quartermaster
RAD	Reserve Ammunition Depot
RAF	Royal Air Force
RAuxAF	Royal Auxiliary Air Force
RAFM	Royal Air Force Museum
RAFVR	Royal Air Force Volunteer Reserve
RCAF	Royal Canadian Air Force

RE	Royal Engineers
RFC	Royal Flying Corps
RIAF	Royal Indian Air Force (from April 1944)
RNAS	Royal Naval Air Service
SA	Stores Accounting
SAA	Small Arms Ammunition
SCM	Support Chain Management
SD	Stores Depot
SM	Sergeant Major
SNCO	Senior Non-Commissioned Officer
SofS	Secretary of State
Stores	Air force material other than supplies <sup>1</sup>
Supplies	Food, forage, fuel, petrol, oil, light, disinfectants and medical comforts <sup>2</sup>
TAF	Tactical Air Force.
TNA	The National Archives
TOR	Terms of Reference
UEW	Universal Equipment Wing
UED	Universal Equipment Depot
UK	United Kingdom
USA	United States of America
USAAF	United States Army Air Force
VC	Victoria Cross
WAAC	West African Air Corps
WAAF	Women's Auxiliary Air Force
WO	Warrant Officer
WRAF	Women's Royal Air Force
WRNS	Women's Royal Naval Service

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<sup>1</sup> As defined in Air Ministry, Air Publication (AP) 1301, Royal Air Force War Manual, Part II: Organization and Administration (London: Air Ministry, 1940), Appendix I, p.3.

<sup>2</sup> Ibid, p.3.

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## Introduction

By the end of the Second World War, the total number of aircraft operated by the British Royal Air Force (RAF) had risen from 3,555 on the outbreak of war, to 55,469 in May 1945.<sup>1</sup> Similarly, the number of its personnel (men and women) had risen substantially from 175,692 in early September 1939, to 1,130,460 by the beginning of September 1945.<sup>2</sup> The RAF's global presence (whether on established facilities or in the field) was widespread, with units eventually operating across Europe to as far afield as North Africa, the Mediterranean, India and the Far East. To deliver air power on this almost global scale required an extensive and efficient support infrastructure; a key part of this was logistics. At the strategic level, the significance of logistics was summed up by Field Marshal Wavell:

The more I see of war, the more I realize how it all depends on administration and transportation...it takes little skill or imagination to see where you would like your army to be and when; it takes much knowledge and hard work to know where you can place your forces and whether you can maintain them there. A real knowledge of supply and movement factors must be the basis of every leader's plan; only then can he know how and when to take risks with those factors, and battles are won by taking risks.<sup>3</sup>

General Dwight D. Eisenhower commented that 'You will not find it difficult to prove that battles, campaigns, and even wars have been won or lost primarily because of logistics'.<sup>4</sup> The earliest reference to logistics and its significance to air power can be found in the seminal work of the Italian general and air power theorist Douhet who, in 1921, quite prophetically observed that during wartime, an air force would need to operate from dispersed airfields in order to survive. He suggested that it would be necessary to:

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1 O. Thetford, *Aircraft of the Royal Air Force Since 1918* (London: Putnam, 1995), p.396.

2 Air Ministry, *Royal Air Force Personnel Statistics for the Period 3rd September 1939 to 1st September 1945* (London: Air Ministry, 1946), Section I, Table I, pp.1-5.

3 Cited in M. Van Creveld, *Supplying War – Logistics from Wallenstein to Patton* (2nd Edition) (New York (USA):Cambridge University Press, 2004), p.231.

4 Cited in Logistics Quotations, posted by Naval Supply Systems Command (NAVSUP)  
<[http://www.au.af.mil/au/awc/awcgate/navy/log\\_quotes\\_navsup.pdf](http://www.au.af.mil/au/awc/awcgate/navy/log_quotes_navsup.pdf)> [accessed 31 Jan 15].

...create a logistical aerial unit, which will have to be provided with all the needs of life, movement, and combat, which must in turn be supplied by its own aerial organization. To fulfil its purpose, an independent Air Force must be a completely self-sufficient organization able to move in the air and to change its location on the surface autonomously.<sup>5</sup>

His view was largely influenced by the experience of the allied air forces during the First World War, especially the Royal Flying Corps who found that the mobility of its squadrons and their support infrastructure was critical, particularly during the German offensive in 1918.<sup>6</sup> One of the clearest references to the significance of RAF logistics during the Second World War can be found regarding the Normandy campaign of 1944 in the despatch submitted to the Supreme Allied Commander by Air Chief Marshal Sir Trafford Leigh-Mallory, Air Commander-in-Chief, Allied Expeditionary Air Force (AEAF) in November, 1944:

The statistics of the average daily consumption and wastage of P.O.L and ammunition also reveal something of the supply organization. During July, A.E.A.F expended daily 750 tons of bombs and more than 200,000 rounds of ammunition. The fuel consumption of A.E.A.F in July reached approximately 30,000,000 gallons of petrol, almost 1,000,000 gallons per day. A large part of this fuel and ammunition had to be transported into the beach-head and up to forward airfields. In this connection the work of Air Force beach squadrons deserve special mention. These parties went in with the follow-up troops on D-Day and due in no small measure to their efforts, the first airfields were stocked ready for operations in the beach-head on D+3.<sup>7</sup>

This is but a late war observation; there were five long and hard years of conflict prior to that. With operations eventually on an almost global scale, logistics was crucial to the successful delivery of air power, and air power proved to be a crucial component in winning the war. Its criticality was emphasised by Richard Overy who commented that 'Air power did not win the war on its own, but it proved to be the critical weakness on the axis side and the greatest single advantage enjoyed by the Allies'.<sup>8</sup>

5 G. Douhet, *The Command of the Air* (Alabama (USA): The University of Alabama Press, 2009), p.103.

6 P. Dye, 'The Royal Flying Corps Logistic Organisation', *Air Force Journal of Logistics*, Volume XXII, Number 1 (1998), 32-38 (p.36).

7 Recorded in the Fourth Supplement to the London Gazette, *Air Operations by the Allied Expeditionary Air Force in N.W. Europe from November 15th to September 30th 1944*, Issue 37838, 2 January 1947, p.80.

8 R. Overy, *Why the Allies Won* (London: Pimlico, 2006), p.396. Overy explores this theme in more detail on pages 275-278 of the same work. Further discussion on the significance of air power to Allied victory can be found in: R. Overy, *The Air War 1939-1945* (Dulles (USA):Potomac Books, 2005), pp.203-211; D.I. Hall, *Strategy for Victory – The Development of British Tactical Air Power 1919-1943* (Westport, (USA):Praeger Security International, 2008), p.156; J. Buckley, *Air Power in the Age of Total War* (London: UCL Press, 1999), pp.168-169, 196-197 and W.J. Boyne, *The Influence of Air Power Upon History* (New York (USA): Pelican Publishing, 2003), p.283.

## Aim of the Thesis

The aim of this thesis is to examine the origins, development and effectiveness of RAF logistics, with the main focus being the Second World War period.

## The Purpose of the Thesis

The Air Ministry's Air Historical Branch narratives and monographs on various aspects of the RAF's work in the Second World War provide a useful starting point for air power research.<sup>9</sup> These do make reference to logistics in a number of places, especially the work entitled *Maintenance* which does go into some detail in this respect.<sup>10</sup> There are, however, limitations in this work and this is commented on later in this chapter. Aside from this, the coverage of RAF logistics in the wider literature on air power history, particularly its effectiveness, is poor. Of the many books, papers and articles written on the history of the RAF in the Second World War, most make scant acknowledgement of the significance of logistics (if at all), with the general tenor being what air power has done in terms of delivering military effect, along with the hardware required and the tactics involved. Richard Overy reinforces this perspective suggesting that:

For much of the last century [20<sup>th</sup>] the focus of this history was on air combat and aircraft technology, often divorced from the wider history of warfare, or from the history of scientific and technical development.<sup>11</sup>

This inclination is particularly noticeable, for example, with works on the Battle of Britain where a number of the main texts focus entirely on the campaign itself, the aircraft and pilots, and the ground crews who kept the fighters serviceable.<sup>12</sup> There are a few exceptions but these concentrate on aircraft production, the supply of 100 octane fuel and aircraft maintenance.<sup>13</sup> In researching for a paper presented to the RAF Historical Society's seminar on logistics support to deployed operations in 1997, Humphrey Wynn found that:

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<sup>9</sup> These narratives are cited throughout this thesis and are listed for completeness in the Bibliography.

<sup>10</sup> See: Air Ministry (AHB) (1954), *The Second World War 1939-1945 Royal Air Force – Maintenance*, Air Publication 3397.

<sup>11</sup> S. Cox and P. Gray (eds), *Air Power History – Turning Points from Kitty Hawk to Kosovo*, (Abingdon: Frank Cass, 2002), p.ix.

<sup>12</sup> See, for example: S. Bungay, *The Most Dangerous Enemy – A History of the Battle of Britain* (London: Aurum Press, 2000); R. Hough & D. Richards, *The Battle of Britain- The Jubilee History* (Sevenoaks: Hodder & Stoughton, 1989); T.C.G. James, *The Battle of Britain* (London: Routledge, 2000) and J.F. Turner, *The Battle of Britain* (Shrewsbury: Pen & Sword, 1998).

<sup>13</sup> See, for example: Hough & Richards, *The Battle of Britain*; G. Bailey, 'The Narrow Margin of Criticality: The Question of the Supply of 100-Octane Fuel in the Battle of Britain', *English Historical Review*, Volume CXXIII, Number 501 (2008), 394-411 and P. Dye, 'Logistics and the Battle of Britain', *Air Power Review*, Volume 3, Number 4 (2000), 14-36.

There is a great dearth of information in historical records of the Second World War about logistics. Plenty of high level planning, on strategy at Chiefs of Staff levels; plenty on operations and tactics – about what happened when high-level strategy was put into effect: very little on logistics, the nuts and bolts of how equipment and supplies got to where they were needed.<sup>14</sup>

In many cases, logistics is often referred to indirectly where authors illustrate their works with statistical data such as aircraft production numbers<sup>15</sup> or the tonnage of munitions expended during the bomber offensive in Europe.<sup>16</sup> Logistics is often reduced to a bare fact, devoid of any wider context such as where the supplies came from, how they got there and who was involved in that process. Some authors, almost apologetically, make closing references in their works to the vital role of ground crews. The problem here is that the lack of any real detail means that the multitude of ground disciplines meld into almost one anonymous identity and the logistics' perspective is lost. For example, John Terraine in his extensive work on the RAF in the European theatre of the Second World War, reserves such comment to his penultimate page:

The overwhelming majority of the RAF's million were to be found in the ground crew – that assembly of skilled, educated, individualistic, irreverent, dependable men without whose untiring labours the aircraft would not have flown, the operations would not have happened, the victory could never have been won.<sup>17</sup>

Where more direct reference is made, it is often brief and usually begs further comment. Stuart Peach for example, in writing about air power and the fall of France in 1940, makes a brief comment on logistics, highlighting that 'The excellent 'system' established by the Royal Flying Corps and Royal Air Force in France in 1918 was not set up in 1939. Instead, it was a hand-to-mouth

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14 H. Wynn, 'The Logistics of Air Support for the Second World War Land-Air Campaign', *Proceedings of the RAF Historical Society Seminar – Logistics Support to Deployed Operations*, 28 October 1997 (Brampton: HQ Logistics Command, 1997), p.1. Similar comment is also made in Stockfish, J.A., *Linking Logistics and Operations: A Case Study of World War II Air Power*, A RAND Note Sponsored by the United States Air Force (Santa Monica, CA (USA): RAND Corporation, 1991) - this author makes the additional comment that very few works consider the relationship between logistics and operations.

15 See, for example: J. Terraine, *The Right of the Line – The Royal Air Force in the European War 1939 - 1945* (Ware: Wordsworth Editions, 1997), p.191; J. Holland, *The Battle of Britain – Five Months that Changed History May-October 1940* (London: Bantam Press, 2010), pp.169 and 322; P. Dye, 'Sustaining Air Power-The Influence of Logistics on Royal Air Force Doctrine' *Air Power Review*, Volume 9, Number 2 (2006), 41-51 and Dye, 'Logistics and the Battle of Britain', 3-42.

16 See, for example: D. Richards, *The Hardest Victory – RAF Bomber Command in the Second World War* (London: Penguin Books, 2001), p.291; A.W. Cooper, *The Air Battle of the Ruhr – RAF Offensive March to July 1943* (Shrewsbury: Airlife, 1992) p.134; A. Harris, *Bomber Offensive* (London: Greenhill Books, 1990), p.241 and Terraine, *The Right of the Line*, p.537.

17 Terraine, *The Right of the Line*, p.686.

existence for Barratt's squadrons, with many key elements in extreme logistical difficulty'.<sup>18</sup> Of the more recent works, comments made by Robin Higham and Stephen Harris pose one of very few challenges for scholars to examine logistics. In considering what they class as defeats of the Royal Air Force (Norway, France, Greece and Malaya 1940-1942), the authors highlight particular logistics' issues with the campaigns in Norway and France.<sup>19</sup> However, it is in their suggestions for further research that they make the useful recommendation that, inter alia, more study of logistics is much needed.

The discipline does appear to be generally acknowledged as being a critical aspect of air power delivery, but so many writers on the subject have, at best, made only fleeting references and, at worst, made no reference at all.<sup>20</sup> It therefore lacks historical scrutiny. As the next section in this chapter will confirm, there is indeed a significant dearth of material on logistics, especially relating to the RAF during the Second World War. Why should that be? Casual observers might suggest that the discipline lacks the interest of tales of battles in the air and the accompanying deeds of 'derring-do'. Perhaps a clue might lie in the view of General Omar Bradley (commander of the US 1<sup>st</sup> Army who landed at Utah and Omaha beaches on D-Day) who, on the one hand, described logistics as the 'lifeblood of the Allied armies in France', but on the other as 'the dullest subject in the world'.<sup>21</sup> A similar comment is made by Robin Higham and Stephen Harris who suggest that the disciplines of 'maintenance, wastage, consumption, and supply' are 'dull but basic subjects'.<sup>22</sup> The American military historian, Colonel Albert Garland echoes this theme when outlining his thoughts on writing military history, observing that '...many military historians find the study of military logistics boring and unrewarding'. He does, however, add '...but if they are to understand military operations, they must learn all they can about military logistics'.<sup>23</sup> This theme continues in the edited collection *Feeding Mars*, where John Lynn observes in his preface that 'logistics lacks the

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18 S.W. Peach, *A Neglected Turning Point in Air Power History: Air Power and the Fall of France* in S. Cox & P. Gray (eds), *Air Power History – Turning Points from Kitty Hawk to Kosovo* (Abingdon: Frank Cass, 2005), p.150.

19 R. Higham and S.J. Harris (eds), *Why Air Forces Fail – The Anatomy of Defeat* (Kentucky (USA): The University Press of Kentucky, 2006), pp.320, 322 and 325.

20 Also commented on by P.Dye, *The Bridge to Airpower – Logistics Support for Royal Flying Corps Operations on the Western Front, 1914-18* (Annapolis (USA):Naval Institute Press, 2015), p.5. Dye makes the point that 'The relationship between logistics and airpower has been little explored'.

21 T. Hall (ed), *D-Day – Operation Overlord - From its Planning to the Liberation of Paris* (London: Salamander Books, 1993), p.115.

22 Higham and Harris, *Why Air Forces Fail*, p.337.

23 A.N. Garland, 'Thoughts on the Writing of Military History', *Military Affairs*, Vol 35, No 1 (Feb 1971), 18-20 (p.19).

drama of combat. It can be expressed on balance sheets no more exciting than shopping lists; movement is not measured by the dashing gallop of charging cavalry but by the steady plod of draft horses'.<sup>24</sup> Edward Luttwak comments that '...the means by which armed forces were equipped and supplied in peace and war are quite often simply ignored or, at best, treated only in a fragmentary fashion'.<sup>25</sup> Jonathan Roth makes the insightful suggestion that 'as with so many human institutions, logistics is least observable when it works well, and usually only enters the historical record when it breaks down'.<sup>26</sup> Whilst criticism could be levelled at air power historians for failing to present a balanced picture, it could equally rest with professional logisticians who, with a more informed professional insight, could also have contributed to the scholarship. The reasons for writing this thesis though are not just to redress the shortage of material in the literature; it also needs to provide an input of value in its own right. The operationally focused works enable an understanding of *why* and *where* air power was employed; a deeper understanding of air logistics enables an appreciation of *how* air power was sustained.

### **Definition and Scope of Logistics in this Thesis**

Logistics is a term which has gained rapid and widespread usage in recent years. From a visual perspective, this view is supported by the number of heavy transport vehicles on British roads, once operating as haulage or transportation companies, now emblazoned with art work proclaiming them as specialists in logistics solutions.<sup>27</sup> Further examples of such usage can be found in the media, with television presenters and reporters using the term when commenting on large scale events to describe a multitude of support activities, but would probably be more accurately described as administrative. This widespread usage is also commented on by Stephen Russell who observed that:

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24 J.A. Lynn (ed), *Feeding Mars – Logistics in Western Warfare from the Middle Ages to the Present* (Oxford: Westview Press, 1993), p.vii.

25 E.N. Luttwak, *Logistics and the Aristocratic Idea of War* in Lynn, *Feeding Mars*, p.3. See also R. Glover, 'War and Civilian Historians', *Journal of the History of Ideas*, Vol 18, No 1 (Jan 1957), 84-100 (p.89).

26 J.P. Roth, *The Logistics of the Roman Army at War (264 BC – AD 235)* (Leiden (Netherlands): Brill, 2012), p.3.

27 Examples of such companies from the Road Haulage Association 'Find a Haulier' web page include: 24/7 Express Logistics Ltd; 2mv Logistics and A&D Logistics. [www.rha.uk.net/find-a-haulier](http://www.rha.uk.net/find-a-haulier) (last accessed on 19 July 2012).

Beginning in the 1970s, the term logistics crept into the lexicon of the common culture. The word is now being used with regard to the supply support of activities from church picnics to the Olympics.<sup>28</sup>

A similar observation is made by Stuart Emmett who comments that 'in the UK, one can observe the new name on a freight transport vehicle that before was called 'Fred Smith Transport,' is now called 'Fred Smith Logistics'. Logistics can therefore be a confusing word'.<sup>29</sup> The literature, however, seems to be unanimous in the view that the term has its roots in the world of the military, although its etymology can first be traced to the Ancient Greek, *λογιστική* 'Logistik' meaning skilled in calculating.<sup>30</sup> In a purely military context the term emerges in the French 'Logistique' who was a Napoleonic officer responsible for quartering troops and finding animal forage.<sup>31</sup> It is not, however, the origin of the word that prompts debate, but what the term encompasses. The literature is replete with numerous attempts at defining the term, from the relatively simple 'logistics is concerned with the movement of goods'<sup>32</sup> to the more complex such as:

A single logic to guide the process of planning, allocating and controlling financial and human resources committed to physical distribution, manufacturing support and purchasing operation.<sup>33</sup>

or:

Logistics is an extension of physical distribution management [an accepted term for managing the operation of supplying immediate customers] and usually refers to the management of materials and information flow from a business, down through a distribution channel, to end customers.<sup>34</sup>

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28 S. Russell, 'Growing World of Logistics – A General Theory of Logistics Practices', *Air Force Journal of Logistics*, Volume XXIV, Number 4 (2000), 13-17.

29 S. Emmett, *Supply Chain in 90 Minutes* (Cirencester: Management Books 2000 Ltd, 2005), p.64.

30 P.S. Sarin, *Military Logistics – the Third Dimension* (New Delhi (India): Marias Publications, 2000), p.30. Other scholars comment that, before the 1950s, logistics was also generally thought of in military terms – see R.H. Ballou, 'The Evolution and Future of Logistics and Supply Chain Management', *English Business Review*, Vol 19, No 4 (2007), 332-348 (p.333).

31 J.F. Robeson & W.C. Copacino (eds), *The Logistics Handbook* (New York (USA): The Free Press, 1994), p.3.

32 D. Burt, S. Petcavage & R. Pinkerton, *Supply Management* (Eighth Edition) (New York (USA): McGraw Hill, 2010), p.58.

33 D.J. Bowersox, D.J. Class & O.K. Heferich, *Logistical Management* (3rd Edition) (London: Macmillan, 1986), p.3.

34 Slack, N, Chambers, S, Harland, C, Harrison, A and Johnston, R, *Operations Management* (London: Pitman Publishing, 1995), p.511.

A further complication in the pursuit of a definition concerns the inclusion, or otherwise, of the engineering function, though this argument appears to be a preoccupation of the military. For many years there existed in the RAF a clear demarcation between engineering and supply, with both disciplines represented by a specialist ground branch and associated trades (for officers and other ranks respectively).<sup>35</sup> This remained a clearly understood division of responsibilities for many years but, by the early 1990s, the Service found the need to expand its scope of logistics with the introduction of what was known as Support Chain Management (SCM); essentially, this was a standard supply chain from Suppliers to Customers, but with engineering added as a 'link' following Contracting, Purchasing, Storage and Distribution.<sup>36</sup> Coincident with this philosophical 'shift', RAF Logistics Command was formed to embrace the change and to provide a home for numerous organisations which provided SCM services. The official history of the Command related how SCM:

...provided a more coordinated approach to the management of assets, and involved a joined-up strategy covering all processes in the management of an equipment, to improve availability of spares and reduce stock levels.<sup>37</sup>

Logistics Command was relatively short lived and the Strategic Defence Review of 1998 acknowledged that a tri-Service approach was required and announced the formation of the Defence Logistics Organisation (DLO). Thus, the functions of RAF Logistics Command were effectively absorbed into this new Defence-wide formation. Whilst the concept still endures at a pan-Defence level, the fashion for an all-embracing term within the RAF itself seems to have faded. This view is emphasised by the fact that, what was the RAF Supply Branch, became the Logistics Branch in 2009 and technical activity remains the responsibility of the RAF Engineering Branch and Trades. It is also worth noting that the North Atlantic Treaty Organisation (NATO) continues to take a much wider view of what logistics encompasses, defining it as follows:

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<sup>35</sup> The logistics discipline was first embodied in a professional guise as the Stores Branch in 1920; this foundation is discussed in more detail in Chapter 1 of this thesis. The engineering discipline was not formalized as a ground Branch until 1940 and titled the Technical Branch.

<sup>36</sup> Ministry of Defence (MOD), *Royal Air Force Support Management DGSM (RAF), Support Excellence – A Guide for Staff* (Undated), p.24.

<sup>37</sup> RAF Logistics Heritage Centre Archive (LHCA), Box 13 (Organization), Booklet to Commemorate the Disbandment of Royal Air Force Logistics Command dated 29th October 1999, p.2.

The science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, the aspects of military operations which deal with:

- design and development, acquisition, storage, transport, distribution, maintenance, evacuation and disposal of materiel.
- transport of personnel;
- acquisition or construction, maintenance, operation and disposition of facilities;
- acquisition or furnishing of services; and
- medical and health service support.<sup>38</sup>

Some academics in the management science field have also widened their definitions in this respect, none perhaps more clearly than John Langford who describes logistics as:

The application of engineering, operational and managerial skills to provide a product with prerequisite quality, reliability, maintainability and supportability and to sustain safe and cost effective utilization of that product for its intended purpose throughout its projected service life.<sup>39</sup>

Clearly, the pursuit of a universally agreed definition is a debate which would generate an academic paper in its own right, but such a quest is not within the scope of this work. What is important is to specify a definition for this thesis so the scope is clearly understood. It is suggested that the answer to the dilemma lies in the work of one of the earliest writers on the topic in the modern era, the Frenchman Jomini. His views are described in Martin Van Creveld's *Supplying War*, generally acknowledged as the seminal work on military logistics.<sup>40</sup> In this work, Van Creveld describes how Jomini included in his definition 'the practical art of moving armies' and providing for the successive arrival of convoys of supplies and establishing and organizing... lines of supplies'.<sup>41</sup> Van Creveld suggests that the elements of Jomini's definition can be joined up to form 'the practical art of moving armies and keeping them

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38 North Atlantic Treaty Organisation (NATO), *NATO Logistics Handbook* (Brussels: NATO, 2007), p.4.

39 J.W. Langford, *Logistics - Principles and Applications* (2nd Edition) (New York (USA): McGraw-Hill, 2007), p xvii.

40 Whilst Van Creveld's work was a significant contribution to the historiography of military logistics, some scholars are beginning to take issue with his perspective on the subject. The academic Thomas Kane, for example, raises a number of issues, not least of which is that he believes Van Creveld's *Supplying War* 'implies that the logistical factors which affect victory and defeat are beyond any leader's conscious control'. T.M. Kane, *Military Logistics and Strategic Performance* (London: Frank Cass, 2001), p.7 refers. See also T.M. Kane, *Strategy: Key Thinkers – A Critical Engagement* (Cambridge: Polity Press, 2013), p.33.

41 Van Creveld, *Supplying War*, p.1.

supplied'.<sup>42</sup> Peter Foxtton, author of the land force logistics' work *Powering War* also takes this line and declares his definition as 'The maintenance and transportation of armed forces.'<sup>43</sup> Maintenance includes equipping and then supplying'.<sup>44</sup> Julian Thompson, however, does point out that Jomini's definition is set in a much broader context of the staff work of campaigning and that in his examples in *The Art of War*, 'strays even further from logistics , into the realms of strategy and grand tactics, or the operational art'.<sup>45</sup> Notwithstanding Thompson's reservations, Jomini's basic definition as suggested by Foxtton cuts to the quick – his definition of logistics need be no more complex. For the purpose of this thesis, therefore, the scope of the term is limited to supply and movements' factors and excludes engineering activity as this over-complicates the scope, albeit the synergy with this is acknowledged where appropriate.<sup>46</sup>

## The Historiography of RAF Logistics

The official histories of the Second World War provide a useful insight to the national economic and industrial aspects which had a direct bearing on logistics. The work by the historians Hancock and Gowing, *British War Economy*, provides good background material on industrial production, along with detailed narrative on the growth of American support through the Lend-Lease scheme.<sup>47</sup> Similar works in this series provide more detail on British war production, with valuable material on RAF procurement. The work by M.M. Postan, *British War Production*, provides an insight to the pre-war re-equipment of the RAF and aircraft production, whilst J.D. Scott and R.Hughes' *Administration of War Production*, provides a valuable accompanying volume which covers much of the organisational and managerial aspects of aircraft production.<sup>48</sup> Logistical issues arising from engineering are also explored in M.M. Postan, D. Hay and J.D. Scott's *Design and Development of Weapons*.<sup>49</sup> Later scholarship by the historian Correlli Barnett considers the wider issue of

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42 Ibid.

43 P.D. Foxtton, *Powering War – Modern Land Force Logistics* (London: Brassey's, 1999).

44 P.D. Foxtton, 'Powering War', *Proceedings of the BCMH Summer Conference*, 20-22 July 2007, p.2.

45 J. Thompson, *Lifeblood of War – Logistics in Armed Conflict* (London: Brassey's, 1991), p.5.

46 Peter Dye includes maintenance in his definition of 'aviation logistics' in P.Dye, *The Bridge to Airpower – Logistics Support for Royal Flying Corps Operations on the Western Front, 1914-18* (Annapolis (USA):Naval Institute Press, 2015), p.2.

47 W.K.Hancock and M.M. Gowing, *History of the Second World War – British War Economy* (London: HMSO,1949).

48 J.D. Scott and R. Hughes, *History of the Second World War –Administration of War Production* (London: HMSO, 1955).

49 M.M. Postan, D. Hay and J.D. Scott., *Design and Development of Weapons – Studies in Government and Industrial Organisation* (London: HMSO,1963).

the industrial effectiveness of aircraft production in *Audit of War*, whilst the historian Sebastian Ritchie provides a more in-depth exploration of British aircraft production from 1935 to 1941 in his *Industry and Air Power*.<sup>50</sup> The debate regarding the effectiveness of aircraft production is also explored by the historian David Edgerton in *Britain's War Machine* and *England the Aeroplane*.<sup>51</sup>

As already commented on, the Air Ministry AHB narratives and monographs have the greatest density of logistics' coverage in the available literature on RAF air power for this period. These sources, however, have limitations: there is little comment on the identity, structure, development and work of the Equipment Branch and Trades throughout the period; there is limited discussion on the range and nature of specialist organisations formed to deliver logistics to the front line; there is limited detail of the logistic procedures employed, their effectiveness and how lessons were learned and there is no social or cultural context.

Outside of the official histories, the coverage of air logistics in secondary sources diminishes considerably. The men and women of RAF logistics were to be found amongst the ground branches and trades, a diverse range of specializations often colloquially referred to as ground crew. Apart from comment in broader, campaign focussed works, it is perhaps here that an examination of logistics could be expected. The earliest work to consider RAF ground crews was produced by Air Chief-Marshal Sir Philip Joubert de La Ferté in 1961.<sup>52</sup> Its style, however, is heavily anecdotal and lacks references and a bibliography. Moreover, its coverage is constrained to a limited range of topics such as aircraft ground crew in general, the Women's Auxiliary Air Force, Motor Transport and the RAF Regiment. Despite a very short chapter on Maintenance Command, there is no other reference to logistics.

The first work to take a wider view was published by F.J. Adkin in 1983 and considers the history of RAF ground crew up until the end of the Second

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50 C. Barnett, *The Audit of War- The Illusion and Reality of Britain as a Great Nation* (London: Pan Books, 1986) and S. Ritchie, *Industry and Air Power – The Expansion of British Aircraft Production, 1935-1941* (London: Frank Cass, 1997).

51 D. Edgerton, *Britain's War Machine – Weapons, Resources and Experts in the Second World War* (London: Penguin Books, 2012) and D. Edgerton, *England and the Aeroplane – Militarism, Modernity and Machines* (London, Penguin Books, 2013).

52 P.B. Joubert de la Ferté, *The Forgotten Ones- the Story of the Ground Crews* (London: Hutchinson, 1961).

World War.<sup>53</sup> Although this has a very basic bibliography, and acknowledges that files from the Public Record Office (now The National Archives) were consulted, a lack of any footnoting limits its level of scholarship. In terms of content, Adkin's work is largely preoccupied with aircraft ground crews and their exploits, a feature probably influenced by the fact that the author is an ex-RAF Airframe Fitter. Similar to de la Ferté's work, Adkin makes little reference to logistics apart from brief comment on the supply of spares and fuel to the Royal Flying Corps in France during 1915.<sup>54</sup> Both of these works will probably appeal to ex-RAF technical tradesmen who will no doubt identify with the extensive anecdotal content and provide a sense of satisfaction that their oft-perceived, less glamorous contribution to the work of the RAF has been acknowledged. Paragraphs in the closing pages of each book such as 'there will still be a need in the RAF for the type of individual I have tried to describe in this story. Bless 'em all, boys and girls together' and 'the few incidents described can only be a fraction of the thousands waiting to be told; if the erks [sic] could only record them before it is too late, if only for posterity and to tell historians how much they contributed', suggest that de la Ferte's and Adkin's work sit more within the 'popular' history field and have limited value in the more scholarly examination of air power.<sup>55</sup>

A move from the ground crew focus came in 1990 with John James' publication of *The Paladins*, a social history of the RAF up to the outbreak of the Second World War.<sup>56</sup> Arguably, the fact that the author is an ex-Air Ministry psychologist has enabled a more detached examination of both air and ground crews and a description of the evolution of the pre-war service within which they worked. Of particular note, James describes the development of a much wider range of Branches and Trades, although this tends to be more biased towards officers than other ranks. He does make useful comment on the early structure and numerical development of the RAF Stores Branch. The work benefits from stronger scholarship through the use of chapter notes and references. The latest work which makes a broad contribution to air power study with some comment on logistics is Ian Philpott's, two volume encyclopaedic examination of

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53 F.J. Adkin, *From the Ground Up – A History of RAF Ground Crew* (Shrewsbury: Airlife, 1983).

54 Ibid, pp. 54-55.

55 Joubert de la Ferté, *The Forgotten Ones*, p.246 and Adkin, *From the Ground Up*, p.215.

56 J. James, *The Paladins – A Social History of the RAF up to the Outbreak of World War II* (Aylesbury: Futura, 1990).

the inter-war years.<sup>57</sup> Volume One includes a useful overview of RAF supply in the 1920s, though it is little more than a snapshot based on the process and policy set out in the RAF Stores regulations of the time. Volume Two continues in this vein, with a useful overview of the Groups within Maintenance Command, the constitution of the RAF Stores Branch and a further development of supply process and policy as defined within Air Publication 830. This is by far the most detailed exploration of the logistics perspective, though it covers only the period up to 1939. The limitation of Philpott's work is that it is clearly intended as an encyclopaedic resource and explores many topics, especially logistics, in isolation from how the RAF was employed as a fighting force. Consequently, there is no evaluation or narrative of logistics in the broader context of air power delivery. It is clear that Philpott has researched these volumes extensively, although there is no footnoting and the bibliography is limited.

The transportation aspect of logistics is reasonably well covered in the literature but the overall tenor is on the hardware involved and there is little comment, for example, on how passengers and freight were processed<sup>58</sup>; details of the latter are invariably to be found in military journals and then usually as early paragraphs in articles discussing post-war air movements.<sup>59</sup> The official history, *Inland Transport*, provides a useful overview of the work of the Ministry of War Transport covering road, rail and water transportation, but its coverage is quite generic and it is difficult to extract RAF specific information.<sup>60</sup> Road transportation is examined in Bruce Robertson *Wheels of the RAF* but the general tenor is one of an enthusiast's guide to the vehicles themselves, with very little on the part they played in supply chain operations.<sup>61</sup> Although primarily a work on the United States Army's transportation system during the Normandy Campaign and after in 1944/1945, Pat Ware's *Red Ball Express – Supply Line from the D-Day Beaches* provides useful information on a very specific road transport operation which British forces benefitted from, although

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57 I.M. Philpott, *The Royal Air Force – An Encyclopedia of the Inter-War Years, Volume I, The Trenchard Years 1918 to 1929* (Barnsley: Pen & Sword, 2005) and *The Royal Air Force – An Encyclopedia of the Inter-War Years, Volume II, Re-Armament 1930 to 1939* (Barnsley: Pen & Sword, 2008).

58 For example: R. Townshend Bickers, *Military Air Transport – Airlift – The Illustrated History*, (London: Osprey, 1998); C. Cole & R. Grant, *But Not in Anger – The RAF in the Transport Role* (London: Ian Allan, 1979); K. Macksey, *For Want of a Nail: The Impact on War of Logistics & Communications* (London: Brassey's, 1989) and H. Wynn, *Forged in War – a History of Royal Air Force Transport Command 1943-1967*, (London: The Stationery Office, 1996).

59 M.J. Brown, 'RAF Movements – A Short History', *Air Clues*, December (1992), 449-454.

60 C.I. Savage, *History of the Second World War – Inland Transport* (London: HMSO, 1957).

61 B. Robertson, *Wheels of the RAF – Vehicles of the Flying Services Through Two World Wars* (Cambridge: Patrick Stephens Ltd, 1983).

the level of detail in this respect limits the extent to which the wider value to the RAF can be assessed.<sup>62</sup> Information on the role of the railways fares better, with one of the earliest publications being *Facts About British Railways in Wartime* produced by the British Railways Press Office in 1943; its coverage is however, broad brush, and provides a more general interest examination.<sup>63</sup> A more detailed study emerged in 1964 with Carter's *Railways in Wartime* which traces the use of the railways from the American Civil War through to 1946; its references to air logistics are quite limited.<sup>64</sup> Robertson's five part series in the aviation magazine *Air Pictorial on Railways and Air Warfare* from 1914 to the 1970s is perhaps the first work which focuses on how this mode of transport played a part in air logistics.<sup>65</sup> This was followed some eight years later by Bill Corser who produced an overview (in three parts) on the relationship between the railways and aviation in the magazine *FlyPast*.<sup>66</sup> Corser also examined the RAF Railway on the Island of Masirah, in a dedicated book as well as a magazine article also in *FlyPast* magazine<sup>67</sup>; this railway is also commented on in Colin Richardson's wider examination of the RAF's basing on Masirah.<sup>68</sup> Corser also produced a useful examination of how the railways provided logistic support of Britain's Air Defence Forces from 1914-1994 but its coverage is in a gazetteer format which examines the topic by specific sites.<sup>69</sup> The narrow gauge railway at the explosives depot RAF Chilmark also attracted attention in a short article in the *Railway Magazine* written by A.F. Saunders in 1976.<sup>70</sup> A more scholarly examination of the role of railways in warfare, with a number of references to the part they played in logistics (though not specifically the RAF supply chain) is provided by Christian Wolmar in his works *Engines of War* and *Fire and Steam*.<sup>71</sup>

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62 P. Ware, *Red Ball Express – Supply Line from the D-Day Beaches* (Hersham: Ian Allan Publishing, 2007).

63 British Railways Press Office, *Facts About British Railways in Wartime 1943* (London: British Railways Press Office, 1943).

64 E.F. Carter, *Railways in Wartime* (London: Frederick Muller Ltd, 1964).

65 B. Robertson, Railways and Air Warfare (Parts 1-5), *Air Pictorial* (March-July 1987), 109-111(March), 158-159 (April), 195-197(May), 236-237 (June) and 276-277(July).

66 W.J.L. Corser, Railways and Military Aviation (Parts 1-3), *FlyPast* (September 1995 & December 1995), 28-30 (September 1995), 25-26 (December 1995).

67 W.J.L. Corser, *The RAF Masirah Railway* (Pinner: RAM Productions Ltd, 1994) and *The RAF Masirah Railway*, *FlyPast* (March 1995), 52-54.

68 C. Richardson, *Masirah – Tales from a Desert Island* (Durham: Pentland Press, 2001).

69 W.J.L. Corser, *Wings on Rails – Industrial Railways in the Logistics Support of Britain's Air Defence Forces 1914-1994*, World War Two Railway Study Group Publication No.2 (Fleet: Arcturus Press, 2003).

70 A.F. Saunders, The Little Trains of Chilmark, *The Railway Magazine*, Volume 122, Number 899, March 1976, 116-118.

71 C. Wolmar, *Engines of War – How Wars Were Won and Lost on the Railways* (London: Atlantic Books, 2010) and C. Wolmar, *Fire and Steam – How the Railways Transformed Britain* (London: Atlantic Books, 2007).

The role of water transport in RAF logistics is the least well covered in the literature with troopships and sea trooping the main focus of interest. This area was first examined by Colonel H.C.B. Rogers in 1963 as a broad approach from the Seventeenth Century through its replacement by air trooping for United Kingdom forces in the early 1960s.<sup>72</sup> A more detailed examination of the area which, inter alia, explored the role during the First and Second World Wars appeared was published by Robertson in 1990.<sup>73</sup>

The role of air transport is reasonably well covered. Richard Townshend Bickers' *Military Air Transport* provides a general history, but detail of RAF operations is fairly limited due to the multi-national perspective of this work.<sup>74</sup> There is much better coverage of RAF operations in Humphrey Wynn's history of RAF Transport Command *Forged in War* and the more generic history by Roderick Grant and Christopher Cole *But Not in Anger* which examines the RAF in the Transport Role<sup>75</sup>; of these two works, Grant & Cole provides the greatest detail in terms of how air transport played a part in logistics. More focused works on the use of air transport have also been produced including: Anne Baker and Sir Ronald Ivelaw-Chapman's *Wings Over Kabul*; Roger Annett's *Drop Zone Burma* and E. Bennett-Bremner's *Front-Line Airline*.<sup>76</sup>

The availability of small print-run publishing has encouraged some veterans and amateur historians to produce histories which contribute to the understanding of specific areas within the logistics area. A history of 100 Maintenance Unit at RAF South Witham by Martyn Chorlton provides a useful examination of a typical 42 Group explosives depot<sup>77</sup>, whilst Bryan Blow's history of 51 (RAF) MT Company 1942-1956 enables a clearer understanding of the operation and significance of MT in North Africa and Italy.<sup>78</sup> Published, autobiographical accounts are scarcer with only three emerging from the latter part of the Second World War period. A useful insight into the work of the RAF

72 H.C.B. Rogers, *Troopships and Their History* (London: Seeley Service & Co, 1963).

73 R.G.Robertson, Troopships and Trooping (Parts 1-8), *Ships Monthly*, May-December 1990, <http://www.movcon.org.uk/History/Documents/DID/D-MCHS%200290.10.htm> (last accessed 14 September 2012).

74 Townshend Bickers, *Military Air Transport*.

75 See: Wynn, *Forged in War* and Cole & Grant, *But Not in Anger*.

76 See: A. Baker and R. Ivelaw-Chapman, *Wings Over Kabul – The First Airlift* (London: William Kimber, 1975); R.Annett, *Drop Zone Burma – Adventures in Allied Air-Supply 1943-45* (Barnsley: Pen & Sword, 2008) and E.Bennett-Bremner, *Front-Line Airline: Air Transport during the South-West Pacific War 1939-44* (London: Paul Elek Publishing, 1945).

77 M. Chorlton, *Danger Area – A Complete History of RAF South Witham 100 Maintenance Unit* (Spalding: Old Forge Publishing, 2003).

78 B. Blow, *The History of 51(RAF) MT Company (Squadron) 1942-1956* (Bryan Blow, 1987).

Beach Squadrons during operation OVERLORD in 1944 can be found in the works of Glen McBride and Alan Melville, along with Douglas Young-James' experiences with 91 Air Stores Park in Burma and Japan, during 1944 and 1945.<sup>79</sup> As far as journal and magazine articles are concerned, Air Vice-Marshal Peter Dye has perhaps made the greatest contribution to the study of logistics, although his work takes the wider view of the definition of logistics (discussed earlier in this introduction) and his articles have a very strong maintenance flavour.<sup>80</sup> Dye's doctoral research in this field has been published in the *Bridge to Airpower* and is the most recent work which considers the relationship between logistics and British air power in the First World War.<sup>81</sup>

In conclusion, an examination of the wider literature shows that, aside from the AHB official histories, there is little detailed examination of RAF logistics and its role in the delivery of air power during the Second World War. A number of authors have examined specific aspects of logistics such as transportation but, on the whole, these are not set in in a broader logistics or operational context. Moreover, there does not appear to be a single work which ties these specialist studies together into an all-embracing view of RAF logistics during the period.

## Research Questions

Given this sporadic coverage, five key research questions emerge:

- 1 What was the RAF logistics organisation and how did it come into being?
- 2 How and why did the logistics organisation develop during the period from the expansion programme of the mid-1930s until the outbreak of war in 1939?

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79 G. McBride, *D-Day on Queen's Beach Red* (Brisbane (Australia): Moore Print Pty Ltd, 1994), A. Melville, *First Tide – D-Day Invasion June 6th 1944* (London: Skeffington & Son Ltd, undated) and D. Young-James, *Memoirs of an ASP* (London: Neville Spearman, 1965).

80 See: Dye, 'The Royal Flying Corps Logistic Organisation', 32-38; Dye, 'Logistics and the Battle of Britain', 3-42; Dye, 'Sustaining Air Power', 41-51 and P. Dye, 'France and the Development of British Military Aviation', *Air Power Review*, Volume 12, Number 1 (2009), 1-12.

81 P.J Dye, 'Air Power's Midwife – Logistics Support for Royal Flying Corps Operations on the Western Front, 1914-1918' (unpublished doctoral thesis, University of Birmingham, 2013) and P.Dye, *The Bridge to Airpower – Logistics Support for Royal Flying Corps Operations on the Western Front, 1914-18* (Annapolis (USA):Naval Institute Press, 2015).

- 3 Who made it happen? Had the RAF achieved this independently or were there other contributors?
- 4 How did the RAF's logistics organisation sustain the employment of RAF air power throughout the war?
- 5 How did the RAF adjust its logistics organisation to meet the evolving needs of RAF air power throughout the war and with what success?

These five questions give rise to the three generic themes which are included in the thesis title namely: Transformation, Sustainment and Flexibility. The overall conclusions in Chapter Nine use these themes to provide a clearer, and less complex, overview. The relationship of the key research questions to the generic themes is shown in Table 1:

<b>Research Question</b>	<b>Generic Theme</b>
1. What was the RAF logistics organisation and how did it come into being?	Transformation
2. How and why did the logistics organisation develop during the period from the expansion programme of the mid-1930s until the outbreak of war in 1939?	
3. Who made it happen? Had the RAF achieved this independently or were their other contributors?	Sustainment
4. How did the RAF logistics' organisation sustain the employment of RAF air power throughout the war?	
5. How did the RAF adjust its logistics organisation to meet the evolving needs of RAF air power throughout the war and with what success?	Flexibility

**Table 1 -**  
**Research Questions and Themes**

## **Research Methodology**

In considering an appropriate methodology for this research, there is a fundamental issue regarding intellectual approach. From an academic perspective, logistics is usually viewed as a social/management science discipline. Given that this thesis primarily examines an aspect of the RAF's operation and capability during the Second World War, and therefore requires an historian's approach, a potential conflict emerges between historical and

social science research methodology. In terms of methodological difference, the historian William McDowell provides a useful differentiation:

A basic contrast has always been seen to exist between historical narrative and theoretical models in the social sciences. Some social scientists believed that traditional historical narrative provided little more than a descriptive account of the past with insufficient analytical content. The greater emphasis on quantitative data in the social sciences did require the construction of abstract models...<sup>82</sup>

Whilst McDowell does not rule out any inter-relationship between the two disciplines, his comments indicate that there are difficulties in dovetailing the two approaches. Conversely, the historian John Tosh's work on historiography strongly supports inter-disciplinary approaches, especially from the field of social science. Indeed, he makes the point that '...there are strong reasons why historians should – in the first instance at least – avail themselves of imported theory'.<sup>83</sup> The significance of this issue is that, to examine logistics in an historical context, the question of scope requires careful consideration. The definition of logistics which was considered earlier in this introductory chapter indicates that it can be considered from a macro or micro perspective. At the macro analytical level, which Mossman defines as where '...attention is focused on the larger forces at work...', the question of scope is easier to handle and (inter alia) might consider how the availability of fuel, ammunition and supplies affected the outcome of a specific battle or campaign. At the micro analytical level, defined by Mossman as '...the various forces at work in sub-segments...'<sup>84</sup> this becomes more difficult to handle. Most of the books which consider military logistics do so from a macro perspective, with occasional references to micro detail to illustrate specific points.<sup>85</sup> Whilst this might appeal to a wider-readership, much of the detail shows how logistics actually worked. In order that the research questions can be properly addressed, a micro approach needs to be taken to enable a more forensic and informative analysis.

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82 W.H. McDowell, *Historical Research – A Guide* (Harlow: Pearson Education, 2002), p.16.

83 J. Tosh, *The Pursuit of History – Aims, methods and new directions in the study of modern history* (Fifth Edition) (Harlow: Pearson Education, 2010), p.223.

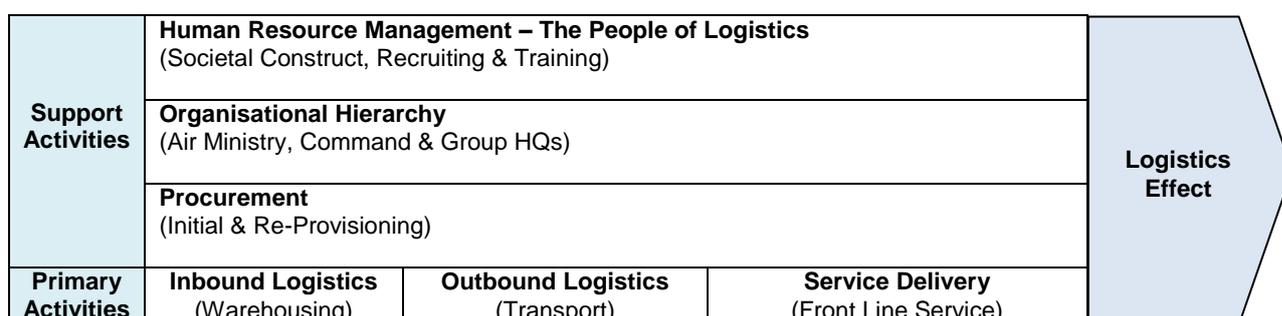
84 F.H. Mossman, 'Logistics of Distribution Systems In the Economy', *Transportation Journal*, Volume 1, Number 3 (Spring 1962), 30-33.

85 See, for example: Van Creveld, *Supplying War*; Thompson, *Lifblood of War* and Foxton, *Powering War*.

To provide a framework for research which enables an analysis of specific sub-disciplines within logistics, it was decided to use a model that is well respected in the management science discipline and one often referred to in the subject of supply chain management – Porter’s Value Chain. Although the term ‘supply chain’ was not in general use during the Second World War period, modern analytical approaches to the subject do provide a helpful framework to explain the operation of all parts of logistics. In doing so, it is useful to just outline what the term actually means. Contemporary management science literature provides a number of definitions but the work of Chopra and Meindl provides one of the most concise, defining a supply chain as consisting of:

...all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain includes not only the manufacturer and suppliers, but also transporters, warehouses, retailers and even customers themselves. Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request.<sup>86</sup>

Porter’s original model was a means of showing a range of activities in an organisation which were seen as delivering a valuable product or service and consisted of support activities (e.g. Human Resource Management) and primary activities (e.g. inbound logistics).<sup>87</sup> Porter’s model has therefore been adapted in order to identify the key components of the RAF’s supply chain and is detailed in Figure 1.



**Figure 1 -  
RAF Supply Chain Model 1939-1945 (after Porter)**<sup>88</sup>

<sup>86</sup> S. Chopra and P. Meindl, *Supply Chain Management – Strategy, Planning and Operation*, Third Edition (New Jersey (USA): Pearson Prentice Hall, 2010), p.3.

<sup>87</sup> M.E. Porter, *Competitive Advantage – Creating and Sustaining Superior Performance* (New York (USA): Free Press, 2004), p.36.

<sup>88</sup> Adapted from Porter’s Value Chain Model illustrated in K. Lyons and B.Farrington, *Purchasing and Supply Chain Management (Seventh Edition)* (Harlow: Prentice Hall, 2006), Figure 3.13, p.102.

Although developed for a commercial context, Porter's concept enables a more analytical approach to be taken in considering the key components of the supply chain. As Porter points out 'Every firm is a collection of activities that are performed to design, produce, market, deliver and support its product'; for the terms 'firm' and 'product', the replacements 'RAF' and 'Air Power' can be substituted respectively.<sup>89</sup> Porter adds that a '...firm's value chain and the way it performs individual activities are a reflection of its history, its strategy, its approach to implementing its strategy, and the underlying economics of the activities themselves'.<sup>90</sup>

### **Structure of the Thesis**

The first two chapters of this thesis provide lead-in material to the main part which covers the Second World War. Chapter One addresses the first research question and considers the identity of the RAF logistics organisation and its origins, from the First World War through to the period just before the Expansion Programme in 1934. Chapter Two considers the second research question of how and why the logistics organisation developed during the Expansion Programme itself, until the outbreak of war in September 1939.

Chapters Three and Four address the third research question and is the point where the developed version of Porter's model first comes into play and shapes the chapter titles from there on. Chapter Three considers the human resource element and identifies the men and women, military and civilian, who made the logistics' organisation work. Chapter Four continues the personnel theme but examines the organisation of logistics (organisational hierarchy), along with recruitment and training.

Chapters Five, Six and Seven, address the fourth research question; broadly speaking, these all examine various aspects of sustaining air power during the Second World War, with comment on various aspects of performance. Chapter Five examines how resources were acquired (Procurement), Chapter Six examines where and how stock was received into

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<sup>89</sup> Porter, *Competitive Advantage*, p.36.

<sup>90</sup> *Ibid*, p.6.

service and protected (Inbound Logistics) and Chapter Seven considers the distribution process, including movement by road, rail, water and air (Outbound Logistics). Chapter Eight addresses the fifth, and final research question and examines how a logistics service was delivered to the RAF's front-line (Service Delivery), with particular emphasis on how successfully the RAF achieved *logistical reach*. Chapter Nine is the overall conclusion to the thesis and draws together the various strands of research under the generic themes, before finally examining and assessing the overall effectiveness of RAF logistics during the Second World War. In terms of Porter's model this informs the final element of the diagram – logistics effect.

# Chapter One: Laying the Foundations - The Origins and Early Development of RAF Logistics

## Introduction

The RAF was formed in the closing stages of the First World War, following the merger of the Royal Flying Corps (RFC) and the Royal Naval Air Service (RNAS). The RAF's logistics organisation, structure and procedures were shaped, initially by lessons learned from the First World War period and then progressively developed to support early inter-war operations. By the outbreak of the Second World War, however, RAF logistics was very different, largely as a result of the transformation it experienced during the Expansion Programme which began in 1934. This formative period is the baseline from which RAF Logistics was evolved and is a fundamental part in understanding what was eventually developed for the Second World War itself. This chapter examines this genesis up to the end of 1933.

## Formation of the RFC

The RFC emerged as a result of the work of a standing sub-committee of the Committee of Imperial Defence in November 1911, which had been tasked by the Prime Minister to '...consider the future development of aerial navigation for naval and military purposes...'.<sup>1</sup> The outcome of this work included a recommendation that a Flying Corps be established, consisting of a Military and a Naval Wing, a Central Flying School and an Aircraft Factory.<sup>2</sup> Following ministerial approval of the Committee's final report, the RFC was established by Royal Warrant on 13 April 1912.<sup>3</sup> Given the difference in Army and Navy operating requirements, the Naval Wing moved further away from the RFC and soon evolved into what unofficially became known as the RNAS.<sup>4</sup> By July 1915, the Admiralty declared that officers of the Naval Wing would become part of the

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1 W. Raleigh, *The War in the Air – Being the Story of the Part Played in the Great War by the Royal Air Force*, Volume One (Eastbourne: Reprinted by the Naval & Military Press, originally released 1922) p.198.

2 Ibid, p.198. See also Air Ministry, Pamphlet (Air) 328, *Four Lectures on the History of the Royal Air Force* (First Edition) (London: Air Member for Training, 1945), first lecture, p.8.

3 Raleigh, *The War in the Air*, p.199. See also Air Ministry, Pamphlet (Air) 328, *Four Lectures on the History of the Royal Air Force* (First Edition) (London: Air Member for Training, 1945), first lecture, p.8.

4 Air Ministry, Pamphlet (Air) 328, *Four Lectures on the History of the Royal Air Force* (First Edition) (London: Air Member for Training, 1945), first lecture, p.9.

Military Branch of the Royal Navy and, on the 29 July 1915, the Admiralty officially constituted the RNAS.<sup>5</sup>

## Logistics in the RFC

By the time the German Army entered Belgium on 4 August 1914 and the subsequent declaration of war by Britain, the RFC had just sixty-three aircraft and ninety-five motor transport (MT) vehicles.<sup>6</sup> The Corps deployed to France for the first time with the British Expeditionary Force in August 1914 with just four squadrons of aircraft and an Aircraft Park which provided logistical support.<sup>7</sup> One of the earliest logistical difficulties which the RFC experienced was due to the relative infancy of aircraft production. At the outbreak of war, there were just twelve aircraft-manufacturing firms in Britain, three of which were producers of seaplanes. In terms of output, total production amounted to just 100 aircraft per year.<sup>8</sup> This limited manufacturing capacity meant that the British were largely dependent on France to meet its needs. Indeed, the demand for aircraft in the first six months of the war was so great that some 100 aircraft were bought from French companies; by the end of the war, 1,500 airframes had been acquired from this source.<sup>9</sup> Notwithstanding the problems with supply of whole aircraft, there was also a lack of suitable aero engines; in the spring of 1914, the Government had even resorted to offering a £5,000 prize for a British-designed engine.<sup>10</sup> Here too, the British were reliant on engines of French design, especially for the first six months of the war. The engine supply situation was further compounded by, quite ironically, a pre-war dependence on Germany for the production and supply of magnetos. British production was woefully inadequate and the source of supply was based on just one company. As a result, both the War Office and the Admiralty relied heavily on the import of mainly German built magnetos. The shortage came to a head in the Summer of 1916 when pre-war delivered supplies of the German built magnetos were exhausted; it was not until the Autumn that the British-produced reliable

5 S.W. Roskill (ed), *Documents Relating to the Naval Air Service*, Volume 1, 1908 - 1918 (London: Spottiswoode, Ballantyne and Co, 1969), 1908-1918, Admiralty Weekly Order No 1204/15 (Adm. 1/8408) dated 29 July 1915, pp. 212-213.

6 Ibid, p.49.

7 J.E. Edmonds, *History of the Great War – Military Operations France & Belgium 1914* (August-October 1914) (London: MacMillan & Co, 1922), p.48.

The broad details of which components of the RFC would deploy with an expeditionary force had been determined in late 1913 – see TNA, AIR1/118/15/40/56, RFC Military Wing, Question of Organization, Arrangements for Mobilization, November 1913 – August 1914.

8 H.A. Jones, *The War in the Air*, Volume Three (Eastbourne: Naval & Military Press, originally released 1931), p.254.

9 Dye, 'The Royal Flying Corps Logistic Organisation', p.33 and Dye, 'France and the Development of British Military Aviation', pp.1-12.

10 Jones, *The War in the Air*, Volume Three, p.254.

magnetos became available and then only at a rate of between twenty and thirty a week. Raw material supply was one of the main causes of the lack of progress, with some components being sourced from as far away as Japan and America. Spares for repair were in very short supply and spare magnetos were often obtained by diverting those destined for new engine production.<sup>11</sup>

Despite the popularly held view that aircraft of this time were primitive structures made from just wood, wire and canvas, the reality was more complex. This was a factor which quite quickly began to complicate logistics. Such a perception is well illustrated by Peter Fearon, for example, who suggested that 'the construction of an airframe – spars of wood held together with glue and wire, then covered in fabric – was a relatively simple affair ...'.<sup>12</sup> By Second World War standards, aircraft construction was comparatively straightforward in terms of material technology, but was still relatively complex in terms of the range of materiel required, not just for initial manufacture, but also for spares to support repairs in the field. The fuselage of the RE8 aircraft, for example (excluding the wood itself), consisted of 273 individually referenced items, within which there was a total of some 800 parts including nuts, bolts, washers, rivets, split pins, bracing wires and various metal jointing plates.<sup>13</sup> As aircraft design matured they became more complex machines and were more demanding to maintain. Aside from the main aircraft structure, the range of on-aircraft equipment, all of which required spares, expanded significantly to include: wireless sets; Lewis and Vickers machine guns (including magazines and mountings); bombs, bomb carriers, sights and release gears; cameras and photographic equipment. There was also a wide range of miscellaneous stores such as brass, copper, gun-metal, solder, mild-steel, tool-steel, tin, copper-tubing, acetone, beeswax, paint, soda, soap, tallow, varnish, carbide, oil and timber.<sup>14</sup> One of the earliest writers to comment on the difficulties of military aircraft maintenance was Major W.S. Brancker in June 1914, who observed that '...the aeroplane and its engine are both fragile and delicate' and that during war increased demands placed on aircraft machines would invariably lead to 'numerous breakages and strains, all of which take time and skill to repair, and

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11 Jones, *The War in the Air*, Volume Three, pp.255-256.

12 P. Fearon, 'The Growth of Aviation in Britain', *Journal of Contemporary History*, 20(1) (January 1985), 21-40 (p.23).

13 Trenchard Museum Archive (TMA), Royal Aircraft Factory, *Spare Parts for Aeroplanes – Type R.E.8. with R.A.F. 4A Engine (March 1917)*. This analysis does not include the aircraft's engine, cockpit components, armaments, undercarriage or the tailplane & rudder assembly.

14 Jones, *The War in the Air*, Volume Three, p.252.

which demand the provision of large quantities of spare parts...'.<sup>15</sup> Brancker added that the '...difficulty of supply of spare parts will be increased in proportion to the number of different types of aeroplanes employed'.<sup>16</sup> These views were borne out by the RFC's experience during the war and were commented on by Air Commodore Robert Brooke-Popham in a lecture just after the war who stated that:

It is, therefore, of the highest importance that spare machines and spare parts of every sort shall be instantly available. This means large base depots and an efficient channel of supply between depots and squadrons and on the sound working of this supply system the efficiency of the Air Force in any theatre of war very largely depends.<sup>17</sup>

The complexity of this task was expanded on by Lord Weir of Eastwood writing in *Flight* magazine in July 1919. Amidst quite a detailed and scientific exploration of the issues involved in operating aircraft, Weir commented that there had been an 'inability to take the fullest advantages of standardisation, owing to the necessity of making continuous progress in design and performances of machines' and drew attention to the '...extreme complexity and variety of the elements contributing to the provision and equipment of War [sic] aeroplanes'.<sup>18</sup> This all required an aircraft industry which could keep pace with the material needs of the RFC. Whilst Britain had a limited aircraft industry prior to 1914 and had initially been slow to develop this, the situation changed rapidly throughout the war.<sup>19</sup> This growth is commented on by David Edgerton, who emphasised the point that 'the war saw the creation of a very large aircraft industry, with increases in output accelerating through the war'.<sup>20</sup> This industrial growth spawned an extensive range of aircraft makes and types; by 1918, the RFC had operated some fifty-seven of these, sourced from twenty-two different manufacturers. This manufacturing base consisted not just of specialist aircraft manufacturing firms, but had broadened to include production by motor car firms, furniture makers and architectural decorators.<sup>21</sup> It was a similar picture for

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<sup>15</sup> W.S. Brancker, 'The Aeroplane in War' (tenth of a series of lectures arranged by the Military Education Committee at the University of London), *Flight*, 12 June 1914, p.632.

<sup>16</sup> Ibid.

<sup>17</sup> Brooke-Popham, 'The Air Force', *RUSI Journal* (1920), 43-70, cited in Dye, 'Sustaining Air Power', p.46.

<sup>18</sup> Lord Weir of Eastwood, 'Some Developments in Aircraft Design and Application During the War', *Flight*, 17 July 1919. p.955.

<sup>19</sup> Barnett, *Audit of War*, p.127.

<sup>20</sup> Edgerton, *England and the Aeroplane*, p.22.

<sup>21</sup> Ibid.

aero engines with thirty-two different variants having been used.<sup>22</sup> Edgerton also makes the important point that to this extensive range of firms, 'a huge number of subcontractors may be added' which were producing, for example 'propellers, electrical firms supplying magnetos, chemical firms supplying 'dope', textile firms supplying canvas and firms supplying instruments and cameras'.<sup>23</sup>

The procurement picture was further complicated in that the RFC also became increasingly reliant on the supply of aircraft and aero engines (and the associated spares) from France. Whilst this source of supply represented only 5 per cent of total wartime production, it amounted to nearly 40 per cent in 1915. The figure for aero engines was larger, representing 40 per cent of total wartime production and over 50 per cent in 1915.<sup>24</sup> By October 1918, and factoring out aircraft and engine types which had by that stage become obsolete, the newly formed RAF was still operating around forty-two aircraft makes and types and some fifty-two engine variants.<sup>25</sup> The significance for logistics is that the extent and diversity of aircraft and aero engines all required spare parts, many of which were not interchangeable and were therefore unique to specific manufacturers. The quantity of required spares needed to be forecast and then orders placed through a multitude of contracts.

As the war progressed, the maximum number of aircraft that a squadron was permitted to hold at any one time (known as the aircraft establishment (AE)) increased and this led to a corresponding increase in the equipment and spares requirement. In March 1916 the squadron AE increased to eighteen aircraft, further expanding to twenty four in March 1917.<sup>26</sup> Deliveries of new aircraft to meet the changing AE between 1914 and 1918 were quite dramatic, progressively increasing from eighty four in 1914 to 7,230 in 1918.<sup>27</sup> The growth in aircraft numbers was not just to meet an expanding Flying Corps but also to

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22 Figures calculated from Jones, *The War in the Air, Appendices*, Appendix XXVII – Types of Aircraft 1914-18: Technical Data, Table A.

Aeroplanes, pp. 178-183. Totals exclude seaplanes and ship aeroplanes as the data tables do not make it clear if these were operated by the RFC or RNAS. By the Armistice in November 1918, a number of these had become obsolete and were no longer in operational service.

23 Edgerton, *England and the Aeroplane*, p.23.

24 Dye, 'France and the Development of British Military Aviation', p.6.

25 Figures calculated from Jones, *The War in the Air, Appendices*, Appendix XLI – Disposition of Aircraft and Engines on Charge of the Royal Air Force at 31st October 1918, Table A. Aeroplane and Seaplanes (Airframes), pp.188-189. Seaplanes and Ship Aeroplanes totals have not been included to maintain a like-for-like comparison with the 1914-1918 figures. Engine figures calculated from Jones, *The War in the Air, Appendices*, Appendix XLI, Table B. Engines, pp.190-191.

26 Jones, *The War in the Air*, Volume Three, p.253.

27 Ibid, p.253.

meet shortfalls from attrition which was substantial; in the period from 12 June 1915 to 1 March 1917, of the 7,137 aircraft taken into service, 4,047 were struck off Service charge – some 57 per cent of the deliveries.<sup>28</sup> By the end of October 1918, the newly formed RAF had a total of 22,171 aircraft on charge but with a total of 37,702 aero engines; of these, 5,090 were in the process of repair and 4,880 in store (of which 2,741 were obsolete).<sup>29</sup> Although a significant number were purchased from overseas, 55,093 aircraft and 41,034 engines had been manufactured in Britain.<sup>30</sup> This substantial growth led to a corresponding increase in the range and quantity of aircraft and related equipment spares.

The operation of aircraft also called for large quantities of fuel and the supply of this presented a significant challenge, not just in terms of quality requirements but also the sheer volume required to support the RFC's rapidly growing aircraft fleet; by 1916, the RFC was consuming some 200,000 gallons per month.<sup>31</sup> Refuelling of aircraft was carried out by hand and was a time consuming and laborious process; the Sopwith Camel F1 aircraft, for example, required the best part of ten cans of aviation spirit (four gallon capacity) to fill its fuel tanks.<sup>32</sup> Due to the high quality control requirements, the filling operation for aviation spirit needed special supervision and this was carried out at Portishead (near Bristol) until the spring of 1918 when, due to the size of consumption (which had then increased to around 600,000 gallons per month), filling was carried out in France at Rouen and Calais. From that point on, all fuel (aviation and motor transport) used in France and Italy was filled and distributed from these installations.<sup>33</sup>

Given these resource requirements, it was essential that the RFC had an efficient and reliable logistics system; this the Corps developed and it served them well throughout the First World War. In essence, it consisted of four distinct elements. The first of these was procurement. Complete aircraft and

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28 The War Office, *Statistics of the Military Effort of the British Empire During the Great War 1914-1920* (London: Reprinted by the Naval & Military Press, originally released 1922) Part VIII, Section 1, pp.497-498.

29 H.A. Jones, *The War in the Air – Being the Part Played in the Great War by the Royal Air Force*, Appendices (Eastbourne: Reprinted by the Naval & Military Press, originally released 1937), pp.188-191. The figures quoted include all aircraft types (aeroplanes, seaplanes & ship aeroplanes) for the At Home, Expeditionary and Eastern theatres.

30 Ibid, p.154.

31 J.E. Edmonds, *History of the Great War – Military Operations France & Belgium 1916* (London: MacMillan, 1922), pp.102-104.

32 The Sopwith Camel had a main pressure tank of thirty gallons and a gravity tank of seven gallons. J. Pudney, *The Camel Fighter* (London: Hamish Hamilton, 1964), p.21 refers.

33 Edmonds, *History of the Great War 1916*, p.103 and War Office, *Statistics*, Part XXXII(ii) Supply, p.847.

vehicles were purchased by the Director of Military Aeronautics (Equipment Directorate) at the War Office, whilst air stores were provided by the Army Ordnance Department (Ordnance Aeronautical Stores Department); in the case of the latter, stores were sourced either from the Royal Aircraft Factory or directly from industry. The Department's responsibility for aeronautical stores remained until the end of 1916 when it was replaced by the Supply Department of the RFC under the Director of Aircraft Equipment at the Air Board.<sup>34</sup> Production quality standards of aircraft were monitored by an Aeronautical Inspection Department which was formed in December 1913.<sup>35</sup>

The second element was the depot. The requirement for these had been evident from the very early days of the RFC, with a clear need for a location to hold the large volumes of spares being delivered from manufacturers, for the storage of complete aircraft awaiting allocation to units and a repair and maintenance capability which demanded a range of specialist workshops and specialist engineering equipment. The first depot was formed at Farnborough in May 1912 and known as the Line of Communications Workshop; it was renamed the Flying Depot in 1913, before becoming the Aircraft Park in April 1914.<sup>36</sup> Up until the beginning of the First World War, the RFC's inventory was centrally administered by the Flying Depot which replenished stores expended by its squadrons and units on a monthly basis.<sup>37</sup> The sheer range and volume of equipment flowing into the depot, coupled with an ever expanding workshop requirement soon demanded additional space; concurrent with this, it was also found necessary to separate the capabilities for training aircraft and the storage of vehicle spares, paint, photographic and electrical equipment. Consequently, additional facilities were established at Greenwich, Chelsea and Ascot.<sup>38</sup> In early 1916, this home organisation was reorganised into what was known as the Southern and Northern Aircraft Depots. The Southern Depot was based on the original RFC location at Farnborough (where its Headquarters element was located) with a Park on that site and at Chelsea and Ascot. Additionally, a

<sup>34</sup> TNA, AIR 1/2398/268/1, RAF Stores Branch, Notes on History of R.A.F. Stores Branch 1915-1926, pp.2-3.

<sup>35</sup> B. Robertson, 'An AID to quality', *Aeroplane Monthly* (November 1993), 64-66 (p.64).

<sup>36</sup> Raleigh, *The War in the Air*, Volume 1, p.213 and TNA, AIR 1/117/15/40/33, Organisation in the R.F.C. for maintenance in the field and for squadron supplies in war, 28 January - 31 Jul 1914.

<sup>37</sup> TNA, AIR 2/5, RFC: System of Store Accounting, proposals by OC RFC (Maj F.H. Sykes), Sykes to The Secretary War Office, dated 1 March 1913, Attachment entitled 'Regulations for the Storage, Issue and Replenishment of Stores for the Royal Flying Corps. (Military Wing)', p.1.

<sup>38</sup> TNA, AIR 1/2398/268/1, RAF Stores Branch, Notes on History of R.A.F Stores Branch 1915-1926, p.2 and AIR 1/506/16/3/43, Parks and Depots at Home – Organisation for March to May 1916, 20/RFC/107(AO1) 31 May 1916, War Office to Dowding.

Northern Aircraft Depot was formed at Bradford responsible for units north of a line drawn east and west through Nottingham.<sup>39</sup> Three further types of specialist units were established in Britain during 1917: Aircraft Acceptance Parks which were responsible for receiving aircraft from manufacturers, examining and equipping them for operational service, before despatching them to units at home and overseas<sup>40</sup>; Stores Distributing Parks to supply the recently formed RFC Training Brigade and its flying training schools and Stores Depots.<sup>41</sup> These units were the genesis of the RAF's depot system which developed after the war.

The development of the overseas depot system followed similar principles but was more directly influenced by operational needs. The original Aircraft Park at Farnborough deployed with the RFC to France in August 1914 and by the end of October 1914 had become established at St Omer, with its port depot at Rouen. By the middle of 1915, the demands on the Park had grown considerably and a second park was established at Candas, with a port depot at Boulogne. Both of these parks received their equipment by train from their respective port depots.<sup>42</sup> What quickly became apparent was that the parks would become increasingly immobile unless they could be relieved of the heavy repair work commitment. With the decision to form brigades for each army, three new Army Aircraft Parks (AAP) were formed in December 1915, each allocated to one of the new brigades. The new parks were intended to remain as mobile as possible, situated to the rear of the Army and as close to a railhead to enable rapid redeployment. Each park held between two weeks' and one month's stock of stores and looked after the daily needs of the flying squadrons in their respective Army.<sup>43</sup> This was a particularly significant development as the mobility of these new parks would enable them to achieve *logistical reach* if and when flying squadrons were to start moving forward any significant distance. Indeed, stores and supplies were packed into purpose built

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39 TNA, AIR 1/506/16/3/43, Parks and Depots at Home – Organisation for March to May 1916. The revised arrangements were detailed in a letter from the War Office to the OC Administrative Wing RFC – 20/RFC/107(AO1) dated 31st May 1916.

40 R. Sturtivant, J. Hamlin and J.J.Halley, *Royal Air Force Flying Training and Support Units* (Tunbridge Wells: Air Britain, 1997), pp.46-47 and an anonymous article 'Aircraft Acceptance Parks', *Aeromilitaria*, Issue 1/76.

41 TNA, AIR 1/2398/268/1, RAF Stores Branch, Notes on History of R.A.F Stores Branch 1915-1926, p.3; P. Dye, RFC/RNAS/RAF Logistics Units – 1912-1915, D DSGT/1 dated 19 January 1995,p.5 and TNA, AIR 10/273, RFC Stores Regulations 1918, Orders for Squadron Equipment Officers and System of Accounting for R.F.C Units, p.16.

42 Dye, 'The Royal Flying Corps Logistic Organisation', p.33.

43 H.A. Jones, *The War in the Air*, Volume Two (Eastbourne: Naval & Military Press, originally released 1928), pp.188-189.

cases that could be easily loaded onto lorries and stock issued on the move if required.<sup>44</sup> This concept remained a key component of the RAF logistics order of battle and became a key part of the RAF's *War Manual* much later in 1928. With mobility largely preserved through the new AAPs, the former Aircraft Parks at St Omer and Candas became fixed repair and supply parks and were renamed Aircraft Depots on 15 December 1915. Each of the main depots held up to three months' stock of aircraft and vehicle stores and received all new aircraft destined for front line squadrons. In terms of geographical distance, most of the flying squadrons were located six to eight miles from the front line with their new AAPs some five to ten miles further back.<sup>45</sup>

The third element of the logistics organisation was distribution. The movement of stores within Britain and to overseas theatres was heavily dependent on movement by rail, sea and inland waterways; the first two of these were to remain the primary means of distribution for the RAF until air transport became a viable option in the Middle East during the mid to late 1920s. As far as the campaign in France was concerned, most military stores were moved across the Channel by barge and then onwards by rail and/or inland waterways; in the case of the RFC, the majority of its equipment was moved to the Continent via the port depots at Boulogne and Rouen. This total military task alone (of which the RFC's requirement was a relatively small component) was a sizeable undertaking. The quantity of material conveyed by inland waterways in France rose from a weekly average of just over 19,000 tons in November 1916 to a peak of over 66,000 tons in October 1918.<sup>46</sup> The cross-Channel barge tonnage was also particularly extensive, rising from a weekly average of 445 tons in December 1916 to a peak of just over 25,000 tons in October 1918.<sup>47</sup> The total figure for cross Channel shipment between 9 August 1914 and 26 March 1920 was 27,566,245 tons. Of this figure, aircraft stores (excluding fuels, oils and ammunition) amounted to just 131,339 tons or 0.48 per cent.<sup>48</sup> By way of comparison, the figure for hay and oats for livestock (mainly horses and mules) was 5,919,427 tons or just over 21 per cent.<sup>49</sup>

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44 Dye, 'The Royal Flying Corps Logistic Organisation', p.34.

45 Dye, 'The Royal Flying Corps Logistic Organisation', pp. 33-34.

46 War Office, *Statistics*, Part XVIII, Section 2, Table (iii), p.613.

47 *Ibid*, Part XVIII, Section 2, Table (iii), p.613.

48 *Ibid*, Part IX, Section 4, Table (i), p.521.

49 *Ibid*, Part IX, Section 4, Table (i), p.521.

The fourth element of the RFC's logistics' structure was squadron level support. At the heart of this was the need to maintain sufficient stocks of stores and supplies to support flying operations and the wider needs of ground equipment and personnel. The growth in the diversity of equipment types led to an exponential increase in the size of the RFC's inventory and this required a sophisticated stock control and accounting system. The procedures used by the RFC were developed as early as March 1913 and were based on a modified version of the Regulations for Royal Engineers' Services.<sup>50</sup> These were later officially promulgated as the official System of Accounting for the RFC.<sup>51</sup> Many of the basic principles in this document remained in use by the RAF throughout the Second World War. A key feature of the Stores Account System was that items in the RFC's inventory were clearly identified. This was especially important in the support of aircraft where much of their structure, especially aero engines, consisted of closely fitting components and the fitment of exactly the right replacement part was essential. This required the allocation of a part or stock number and was usually one which had already been given to the item by the original manufacturer. Up until 1918, there was no standard RFC system of identification and manufacturers often used quite complex systems. The Royal Aircraft Factory, for example, used a four level identification system consisting of a Unit, Component, Group, Part system to identify spare parts for the RE 8 reconnaissance aircraft.<sup>52</sup> There was also the requirement to know what stock was held, not just for visibility of holdings, but also for reasons of propriety as stores and supplies were, in theory, public property; even in war, the need to protect the 'public purse' was ever present. At the higher level, stores and supplies used by the RFC were classified using a categorization system: Class A which included complete items such as instruments, tools, plant and special stores and Class B items which were components of complete items or consumable stores such as oils and paints.<sup>53</sup> This made the task of inventory management more straightforward as only Class A items were accounted for throughout their in-service life. The overall system required manuscript ledgers to be kept and these formed the main stock record of equipment.<sup>54</sup> Of particular

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50 TNA, AIR 2/5, RFC: System of Store Accounting, proposals by OC RFC (Major F.H. Sykes), Sykes to The Secretary War Office, dated 1 March 1913.

51 TNA, AIR 10/273, RFC Stores Regulations 1918, Orders for Squadron Equipment Officers and System of Accounting for R.F.C Units.

52 TMA, Spare parts for Aeroplanes – Type R.E.8. with R.A.F. 4A Engine (March 1917), Instructions for Ordering Spare Parts.

53 TNA, AIR 10/273, RFC Stores Regulations 1918, Orders for Squadron Equipment Officers and System of Accounting for R.F.C Units, pp.3-4.

54 Ibid, p.21.

note is that the record of stock holdings was purely a local matter and there was no overall record maintained at HQ RFC level. Consequently, without a master record of stock, it was not possible to view the RFC's complete holdings and therefore extremely difficult to re-distribute assets should they be required elsewhere. For example, a squadron might be short of a specific item but the same item might be in plentiful supply at a neighbouring squadron. The challenge of this is best appreciated when set against the overall size of the RFC's inventory which, by the end of the war, had grown to approximately 50,000 different types of item.<sup>55</sup> The requirement for overall visibility of stock holdings remained a significant challenge for RAF logistics throughout the inter-war and Second World War periods. Serious progress towards what was known as 'global' visibility of assets was not achieved until the RAF introduced computerized stock control in 1965.<sup>56</sup>

All of this work required specialists who understood the finer points of logistics. Prior to the First World War, this rested with just two Quartermasters: Lieutenant W.J.D. Pryce for the Military Wing (based at the Flying Depot and known as the Officer in Charge Stores) and Lieutenant F.H Kirby VC for the Central Flying School.<sup>57</sup> For the flying squadrons though, there were no officer appointments as quartermasters and stores were the overall responsibility of the respective squadron commanding officers. To assist them in this task, storekeepers were appointed for each flight within the squadron, with an assistant known as a Storeman and a Ledger Keeper to maintain the records of account and associated paperwork.<sup>58</sup> By the end of 1914, however, operating experience was showing that there was a growing need for a specialist ground branch officer. The shortfall was addressed in January 1915 with the introduction of a new officer specialisation known as an Equipment Officer. There were two grades: Equipment Officer (EO) (with the rank of captain) for Wings and Assistant Equipment Officer (AEO) (lieutenant or 2<sup>nd</sup> lieutenant) for Squadrons (the intention was to have one AEO per Squadron, four per Aircraft

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<sup>55</sup> Dye, 'Sustaining Air Power', p.44.

<sup>56</sup> C. Cummings, 'The Electronic Era', *Journal of the RAF Historical Society*, Number 35 (2005), 96-110.

<sup>57</sup> The Royal Flying Corps, *Flight*, 20 July 19212, No 186 (No 29, Volume IV), p.663 and TNA, AIR 2/5, RFC: System of Store Accounting, proposals by OC RFC (Maj F.H. Sykes), Sykes to The Secretary War Office, dated 1 March 1913. Attachment entitled 'Regulations for the Storage, Issue and Replenishment of Stores for the Royal Flying Corps. (Military Wing), p.4.

<sup>58</sup> TNA, AIR 2/5, RFC: System of Store Accounting, proposals by OC RFC (Major F.H. Sykes), Sykes to The Secretary War Office, dated 1 March 1913. Attachment entitled 'Regulations for the Storage, Issue and Replenishment of Stores for the Royal Flying Corps. (Military Wing), pp. 2,5-8.

Park and one for the Administrative Wing).<sup>59</sup> The title itself is misleading in that the specialisation was responsible for both logistics and engineering. Most of the new Equipment Officer posts were filled by commissioning regular Quartermaster Sergeants of the Royal Engineers and by calling for volunteers, whose previous experience varied between general engineering and a basic knowledge of the internal combustion engine. By June 1915, the Army List shows a total of fifteen EOs, thirty-seven AEOs and thirteen commissioned Quartermasters.<sup>60</sup> The rate of expansion was quite marked as only ten months later in the Army List of April 1916, there were nearly 1,200 EOs, AEOs and Quartermasters serving.<sup>61</sup> A covering memo to a revised training course syllabus issued on 20 July 1918, defined the ideal recruit for the Branch as 'incapacitated flying officers and observers (over twenty-five years old), trained RAF WOs and SNCOs (stores) and civilians of good education and business experience'.<sup>62</sup>

## Mobile Logistics

One RFC initiative in particular had far reaching implications for RAF logistics and helped shape what became known as Air Stores Parks; this later development is examined in Chapters Two and Eight. The German offensive during the spring of 1918 and the advance towards the rail junction at Amiens caused significant supply problems for the RFC and the far sighted concept of mobility (despite the largely static nature of trench warfare which had prevailed for most of the war) came into its own. On the first day of the offensive, many of the RFC's aerodromes came under artillery fire. Consequently, new aerodromes had to be identified and occupied, almost on a day-by-day basis. Indeed, by 5 April 1918, forty-five new aerodromes had been secured.<sup>63</sup> This upheaval brought with it the urgent need to maintain supplies to the squadrons of the newly formed RAF, which became all the more pressing when their supplying units, the Aircraft Parks, had to move as a result of the threat from the

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59 TNA, AIR 1/502/16/3/11, Creation of Equipment Officers dated 19 January 1915 and Air Ministry, Air Publication 125 (2nd Edition), *A Short History of the Royal Air Force*, (London: Air Ministry, 1936), Chapter IV, p.74.

60 National Army Museum (NAM), *The Quarterly Army List July 1915* (London: HMSO, 1915).

61 NAM, *The Quarterly Army List April 1916* (London: HMSO, 1916).

62 TNA, AIR 1/15/15/1/63, New Syllabus – EOs, School of Instruction, 4/6/18 – 8/11/18.

63 H.A. Jones, *The War in the Air – Being the Part Played in the Great War by the Royal Air Force*, Volume Four (Eastbourne: Reprinted by the Naval & Military Press, originally released 1937), p.354.

enemy offensive.<sup>64</sup> To meet the need for these urgently required supplies, the Deputy Quartermaster-General at RFC (RAF) HQ, Brigadier-General H.R.M Brooke-Popham introduced what were known as resupply convoys. His priority was to ensure that each new aerodrome location had adequate stocks of fuel and munitions and as soon as a new site had been identified, stocks were pre-positioned in order that the incoming squadrons could be re-armed and fuelled without delay. To support this concept, two convoys were set up, each of eight light tenders. One of the convoys was loaded with machine-gun ammunition and 25 lb bombs and could deploy at five minutes' notice, day or night; the second convoy provided a delivery service for urgently required spare parts.<sup>65</sup> This initiative enabled the flying squadrons to focus on their operational task and to remain mobile, without the additional burden of maintaining its own resupply of critical stores and supplies.

### **Logistics in the RNAS**

Whilst the RAF was formed from an amalgamation of the RFC and RNAS in 1918, the logistics organisation of the new Air Force was shaped more by Army than Naval procedures. Although a Naval Wing had been included as part of the original RFC when the Corps was formed in 1912, the Admiralty had worked independently from the outset and had established its own Air Department.<sup>66</sup> Whilst a degree of coordination had been achieved between the two Services through a Joint Air Committee from 1912, their meetings ceased in August 1914 with the outbreak of hostilities.<sup>67</sup> Consequently, by August 1914, logistical support for the RNAS had become quite separate from the RFC with the Admiralty's Air Department's Civil Assistant becoming responsible for the supply of stores, spares, freight and transport for naval aircraft.<sup>68</sup> Whilst the design, development and manufacturing capability of the Royal Aircraft Factory was available to both Services, the RNAS developed its own technical department. Such an arrangement enabled the Admiralty to source its aircraft, engines and spares from the open market, whilst the RFC was largely

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64 P. Dye, 'The Royal Flying Corps & Royal Air Force at St Omer', *Cross & Cockade International Journal*, Vol 35, No 2, 2004, 81.

65 Jones, *The War in the Air*, Volume Four, p.355.

66 Raleigh, *The War in the Air*, Volume One, p.207.

67 Jones, *The War in the Air*, Volume Three, pp.258-259.

68 TNA, AIR 2/127, Administration of Royal Naval Air Service and Supply of Material, Air Department Orders – Organisation of Department dated May 1916 and Diagram Showing the Organisation of the Air Department and its Relationship with Admiralty and Board dated 21 May 1916.

dependent on the Royal Aircraft Factory. Not surprisingly, this inevitably led to friction between both air arms who literally competed for resources, rather than working together.<sup>69</sup> This independence led to the RFC and the RNAS each conducting their own logistical support procedures throughout the war. It was not until May 1916 when, amongst wider concerns regarding the extent to which aircraft and crews were being killed on war operations, the question of what was referred to as the 'alleged maladministration of the Flying Services' was investigated by a British Government Committee of Enquiry.<sup>70</sup> The final report of the Committee was published at the end of 1916 with, inter alia, the recommendation that an Air Board be formed by the Cabinet which would coordinate the design, construction and production of aircraft, aero engines and aircraft armament for both the Army and the Royal Navy. The new Board, however, was dominated by a large number of RFC officers, largely as a result of the fact that the RFC was by far the larger of the two air arms.<sup>71</sup> Of the nine key members (excluding the Secretary and assistant secretary), just two Naval officers were included – Rear-Admiral Kerr filling the post of Deputy Chief of the Air Staff and Commodore Paine as Master-General of Personnel. As far as logistics was concerned, Major-General Brancker was appointed the Comptroller General of Equipment.<sup>72</sup> Thus, by the time the RAF was formed, the RNAS had limited influence as far as the development of logistics for the new Service was concerned. Given this, and that the development of British Naval airpower logistics has already been examined at doctoral level, there is little merit in adding further detail of its workings to this thesis.<sup>73</sup>

## Formation of the RAF and the Air Ministry

As early as 1916, the overlapping responsibilities of the RFC and the RNAS, the competition for aircraft and engines, coupled with growing public concern over German bombing raids, led to consideration of the possible

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69 See: R. Barker, *A Brief History of the Royal Flying Corps in World War 1* (London: Robinson, 2002), p.417, F. Sykes, *From Many Angles – An Autobiography* (London: George Harrap, 1942), p.216 and E. Ash, *Sir Frederick Sykes and the Air Revolution 1912-1918* (Abingdon: Frank Cass, 1999), p.126.

70 C.G. Grey, *A History of the Air Ministry* (London: George Allen & Unwin Ltd, 1940), p.57.

71 M. Cooper, 'Blueprint for Confusion: The administrative Background to the Formation of the Royal Air Force, 1912-19', *Journal of Contemporary History*, 22(3), (July 1987), 437-453, (p.447).

72 Grey, *A History of the Air Ministry*, pp.76-77.

73 See: B. Jones, 'Ashore, afloat and airborne: The Logistics of British Naval Airpower, 1914-1945' (unpublished doctoral thesis, King's College, London, 2007).

unification of the air services. Eventually, the Prime Minister, Lloyd George, appointed General Jan Christian Smuts to head a government committee to look at air defence and air organisation.<sup>74</sup> As part of his recommendations in 1917, Smuts recommended the formation of a new service, which would be independent from the Army and Navy; with the passing of the Air Force Bill in November 1917, the RAF officially came in to being on 1 April 1918. Smuts also recommended the formation of an Air Ministry and the first Air Council was established on 3 January 1918 with Lord Rothermere as the first Secretary of State and President of the Council.<sup>75</sup> Whilst the independent and uncoordinated logistics operations of the RFC and RNAS had survived the First World War, the formation of the RAF raised the question of what form the new, single Service approach to logistics would take. The key to this was to be the formation of a new ground Branch of the Service which, in conjunction with the Directorate of Equipment in the Air Ministry, would provide the lead for the delivery of logistics services during the inter-war period and throughout the Second World War itself.

### **Formation of the RAF Stores Branch**

On the formation of the RAF in 1918, the management of logistics below Air Ministry level still remained the responsibility of Equipment Officers which had been established as part of the RFC in 1915, although they still had a dual responsibility for both engineering and stores matters; this had never been an entirely satisfactory arrangement as each of these disciplines required quite different professional backgrounds and specialist knowledge. The requirement for an officer branch solely responsible for logistics (then referred to generically as *stores*) was championed by the RAF's second, post-war Director of Equipment, Air Commodore C.L. Lambe who had taken up post in June 1919.<sup>76</sup> In due course, Lambe proposed the formation of a Stores Branch with the intention that its officers be recruited largely from the ranks. The proposal

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<sup>74</sup> Air Ministry, Pamphlet (Air) 328, *Four Lectures on the History of the Royal Air Force* (First Edition) (London: Air Member for Training, 1945), second lecture, p.9.

<sup>75</sup> Grey, *A History of the Air Ministry*, p.76. See also Air Ministry, Pamphlet (Air) 328, *Four Lectures on the History of the Royal Air Force* (First Edition) (London: Air Member for Training, 1945), third lecture, p.2 and Saunders, *Per Ardua*, pp.222-223.

<sup>76</sup> RAF LHCA, Box 13 (Organization), Listing of Heads of the RAF Equipment & Supply Organization Since 1918 and TNA, AIR 5/239, Establishment of one 'Stores Branch' in RAF and transfer of officers thereto: Dof E to DofP dated 26 August 1919, DofE to DTO, DofP, AFS & CAS dated 20 September 1919.

gained approval from the Secretary of State for War and Air (Winston Churchill) in mid-October 1919, with the official announcement appearing in Air Ministry Weekly Orders in late October 1919.<sup>77</sup> Rates of pay and conditions of service for the new Branch were published in June 1920 with flying officers earning nineteen shillings a day, flight lieutenants one pound and three shillings a day, squadron leaders one pound and ten shillings a day and wing commanders one pound and fifteen shillings a day. These rates of pay, representing a weekly range for the ranks indicated of between six and ten pounds per week, were above what the average civilian worker might expect in the inter-war years - between two and three pounds a week excluding his food, accommodation and clothing.<sup>78</sup> Retirement ages were different for each rank with flying officers and flight lieutenants retiring at the age of forty-five, squadron leaders at fifty and wing commanders at fifty-five.<sup>79</sup> Overall, the new Branch (excluding group captains and above) consisted of 245 officers; 203 had been selected for permanent commissions<sup>80</sup> and forty two for short service commissions.<sup>81</sup> As far as the Air Force List was concerned, the Stores Branch first appeared in its pages in February 1921.

### **Challenges for RAF Logistics in the Early Post War Period**

The immediate post-war years saw the RAF move from a Service on a war footing, consuming vast quantities of equipment and supplies, to a largely peacetime Service with a significantly reduced support requirement. The RAF had demobilized some 275,565 people (officers, cadets and other ranks) during the period 11 November 1918 to 1 May 1920 and by the end of March the same year, had disbanded the Women's Royal Air Force.<sup>82</sup> The new strength by October 1920 was a mere 3,000 officers and 24,000 other ranks – a reduction

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77 TNA, AIR 72/1, AMWOs 1919: Order 1158 – Stores Officers (A.24294), dated 21 October 1919 and TNA, AIR 5/239, Establishment of One 'Stores Branch' in RAF and transfer of officers thereto: CAS to SofS dated 17 October.

78 R. Overy, *The Morbid Age* (London: Penguin Books, 2009), p.xv.

79 TNA, AIR 72/1, AMWOs 1919: Appendix to Order 537 - Stores Officers – Emoluments and Conditions of Service (A.24294) dated 17 June 1920.

80 Ibid, Appendix, pp.3-6. This total consisted of two wing commanders, eight squadron leaders, thirty three flight lieutenants, 148 flying officers and twelve pilot officers.

81 TNA, AIR 72/2, AMWOs 1920: Order 537 – Stores officers – Emoluments and Conditions of Service (A.24294) dated 17 June 1920. This total consisted of three squadron leaders, five flight lieutenants, thirty flying officers and three pilot officers.

82 War Office, *Statistics*, Part xxv, Section 3, Table (i), p.711 & H.A. Jones, *The War in the Air - Being the Story of the Part Played in the Great War by the Royal Air Force*, Volume 6 (Eastbourne: Reprinted by the Naval & Military Press, Undated), p.74.

to less than one tenth of its wartime strength within two years.<sup>83</sup> The number of its flying squadrons were also reduced substantially and by the beginning of 1921 consisted of just nineteen: five each in Britain and Egypt, four each in India and Iraq and one in the Far East.<sup>84</sup>

In addition to existing Empire interests in India and Egypt, Britain also gained a responsibility for territories formerly occupied by the Imperial German and Ottoman dynasties under an initiative by the League of Nations, which included Palestine, Jordan and Mesopotamia (Iraq). As described by Bowyer, responsibility for these 'problem states' brought with it a wave of tribal clashes and anti-British uprisings.<sup>85</sup> It was against this turbulent backdrop, and at a time of continuing debate regarding the need for an independent air force, that the RAF began to secure a key role in what became known as imperial policing.<sup>86</sup> As part of this, the RAF was employed as widely as possible, if anything to demonstrate just how effective (both in terms of cost and resources) air power could be.<sup>87</sup> A significant step forward came in 1921 when, following the success of the RAF in the British Somaliland policing operations, the Service took on the lead role in operations against dissident groups in Iraq and Transjordan; this doctrine became known as air control.<sup>88</sup> A significant point here is that the employment of air power represented significant value for money. For example, the total cost of using the RAF in the month long operations against the 'mad' Mullah in Somaliland in 1920, came to just £70,000. This cost was placed in context by the Secretary of State for War at the time who declared to Parliament that: 'the Royal Air Force on this expedition achieved more than we were able to do in one expedition before the war at an expenditure of over £2,500,000, and that would be £6,000,000 or £7,000,000 of the present currency'.<sup>89</sup> This

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83 Air Ministry, Air Historical Branch (AHB)(1), The Second World War 1939-1945 Royal Air Force, Monograph, *Manning Plans and Policy* (undated), p.1. See also N. Tangye, *Britain in the Air* (London: William Collins, 1944), p.41.

84 RAF Timeline 1918 – 1929 in *RAF Web Site* < <http://www.raf.mod.uk/history/raftimeline19181929.cfm> > [accessed 11 October 2015].

85 C. Bowyer, *RAF Operations 1918-1938* (London: William Kimber, 1988), p.63. See also Saunders, *Per Ardua*, pp.286-288.

86 G.J. Bailey, *The Arsenal of Democracy- Aircraft Supply and the Anglo-American Alliance, 1938-1942* (Edinburgh: Edinburgh University Press, 2013), pp.28-29.

87 See: Air Ministry, Pamphlet (Air) 328, *Four Lectures on the History of the Royal Air Force* (First Edition) (London: Air Member for Training, 1945), third lecture, pp.3-5.

88 See: J. Slessor, *The Central Blue – Recollections and Reflections* (London: Cassell & Co Ltd, 1956), pp.51-73.

89 TNA, AIR 5/579, Report on the Royal Air Force in India by AVM Sir John Salmond, Part I, Page 1, Paragraph 2. See also Bowyer, *RAF Operations*, p.62 although this source states that the cost of the RAF amounted to £77,000.

'imperial policing', as described by Smith, provided '...a cheap and ubiquitous form of colonial control in the more inaccessible corners of the globe'.<sup>90</sup>

There was, however, a dichotomy here for logistics. On the one hand, the post-First World War run-down in the size of the RAF had led to a substantial reduction in the levels of equipment stocks. Indeed, some 10,000 aircraft and 30,000 aero engines (along with accompanying spares) became surplus to requirements and were sold-off for £1,000,000 and 50 per cent of future profits to the Aircraft Disposal Company.<sup>91</sup> On the other hand, the requirement to provide support for emerging, but quite uncertain future commitments, required sufficient equipment to be retained and this became problematical. The Operations Record Book for Number 3 Stores Depot at Milton, for example, makes the comment in 1920 that '...difficulties were experienced in framing an idea as to what quantity of stocks should be held to meet the requirements of the Royal Air Force units in peace time'.<sup>92</sup> It is likely that equipment disposal was achieved with relative ease, though it would have been a sizeable task in terms of the physical work involved to pass this material on from where it was located, to the Air Disposal Company. The question of maintaining sufficient equipment for the future, however, proved to be more challenging. Whilst there is little in Air Ministry records which comments on how this problem was addressed, there is comment in a secondary source which suggests that all was not well at the RAF Stores Depots. Indeed, Bowyer makes the point that, during the Chanak crisis in Turkey during 1922/1923:

every squadron commander involved could testify to the abysmal organisation of the UK stores depots in their equipping the mobilised units initially, while equally awful disorganisation at the receiving end in the Dardanelles had merely added another catalogue of difficulties.<sup>93</sup>

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90 M.Smith, 'The Royal Air Force, Air Power and British Foreign Policy, 1932-37', *Journal of Contemporary History*, Volume 12, Number 1 (January 1977), 153-174 (p.155).

91 Flight, 18 March 1920, p.308. Initially, these aircraft were held by the Aircraft Disposals Board for the Government but were then bought by the Aircraft Disposals Company Ltd; a key player in this syndicate was the aircraft company Handley Page Ltd who acted as the selling agent. Once refurbished, large numbers of the aircraft were then sold overseas. By 1925 the company had sold-on 2,000 airframes and 3,000 engines, generating a profit of £2,500,000 of which half was returned to the Treasury as per the original agreement- see C.H. Barnes, *Handley Page Aircraft since 1907* (London: Putnam, 1976), p.27. The demobilization process is also detailed in Saunders, *Per Ardua*, p.281, an account which also relates that 1,000 tons of ball bearings, 350,000 sparking-plugs and 100,000 magnetos were also disposed of by this means.

92 TNA, AIR 29/959, Milton Aircraft Storage Depot, Operations Record Book, entry for 1920.

93 Bowyer, *RAF Operations*, p.83.

More direct evidence of problems with spares availability can be found in records relating to the RAF in India. The availability of spares became particularly critical in India although here the RAF was dependent on the financial vote of the Army in India. By the beginning of the 1920s the position had become quite desperate and one where using parts from grounded aircraft to keep others serviceable, had become increasingly commonplace. The memoirs of Marshal of the RAF Sir Arthur Harris provide an enlightening view of the situation at the time. Posted to the North West Frontier in 1919/20 as Officer Commanding 45 Squadron, Harris was especially critical of the logistics situation and described how they ‘...lacked everything in the way of necessary accommodation and spares and materials for keeping our aircraft serviceable’.<sup>94</sup> What particularly infuriated him was that there were large numbers of dual-ignition engines available at home that were being sold as scrap by the Disposal Board for a few pounds.<sup>95</sup> The situation deteriorated to the point where Air Vice-Marshal Sir John Salmond (formerly AOC of the RAF Inland Area in Britain) was sent to India in early 1922 to conduct an urgent enquiry.<sup>96</sup> Salmond’s report, which was delivered in August 1922, left no doubt as to the state of affairs, commenting in the opening paragraph that ‘it is with regret that I have to report that the Royal Air Force in India is to all intents and purposes non-existent as a fighting force at this date’.<sup>97</sup> Indeed, of the seventy aircraft on the authorised establishment in August 1922, just seven were serviceable; this critical situation was largely attributed to the lack of spares.<sup>98</sup> There were a number of other contributory factors, all of which were subject to wide ranging recommendations in Salmond’s report. The position took time to recover and showed that operational effectiveness could deteriorate rapidly if logistics were neglected.<sup>99</sup>

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94 Harris, *Bomber Offensive*, p.19.

95 *Ibid*, p.19.

96 *Ibid*, pp.19-20. The seriousness of the situation generated a number of articles in the British press at the end of August 1922: Anon, ‘RAF Equipment in India – Old Machines and No replacements’, *The Times*, 30 August 1922, Anon, ‘RAF Equipment in India – The Humour of A Tragedy’, *The Times*, 31 August 1922, Anon, ‘Indian Air Scandal’, *Daily Mail*, 31 August 1922 and Anon, ‘Scandal of the Indian Air Force’, *Daily Mail*, 31 August 1922.

97 TNA, AIR 5/579, RAF India – Shortage of Equipment. Memorandum to Cabinet and General Action on Sir John Salmond’s Report. Report by Air Vice-Marshal Sir John Salmond on the Royal Air Force in India dated August 1922, Part II, Paragraph 64.

98 *Ibid*, Paragraph 64.

99 TNA, AIR 5/579, RAF India – Shortage of Equipment. Memorandum to Cabinet and General Action on Sir John Salmond’s Report.

## The Post-War RAF Supply Chain

As far as the procurement of aircraft and equipment for the RAF was concerned, this was the overall responsibility of the Director General of Supply and Research. Once in service, the responsibility for the on-going supply support of aircraft, equipment and people rested with the Directorate of Equipment (DGE), one of six directorates under the Chief of the Air Staff (CAS). The further development of this arrangement is described in Chapter Four.

As during the First World War, depots were the next key link in the supply chain but the number of these was drastically reduced in the immediate post-war period. By the end of 1918, the RAF in Britain had inherited eight Stores Distributing Parks (SDP) and seven Stores Depots (SD) from the RFC's logistics organisation. There was little need for such an extensive depot structure and these were therefore rationalized by the Air Ministry which decided that all stores distribution would be carried out from the main depots. Consequently, all eight SDPs were closed leaving in place Numbers 1, 3, 4 and 5 SDs, plus the Packing Depot at Ascot (formerly No 6 SD).<sup>100</sup> Further rationalization took place in September 1921 when No 5 SD (Balloon Stores Depot) was closed and amalgamated with No 4 SD at Ruislip and in 1924 the Army depot at Altrincham was taken over as No 2 SD to accommodate the increasing range of arms, ammunition, pyrotechnics and bombs.<sup>101</sup> Thus, by 1933, the RAF was served by four SDs: No 1 SD Kidbrooke, No 2 SD Altrincham, No 3 SD Milton and No 4 SD Ruislip. These depots received equipment and supplies from manufacturers, maintained a bulk stockholding for the replenishment of unit stocks and acted as distribution centres for RAF stations at home and overseas. As far as overseas depots were concerned in 1920, a stores depot was situated at Alexandria in Egypt with similar functions located within the aircraft parks at Baghdad in Iraq and Lahore in India. In 1924, a supply depot was constructed at Sarafand in Palestine, followed by the establishment of a stores and supply depot at Steamer Point in Aden during 1929. To facilitate the conveyance of men and material abroad, a RAF Embarkation Office was established at the port of Southampton as early in 1921, with a Port Detachment at London's West India Dock in 1930. Port

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<sup>100</sup> TNA, AIR 12398/268/1, Notes on History of RAF Stores Branch 1915-1928, p.4.

<sup>101</sup> TNA, AIR 12398/268/1, Notes on History of RAF Stores Branch, p.4.

detachments were also established on the receiving end overseas to serve their respective depots in India, Egypt, Iraq, Palestine and Aden.<sup>102</sup>

### **Standardized Approach to Logistics Administration**

One of the first logistics priorities in the post-First World War period was to introduce a standardized peacetime approach to stores accounting and storekeeping which would maintain a degree of propriety and public accountability. By and large, the System of Accounting for RFC Units was adopted by the RAF from its formation on 1 April 1918.<sup>103</sup> The opportunity was taken to standardize parts identification and the RAF introduced what was known as Nomenclature which divided the items within the RAF inventory into sections. This enabled each individual item (or line item as they became known) to be given a standard name and a unique identity. For example, a single spring washer (one quarter of an inch) was categorised in Section Number Fifty Four and allocated the specific Reference Number of 162D; thus, this item's official stores identity became 54/162D, Spring, Single,  $\frac{1}{4}$ .<sup>104</sup> This Section and Reference identification provided a logical, standardized and flexible system which served the RAF well throughout the Second World War and well beyond, up until the North Atlantic Treaty Organisation (NATO) codification system was introduced in the mid-1950s.<sup>105</sup>

The lead for this work, inter alia, rested with the Air Ministry's Establishment Committee which was chaired by Bertram Jones who had been transferred to the Air Ministry from the Ministry of Munitions to advise on finance. The findings of the committee became known as the Jones Report and were presented to the Secretary of State in November 1918.<sup>106</sup> The report was particularly insightful about logistics and recognized that careful re-organisation could enable things to be done more efficiently and economically. Moreover, with the imminent demobilization following the cessation of hostilities, there was a pressing need to put in place an efficient logistics organisation that could

<sup>102</sup> RAFC Library, *Monthly Air Force Lists 1920 – 1929* (London) (as at December of each year).

<sup>103</sup> TNA, AIR 72/1, Air Ministry Weekly Order (AMWO) 21/1918, dated 3 Apr 1918.

<sup>104</sup> Example taken from TNA, AIR1/2131/207/115/1, Establishments and Estimates – Mobilization Store Table for the Expeditionary Force, A Squadron RFC 18 Aeroplanes September 1916 (Two Seaters with Wireless Sets), Army Form G1098-33C, dated September 1916, p.9.

<sup>105</sup> B. Eddy & S. Arnett, 'The NATO Codification System: A Bridge to Global Logistics Knowledge', *The DISAM Journal* (Fall 1998) 39-51 (p.39).

<sup>106</sup> TNA, AIR1/16/15/1/73, Equipment Branch – Memorandum on Organisation dated 18 November 1918.

handle the huge stocks of war surplus material. The report recommended that the Controller General of Equipment's (CGE) area should be divided into five separate directorates: Aircraft Equipment, Provision, Stores, Parks & Depots and a Record Branch. There was also a recommendation that was to have far-reaching implications and its outcome would lay the foundations of a new RAF stores organisation. It was suggested that an Accounting Committee be formed to review the methods of store keeping in the RAF, to improve them where necessary, and to establish a standard system that was not to be deviated from without Air Ministry authority.<sup>107</sup>

The Jones Report was considered at the 62<sup>nd</sup> meeting of the Air Council on 19 November 1918 but it was decided that the recommendations could not be adopted during demobilization, rather the report should be passed to the CGE who 'should be guided by the principles laid down on reorganizing his department on a smaller scale'; the file was passed to the CGE for further action on 11 December 1918.<sup>108</sup> It is not clear if the five directorates were ever introduced, but the suggestion regarding the Accounting Committee most certainly was. Shortly after the referral to CGE, a part-time committee was formed by the Director of Equipment to 'create a proper system for peace time working'; this committee was officially named as the Committee on Store Accounting and Storekeeping Procedure and put on a full-time basis in August 1919.<sup>109</sup> The terms of reference bore a very close resemblance to the Jones Report recommendations, with the declared intentions of examining the store keeping methods currently in use at all types of RAF units and to draw up a definitive storekeeping and accounting manual. There were two more requirements in the terms of reference which, for the time, were both innovative and consultative. Firstly, the Committee wished to obtain the opinions of RAF Stores Officers and, secondly, they would investigate store-keeping methods employed by civilian firms engaged in what it termed 'analogous trades'. The committee made a number of visits to Army Ordnance and Supply Depots, Naval Dockyards, Railway Clearing Houses and to commercial firms handling similar stores to the RAF. Their work was not just theoretical and, in many

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<sup>107</sup> Ibid.

<sup>108</sup> Ibid.

<sup>109</sup> TNA, AIR 29/711/17832, Operations Record Book for the School of Store Accounting and Storekeeping, 1929, p4, Air Ministry Office Memorandum Number 123(4).

cases, methods which looked suitable for use in the RAF were first tested in a stores facility at Andover, which had been made available to the Committee for experimental purposes. Many of the new procedures had an immediate and, in some cases, quite a significant effect on the Service. Perhaps the most dramatic of these was picked up in the returns, which had been called for from all areas six months after various procedures had been introduced. One major change was that responsibility for stores held by flights or sections was to be transferred from the Stores Officer to the inventory held by the respective Flight Officer. It is not clear from which date this change became effective, but the six-monthly return revealed that 75 per cent of equipment held by flights had been returned to stores.<sup>110</sup>

By November 1920 most of the new procedures and regulations had been introduced. Shortly afterwards, the regulations were published as Air Publication 830 – Instructions for Store Accounting and Store Keeping, issued by the Director of Equipment in August 1921.<sup>111</sup> At the heart of these regulations was the basic principle that each self-accounting unit would be permitted to hold items on the basis of establishments; this was a set figure for each line item, which specified the maximum number, which could be held at any one time. Once stock holdings dropped to a certain level, the unit concerned then submitted a demand for stock replenishment that, in turn, was provided (or ‘satisfied’ as this later became known) by the appropriate Stores Depot.<sup>112</sup>

## Conclusion

As far as logistics is concerned, the newly formed RAF in late 1918 was fortunate in that it had inherited practices and procedures which had been tried and tested under four years of actual war. Additionally, many of its personnel had served in the RFC and RNAS and brought with them valuable experience which would help shape the new Service as it entered the relative peace of the 1920s and 1930s. Overall, there are four key points which stand out from this formative period up to 1934; these were to prove particularly significant during

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<sup>110</sup> TNA, AIR 29/711/17832, Operations Record Book for the School of Store Accounting and Storekeeping, 1929.

<sup>111</sup> TNA, AIR 10/844, Instructions for Store Accounting and Store Keeping (Amendment Lists: 1-1700, Copy of Air Publication 830 dated August 1921.

<sup>112</sup> Ibid, Chapter III – The Provision and Receipt of Stocks for Stores Depots at Home, Paragraphs 85 to 86.

the remainder of the 1930s and through until the end of the Second World War itself. Firstly, the formation of a specialist logistics discipline in the form of the RAF Stores Branch and Trades provided a clear professional focus for logistics; this was to prove vital during the Second World War when sustaining air power became considerably more demanding and logistics demanded careful consideration in campaign and operational planning. This clarity of purpose was strengthened by the fact that the responsibilities of the new RAF Stores Officer in 1920 no longer included the engineering duties of the RFC's Equipment Officer. The second point of note is that the RFC had identified and developed a clear supply chain structure which consisted of the manufacturing base (industry) at one end, depots as an intermediate accumulation point for onward distribution of equipment to users and a stores section on the majority of RAF units to manage equipment requirements on behalf of the actual users. These three components formed the basic model of the RAF's supply chain for the future. The third point was that this model might need to be extended to support operations away from main bases to provide increased *logistical reach* by the addition of port and mobile units as the operational situation dictated. The final point of note was the availability of spares. It was already becoming clear in the period up to 1934 that aircraft were becoming complex structures and the multitude of types from numerous manufacturers, required careful management to ensure that sufficient spare parts were always available. This was a recurring theme which was exacerbated during the forthcoming Expansion Programme and throughout the Second World War.

## Chapter Two: Biplanes to Monoplanes – Transforming RAF Logistics 1934 to 1939

### Introduction

The beginning of 1934 marked the point at which the post-First World War RAF entered a period of transformation, with two particular occurrences triggering significant change. First, the Italian invasion of Abyssinia in October 1935 (hereafter referred to as the Abyssinian Crisis). This prompted not just a reinforcement of RAF basing in the Suez Canal region (which Italy needed as a supply route to its forces in Abyssinia), but a timely review of RAF mobilization planning.<sup>1</sup> The second factor which was unfolding at about the same time was the growing threat emerging from the military expansion of Nazi Germany; this led to a substantial re-equipment programme for the RAF, collectively known as the Expansion Schemes. This chapter examines the six years from 1934 to 1939, and explains how RAF logistics was transformed from a discipline supporting air power in an imperial context, to one which was largely ready to support highly mobile warfare on a global scale.

### Mobilization Planning and the Abyssinian Crisis

The early post-First World War years saw the RAF operating from largely static bases, both at home and overseas, a point commented on by Captain Norman Macmillan in an early book on air strategy:

For years the Royal Air Force was too closely confined to bases and barracks. When they made a flight away from their bases in peacetime it was an elaborately staged affair which took months of advanced preparation to organize...that is all right in times of peace...but in war the question is not the simple one of a single spectacular flight affecting only a small portion of the activities of the Royal Air Force, but a gruelling matter of beginning what may prove to be a prolonged struggle.<sup>2</sup>

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<sup>1</sup> Philpott, *The Royal Air Force, Volume II*, p.66.

<sup>2</sup> Macmillan, *Air Strategy*, p.41.

This period saw the rapid demobilization of the newly formed RAF to a peacetime footing and there was little need to develop any logistics' support capability for expeditionary operations. This position was made quite clear by the Cabinet on 15 August 1919 which stated that:

...It should be assumed, for forming revised estimates that the British Empire will not be engaged in any great war during the next ten years and that no Expeditionary Force is required for this purpose.<sup>3</sup>

This policy, known as the 'Ten Year Rule', was further extended in 1925 and was the British Government's prime means of limiting defence expenditure. The effect of this limitation is evident from the Air Estimates of 1922 to 1929 which increased from £15,542,000 to £16,960,000; a rise of barely one and a half million pounds over seven years.<sup>4</sup> Notwithstanding the financial limitations on the physical growth of the RAF, its logistics' doctrine continued to develop. The experience of the RFC during the German Spring Offensive of 1918 had clearly demonstrated the requirement for some form of mobile logistics and the resupply convoys devised by Brooke-Popham had proved to be highly successful and bridged the gap between the limited equipment holdings of squadrons and the stores depots (see Chapter One, pages 44-45). It was, however, a temporary measure intended to meet a short-term need. Resupply convoys did not initially become a standing part of the RAF's logistical order of battle, although the principle surfaced again in the late 1920s as part of in-depth thinking on the requirements of Army Co-Operation, and was eventually incorporated as a clearly defined capability in logistics doctrine. This was a highly significant and far-sighted development and one which was to prove crucial in many of the overseas campaigns during the Second World War. As John Millett commented at the end of the Second World War '...the success of the airplane in use against the enemy is dependent upon ground transportation' and 'as troops advance, supply lines must continue to follow'.<sup>5</sup>

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3 TNA, CAB 23/15/616A, Cabinet Minutes and Papers February 1919 – October 1924.

4 Armitage, *The Royal Air Force*, p.292.

5 J.D. Millett, 'Logistics and Modern War', *Military Affairs*, Volume 9, Number 3 (Autumn 1945), 193-207, pp.204-205.

The catalyst for detailed thought on RAF/Army co-operation can be largely attributed to a paper which Squadron Leader Slessor (later Marshal of the RAF) prepared for the RUSI Journal in 1927.<sup>6</sup> As part of its initial pre-publication clearance through the Air Ministry, much comment was generated, not least of which was from the Chief of Air Staff who emphasised the point regarding the need for mobility of RAF squadrons and the importance of minimizing the amount of support equipment which they were required to carry.<sup>7</sup> In the ensuing discussions, a basic planning assumption gradually developed which held that squadron establishments of personnel, vehicles and stores for a future RAF Expeditionary Force would need to be kept to the bare minimum if unhindered mobility was to be achieved.<sup>8</sup> Much of the squadron-owned transport was required to move aircraft, ground support equipment, and personnel, sufficient to cover the period until sustained resupply could be achieved from a more extensive source such as a supply depot. There was limited space for spares and these needed to be reduced to those required for immediate operating needs. This left the question of how to resupply flying squadrons at forward operating locations. It was here that the resupply convoy concept re-emerged in the form of what were known as Air Stores Parks (ASP). As part of the planning work which led to the introduction of the RAF's first *War Manual* in June 1929, the concept of a standard Maintenance Organisation was included which included: a Port Detachment to '...arrange for and facilitate the clearance of RAF material from the dock area'; an Aircraft Depot consisting of a Stores Section and a Repair Sections and an Air Stores Park which was '...solely a stores distributing and collecting unit and is mobile'.<sup>9</sup> As far as equipment stocks were concerned, deployed flying squadrons would hold only three days' worth of spares, with re-supply being carried out by the mobile ASPs, each holding one month's worth of stock and situated within a twenty-five to forty mile radius of up to six deployed flying squadrons. The non-mobile

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6 Slessor's particular interest in RAF/Army co-operation can be attributed to the fact that he was appointed as the CO of Number 4 (Army Co-Operation) Squadron in April 1925 just after completing Staff College. See Slessor, *The Central Blue*, p.42.

7 TNA, AIR 2/1290, Expeditionary Force – Organisation of Repair Work in the Field Forward of the Aircraft Dept (S.30202), Précis of Previous Discussion, p.2

8 TNA, AIR 2/1290, Operations, Expeditions (Code A, 40/1): Expeditionary force: organisation of repair work forward of aircraft depot dated 1932.

9 TNA, AIR 2/1290, Expeditionary Force – Organisation of Repair Work in the Field Forward of the Aircraft Dept (S.30202), Précis of Previous Discussion, p.4 and TNA, AIR 10/2312 Air Ministry, AP 1301, Royal Air Force War Manual, Part II - Organization and Administration (Provisional) dated 1928. By 1932, the official definition of an ASP was 'A maintenance unit organised to facilitate rapid distribution to, and holding a reserve of spares and stores for, fighting units'. Air Ministry, AP 1081, RAF Pocket Book 1932 (HMSO: London, 1932), p.249 refers.

Aircraft Depots, which would hold up to six months' worth of spares, were situated behind the ASPs.<sup>10</sup>

The first inclusion of ASPs in detailed operational planning was as part of a structure intended for RAF contingents to accompany an Army expeditionary force overseas; this plan was structured around the despatch of up to four Army contingents (named A to D respectively), with an RAF contingent accompanying each. All four of the RAF contingents were allocated an ASP (named 1 to 4 respectively), with the Aircraft Depot and a Port Detachment assigned to just Contingent A.<sup>11</sup> The plan was scalable in that Contingent A was intended for immediate despatch, with Contingents B, C and D deploying six weeks, four months and six months respectively afterwards, as circumstances required. At this time, the four ASPs named in the plan were not actually formed and were intended to be established and equipped when the Mobilization Plan was activated.<sup>12</sup> It was, however, quite clear where the ASP's vehicles were to come from and who was responsible for the loading of them. In the case of Number 1 ASP, for example, the majority of the prime mover vehicles and various trailers were earmarked from RAF Kenley, with Numbers 1, 3 and 4 Stores Depots responsible for their loading when required.<sup>13</sup>

It was the Abyssinian Crisis which developed in August 1935 as a result of the growing threat of Italian naval, military and air forces to British interests in Egypt which led to the decision to reinforce the RAF stations in Aden, Egypt, Gibraltar, Malta and Palestine, with a mixture of aircraft types from eleven British-based squadrons.<sup>14</sup> The existing mobilization planning (Mobilization Instructions and Air Staff Memorandums) which had been in place since 1927 proved to be unsuitable for this type of deployment as the existing concept of operations was based on deploying a previously agreed force, to a specific

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10 TNA, AIR 2/1290, Expeditionary Force – Organisation of Repair Work in the Field Forward of the Aircraft Dept (S.30202), DOSD to DofE dated 15 June 1931. See also Dye, 'Logistics Doctrine and the Impact of War', p.211 in Cox and Gray, *Air Power History*, pp.207-223.

11 TNA, AIR 10/1473, Air Staff Memorandum, No. 45 (S.28360), Royal Air Force Contingent Accompanying an Army Expeditionary Force Overseas, Appendix A, dated 1930.

12 Ibid, Appendix A.

13 TNA, AIR 2/1290, Expeditionary Force – Organisation of Repair Work in the Field Forward of the Aircraft Dept (S.30202), Detailed MT Loading and Allotment Table for No 1 ASP.

14 Philpott, *The Royal Air Force, Volume II*, pp.66-67. The units included numbers 3, 12, 22, 29, 33, 35, 41, 74, 204, 210 and 230 Squadrons. See also Bowyer, *RAF Operations*, pp.238-241.

timetable, and to fit in with the Army's Mobilization Programme; the RAF's response required an arrangement which was '...as elastic as possible'.<sup>15</sup>

To address the new planning requirement, the Air Member for Supply and Organisation instructed the RAF's Director of Organisation to form a Mobilization Committee; this was formally constituted on 13 September 1935 with its inaugural meeting held shortly after on 16 September 1935.<sup>16</sup> The initial plan was for the deployment of a main, re-enforcing Field Force with HQ elements, a Base Area element, a Port Detachment and an ASP to support eleven squadrons, as well as a more mobile component known as 'Q' Force consisting of a further two squadrons and supporting elements. Logistically speaking, this first real test of mobilisation planning was not a success. The report on the overall experience by HQ RAF Middle East in October 1936 makes it quite clear that the planners in Britain had fundamentally underestimated the extent to which the re-enforcement would impose on the existing administrative and maintenance organisations in the Middle East; this was estimated to be in the region of a four-fold increase.<sup>17</sup> A particular concern expressed was that an ASP was not pre-formed in Britain and it fell to the Middle East Command to meet this shortfall from its own, already limited resources. The ASP proved to be a critical resource in resupplying flying squadrons operating in the Western Desert over the lengthy and extremely vulnerable lines of communication from the RAF depots at Aboukir and Mersa Matruh.<sup>18</sup> Concern was also expressed regarding the provision of additional, experienced Stores Officers, a situation which was largely attributed to the Air Ministry's policy at the time of employing significant number of civilian Stores Officers; this particular issue surfaced again as part of the review of RAF administrative procedures in 1938 (see Chapter 3, Page 98).<sup>19</sup>

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15 TNA, AIR 20/5792, Formation of Mobilization Committee, notes on the Mobilisation Committee. Notes on the 5th Meeting held on 22 October 1935, p.1.

16 TNA, AIR 20/5792, Formation of Mobilization Committee, notes on the Mobilisation Committee dated 1935.

17 TNA, AIR 2/1923, Report on the Equipment Aspect of the Emergency 1935-1936 in the Middle East Command (ME/S.23991/1 dated 30 September 1936, Part VII – Personnel and Training, Section I – Stores and Maintenance Personnel, p.113.

18 TNA, AIR 2/1923, Report on the Equipment Aspect of the Emergency 1935-1936 in the Middle East Command (ME/S.23991/1 dated 30 September 1936, Formation of No.3 Air Stores Park, p.13

19 TNA, AIR 2/1923, Report on the Equipment Aspect of the Emergency 1935-1936 in the Middle East Command (ME/S.23991/1 dated 30 September 1936, Part VII – Personnel and Training, Section I – Stores and Maintenance Personnel, pp.113.-121.

The RAF Middle East Command's report on the 1935-1936 emergency was a rich source of lessons learned on what could be considered the first real exercise of the mobilisation planning work which took place during the period 1927 to 1930. The Committee's immediate priority was the work required to deploy the re-enforcements for the Abyssinian Crisis but, by the time the last of the deployed squadrons had returned to Britain in late September 1936, its work was re-focused on the RAF's mobilization requirements for a European campaign; this work eventually underpinned the RAF's deployment to France in 1939. Planning for this began in earnest in April 1938 with the formation of a largely Army led team in the War Office called General Staff (Plans). Having studied various Cabinet and General Staff papers, the planning team proposed a number of priorities, the first of which was the despatch of an air striking force to France and its maintenance in the field. In due course this concept became known as the Western or 'W' Plan.<sup>20</sup>

### **The Expansion Programme – 1934 to 1938**

The threat from Germany became increasingly clear following her withdrawal from the Disarmament Conference for a second time in November 1933 and also from the League of Nations – this marked the point at which Hitler no longer concealed his aspirations for rearmament.<sup>21</sup> The threat from Nazi Germany took some time to be taken seriously, with a significant degree of ambivalence amongst many British politicians. Prime Minister Baldwin, however, summed up the Government's new stance as far as the RAF was concerned in March 1934 when he stated that 'This Government will see to it that in air strength and air power this country will no longer be in a position of any inferiority to any country within striking distance of our shores'.<sup>22</sup> The realisation of this vision, however, would take until the outbreak of the Second World War to even come close to fruition. In 1936 the RAF, following the resolution of the Abyssinian Crisis, turned to addressing the threat posed by Germany. After much deliberation in political circles as to the requirement and scale of rearmament, the British Government embarked upon a series of eight

<sup>20</sup> L.A.Hawes, 'The Story of the "W" Plan – The Move of Our Forces to France in 1939', *Army Quarterly*, 101(4) (July 1971), 445-456 (pp.445-447).

<sup>21</sup> D. Seward, *Victory Denied – The Rise of Air Power and the Defeat of Germany* (London: Buchan & Enwright, 1985), pp. 70-71.

<sup>22</sup> Quoted in B.J.C. McKercher, 'Deterrence and the European Balance of Power: The Field Force and British Grand Strategy, 1934-1938', *English Historical Review*, Volume CXXIII, No. 500 (2006), 114 and TNA, CAB 23/87, Minutes of a meeting of the Cabinet 27th January 1937.

Expansion Schemes between 1934 and 1938, although it took until March 1942 for the final scheme to become fully effective.<sup>23</sup> After Germany revealed the foundation of its new air force, the Luftwaffe, in March 1935, the whole process gained greater momentum, with a marked increase in the number of squadrons and aircraft on the home establishment.<sup>24</sup>

The design of the RAF's aircraft had changed very little from the closing stages of the First World War. The Air Ministry account of the RAF's expansion from 1934 to 1939 describes how, in 1934, it was 'a force of wooden biplanes' and 'a world of types which are now but memories and which pilots and air crews of the present day would regard almost as museum pieces, as prehistoric survivals of the era of the Wrights and Farmans'.<sup>25</sup> The expansion of the Service was a critical turning point and consisted of a series of schemes which, not only substantially increased the numbers of aircraft, but significantly updated their design; by 1939 it had become a 'force of metal monoplanes'.<sup>26</sup> This technological transformation is also commented on by J.D Scott and R. Hughes in their work on war production, observing that 'In 1934, aircraft development was on the eve of a major evolution. The era of the fabric-covered biplane, with a fixed undercarriage, and low landing speed, was definitely over'. This source goes on to provide a concise description of the dramatic change to come (particularly in terms of engineering complexity), commenting that 'The newer types of aircraft on the other hand – the fast monoplane with fully cantilevered wings, retractable undercarriage, variable pitch airscrew, all metal construction and stressed skin – was still on the horizon'.<sup>27</sup> The transition from largely wood to metal aircraft construction though represented a significant change for Britain's aircraft industry, not just in technology, but also in cost. As the historian Sebastian Ritchie points out 'the new construction methods involved an increased commitment to development and testing, the acquisition of new

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23 Armitage, *The Royal Air Force*, pp.67-71.

24 Air Ministry, Air Historical Branch (AHB)(1), R.A.F. Narrative (First Draft), *The Expansion of the Royal Air Force 1934-1939*, (undated), p.163.

25 Air Ministry, *The Expansion of the Royal Air Force*, p.71.

26 *Ibid*, p.71.

27 J. Scott and R. Hughes, *History of the Second World War - Administration of War Production* (London: HMSO, 1955), p.36. The revolution in aircraft design is also commented on in the wider literature. See: H.M. Hyde, *British Air Policy Between the Wars 1918-1939* (London: Heineman, 1976), p.321; Terraine, *The Right of the Line*, p.15; L.F.E. Coombs, *The Lion has Wings - The Race to Prepare the RAF for World War II* (Shrewsbury: Airline Publishing Ltd, 1997), p.1; Armitage, *The Royal Air Force*, pp.72-73; Dean, *The Royal Air Force and Two World Wars*, p.39; D. Richards, *Royal Air Force 1939-1945, Volume I – The Fight at Odds* (London: HMSO, 1953) and E. Lund, 'The Industrial History of Strategy: Reevaluating the Wartime Record of the British Aviation Industry in Comparative Perspective, 1919-1945', *The Journal of Military History*, 62 (January 1998), 75-99 (pp.82, 93-94).

machinery, and changes in manufacturing processes, each of which required considerable expenditure'.<sup>28</sup> The expansion schemes introduced a diverse range of aircraft types, from bombers and fighters through to torpedo-bombers, reconnaissance (landplanes and flying boats) and army co-operation. The first of the Schemes (Scheme A) was approved in July 1934 with some of the further schemes being directly attributed to specific concerns or events. For example: Scheme C in May 1935 following Sir John Simon's and Anthony Eden's visit to Hitler in Berlin and Göring's claim of Luftwaffe parity; Scheme F in February 1936 as a result of further German expansion and the Abyssinian crisis; Scheme L in April 1938 after the Austrian *Anschluss* and Scheme M in November 1938 after Munich and was the first 'all-heavy' programme.<sup>29</sup> The overall expansion programme in terms of the planned (and approved) increase in the total number of squadrons and aircraft, from July 1934 through to November 1938, is summarised in Table 2.

Scheme	Dates		Home Based		Overseas Based	
	Approved	Effective	Squadrons	Aircraft	Squadrons	Aircraft
<b>A</b>	18 July 1934	31 Mar 1939	84	960	27	292
<b>C</b>	21 May 1935	31 Mar 1937	123	1,512	27	292
<b>F</b>	25 Feb 1936	31 Mar 1939	124	1,738	37	468
<b>H</b>	24 Feb 1937	31 Mar 1939	145	2,422	27	348
<b>J</b>	22 Dec 1937	Summer 1941	158	2,387 <sup>30</sup>	45	644
<b>K</b>	14 Mar 1938	31 Mar 1941	145	2,305	37	468
<b>L</b>	27 Apr 1938	31 Mar 1940	171	4,138	39	490
<b>M</b>	7 Nov 1938	31 Mar 1942	163	2,549 <sup>31</sup>	49	636

**Table 2 -  
The Approved Aircraft Expansion Schemes 1934 to 1938**<sup>32</sup>

By 1 October 1938, the Expansion Schemes had substantially increased the numbers of squadrons and aircraft. A paper submitted to the Cabinet on 25 October 1938 by the Secretary of State for Air, Sir Kingsley Wood, declared that the first line aircraft strength of the RAF now consisted of: twenty-nine fighter squadrons with 406 aircraft; thirty-one medium bomber squadrons with 372 aircraft and ten heavy bomber squadrons with 120 aircraft.<sup>33</sup> The comparative illustration provided by Sir Maurice Dean, permanent secretary at the Air

<sup>28</sup> Ritchie, *Industry and Air Power*, p.12.

<sup>29</sup> Slessor, *The Central Blue*, pp.184-185 and Bailey, *The Arsenal of Democracy*, pp.30-31.

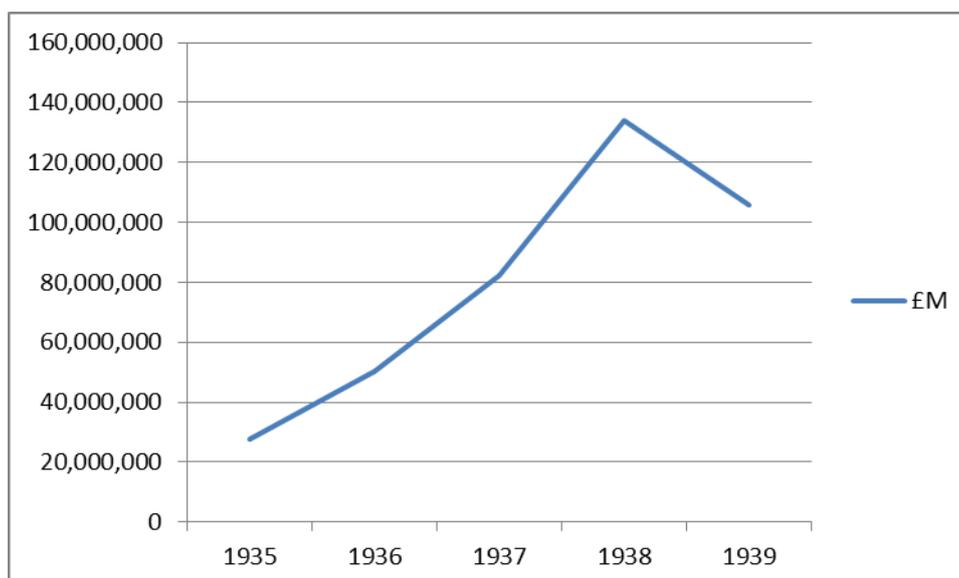
<sup>30</sup> Includes ten squadrons for the Field Force.

<sup>31</sup> Ibid.

<sup>32</sup> Figures correlated from M. Smith, *British Air Strategy Between the Wars* (Oxford: Clarendon Press, 1984), Appendices, pp.328-335 and Air Ministry, *The Expansion of the Royal Air Force*, Appendix 1. There was no scheme B, Schemes H and J never actually came into operation and the remaining missing letters represent tentative suggestions, which did not come to fruition. All figures exclude the Fleet Air Arm.

<sup>33</sup> Air Ministry, *The Expansion of the Royal Air Force*, p.75.

Ministry, places the effectiveness of the Expansion Scheme in a more enlightening context. British military aircraft production, he highlights, ‘...was 54 per cent of that of Germany in 1938 and 96 per cent in 1939’.<sup>34</sup> Commensurate with the Expansion Schemes was a need for a significant increase in manufacturing output. The existing industrial base was able to meet the demands of Schemes A and C, but Scheme F was another matter altogether and the existing manufacturing firms could not tackle the requirement unaided. Consequently, it was decided to introduce what became known as ‘shadow factories’. Based on the large motorcar producers in the Coventry and Birmingham areas, the shadow factories were established on sites close to their parent works and were initially set up to produce airframes and engines - additional plants were soon set up to produce propellers, carburettors and magnetos. The companies originally selected for this scheme were the Austin, Daimler, Rootes, Rover, Singer, Standard and Wolseley companies. However, Singer and Wolseley dropped out of the programme before it was started – their place was soon filled by the Bristol Aeroplane Company and the Austin Motor Company.<sup>35</sup> This extensive expansion activity was met with a corresponding increase in Air Expenditure which rose from £27,496,000 in 1935 to a peak of £133,800,000 in 1938; the profile for the years 1935 to 1939 is shown in Figure 2.



**Figure 2 -  
Air Expenditure for Financial Years 1935 to 1939** <sup>36</sup>

<sup>34</sup> Dean, *The Royal Air Force and Two World Wars*, p.58.

<sup>35</sup> Air Ministry, *Maintenance*, p.3.

<sup>36</sup> Source: R. Higham, *Armed Forces in Peacetime— Britain, 1918-1940, A Case Study* (London: Foulis & Co Ltd, 1962) Appendix II, pp. 326-327. Figures include civil aviation which was included in the annual Air Estimates for the period in question.

Much of the published literature which comments on the Expansion Schemes focuses predominantly on the aircraft production and modernisation success story with little, if any, wider illustration of the many other changes which were required to strengthen the efficiency and effectiveness of the RAF by the outbreak of war in September 1939.<sup>37</sup> One of the earliest changes concerned organisation and this enabled a fundamental improvement from the logistics perspective. The RAF's home command structure in the period up until 1935 was largely geographical in nature and the RAF as a whole was simply divided into 'Home' and 'Overseas'. The home element was classed as the Air Defence of Great Britain and was sub-divided into eight components: Western Area; Central Area; Fighting Area; Number 1 Air Defence Group; Inland Area; Coastal Area; RAF Cranwell and RAF Halton. The overseas element was sub-divided into six components: RAF Middle East; British Forces in Iraq; RAF India; RAF Mediterranean; Aden Command and RAF Far East.<sup>38</sup> The significance of this is that functions such as logistics (below Air Ministry level) were without a single controlling, specialist authority. This led to logistics units being placed within inappropriate formations; the four Stores Depots, for example, were under the command of the Inland Area formation as part of Number 21 Group from 1932 to 1933, then under the direct command of HQ Inland Area from 1934 to 1935, before a further transfer to the command of Number 24 (Training) Group in 1936. The Stores Depots (still within 24 (Training) Group) came under the newly formed Training Command in 1937.<sup>39</sup> The diverse range of aircraft types and supporting activities introduced through the expansion process led to a major reorganisation in the RAF command structure in 1936 with, initially, the introduction of four new commands comprising Bomber, Coastal, Fighter, and Training; three further commands were introduced in 1938 to include Maintenance, Balloon and Reserve.<sup>40</sup> This reorganisation established a clear focus for activities on a functional rather than a geographical basis.<sup>41</sup>

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37 See: Terraine, *The Right of the Line*, pp.15-45; Coombs, *The Lion has Wings*, pp.1-91; Armitage, *The Royal Air Force*, 67-74; Dean, *The Royal Air Force and Two World Wars*, pp.59-81 and H. St.G. Saunders, *Per Ardua – The Rise of British Air Power 1911-1939* (London: Oxford University Press, 1944), pp.315-326.

38 RAFC Library, *Monthly Air Force Lists 1933 – 1935* (London) (as at December of each year).

39 Ibid, *Monthly Air Force Lists 1932 – 1937*.

40 Air Ministry, *The Expansion of the Royal Air Force*, p.132. Training Command was further split into Flying Training Command and Technical Training Command in May 1940.

41 Richards, *Royal Air Force 1939-1945, Volume 1*, p.26.

## Maintenance Command

The Expansion Programme saw a significant increase in the number of RAF maintenance units and the accumulations of war reserves on an unprecedented scale. Amidst this growth, it became apparent that there was a growing need for a single focus for logistics and engineering in the form of a Maintenance Command. This had been recognized in September 1937 when the Director of Organisation submitted a note to the Air Council, suggesting that a dedicated Command should be formed to control the RAF's growing maintenance organisation<sup>42</sup>; up to this point, maintenance, as described by C.G Grey in his *History of the Air Ministry* '...had been rather left to look after itself. Either squadrons did their own repairs and maintenance or sent the aeroplanes or motors which were to be repaired to one of the Depots'.<sup>43</sup> The Director highlighted the fact that the existing units concerned with maintenance were controlled and administered by the Director of Equipment, whilst their domestic administration was taken care of by the Air Officer Commanding-in-Chief, Training Command; consequently, the Director of Equipment was in effect working as an executive Air Officer Commanding over units with functions that were quite remote from him – in addition to a prime responsibility for an Air Ministry department.<sup>44</sup> The proposal to form the new Command was submitted to and approved at an Expansion Progress Meeting with the Secretary of State for Air on 21 September 1937.<sup>45</sup> The Command Headquarters was formed initially within the Directorate of Equipment at the Air Ministry, on 1 April 1938, but was later moved to RAF Andover in August 1938 and then to nearby Ampert by the outbreak of the Second World War.<sup>46</sup>

In broad terms, the new Command's responsibilities were twofold. Firstly, it was to be responsible for controlling and coordinating all the RAF's maintenance services. Secondly, and the more sizable task, it was responsible for the planning and organisation required for the receipt, storage, repair and

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<sup>42</sup> Air Ministry, *Maintenance*, p.9.

<sup>43</sup> Grey, *A History of the Air Ministry*, p.295.

<sup>44</sup> Air Ministry, *Maintenance*, p.9.

<sup>45</sup> Ibid, pp.9-10

<sup>46</sup> TNA, AIR 72/22, AMOs – Administrative, AMO A.159.- Formation of a Maintenance Command (747546/38.-22.4.38) dated 22 April 1938 and Air Ministry, Air Historical Branch (AHB), Air Publication 3236, *The Second World War 1939-1945 Royal Air Force – Works* (London: Air Ministry, 1956), p.284.

distribution of the RAF's equipment in both peace and war. The Command HQ (subject to the direction of the Air Ministry) was responsible for directing and coordinating the work of these groups due to the diversity in composition and functions; the day-to-day administration of the Groups was, on the whole, coordinated by the respective Group HQs. More specifically, the Air Officer Commanding Maintenance Command was directly responsible for the policy which governed how stocks of equipment and supplies would be held and distributed. He was also responsible for mobilization plans and war readiness. As early as August 1938, this latter responsibility was already acknowledging the need to prepare for disruption caused by war disruption and included planning for the distribution of stocks, the diversion of lines of supply if and when required, the supply of labour and railway rolling stock. It was also specifically required that readiness plans for war were to be tested by 'frequent exercises in packing, distribution and mobilisation, in which the cooperation of other Commands will be necessary'.<sup>47</sup> The one area where HQ Maintenance Command retained overall control was in the movement of materiel as this was deemed to be more effective and economical than establishing identical coordinating functions within each of the Group HQs. Moreover, there was also a need for close cooperation with the Command HQ planning staff, the Air Ministry, the Board of Trade and other Government departments.<sup>48</sup> The Air Ministry remained responsible for general equipment policy, determining war equipment schedules, contract arrangements and provisioning of equipment; it was acknowledged at the time that the latter task might be transferred to the command in the future.<sup>49</sup> The command's badge, a raven (Biblically symbolic of providence) in the centre of the standard RAF badge format with the motto of 'Service', was approved by His Majesty King George VI on 7 September 1939.<sup>50</sup>

The Headquarters element of Maintenance Command was responsible for the overall direction and coordination of operations as well as ground defence matters and the control of movements. To provide a more manageable structure for the myriad of technical and logistical activities which came within

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47 TNA, AIR 2/3317, Directorate of Equipment Reorganization 1938, Air Ministry letter S.37588/S.9. dated 26 August 1938, Attached Memorandum – Organisation of Maintenance Command, pp.6-7.

48 *Ibid*, p.7.

49 TNA, AIR 2/3088, Maintenance Command Establishment: 598007/37/F.1. dated 8th December 1938.

50 TNA, AIR 72/23, AMOs - Administrative, AMO A.363/39 dated 7 September 1939 and RAF Museum web site 'Heraldic Badges: Halloween Edition' at: <http://www.rafmuseum.org.uk/blog/heraldic-badges-halloween-edition/> (last accessed on 14 January 2016).

its responsibility, it was divided into four groups: 40 Group (responsible for the storage of equipment and the maintenance of reserve MT vehicles); 41 Group (responsible for the receipt, storage, maintenance and delivery by air of all aircraft); 42 Group (responsible for explosives and fuels) and 43 Group (responsible for repair and salvage). Broadly speaking, Numbers 41 and 43 Groups were predominantly responsible for engineering activities, with Numbers 40 and 42 Groups responsible for logistics.<sup>51</sup> Given the scope of logistics as defined in the Introduction, this thesis will only consider the development and operation of 40 and 42 Groups from here forwards. As far as the holdings of equipment stocks were concerned, these were held on a 'Universal' basis, with each depot holding a complete range and serving as a distributing centre for consumer units within a specified geographical area.<sup>52</sup> A document held in the MOD's AHB (RAF) archive, which appears to be of post-Second World War origin, imaginatively describes the Maintenance Command and Group structure as: 'Resembling that of a combination of iron-mongers, petrol stations, service garages and other chain store businesses – with the Command Headquarters staff as the Board of Directors'.<sup>53</sup> Both 40 and 42 Groups formed their headquarters initially at Andover, but by August 1939 had moved them to Abingdon and Burghfield Common (near Reading) respectively.

Another notable change at this time was one of terminology. With the Expansion Scheme's emphasis on modernization and re-equipment, the term 'Stores', which had been in use since the First World War for the name of the RAF's Branch and Trade, along with the prefix to the depot titles, had started to fall out of fashion and had become dated; many working within the discipline felt that it inadequately covered their responsibilities which, by now, included a much wider range of functions such as movements, transportation, fuels and explosives.<sup>54</sup> Consequently, the RAF Stores Branch was renamed the Equipment Branch in November 1936.<sup>55</sup> Shortly afterwards, on 2 February 1937, the Stores Depots were renamed Equipment Depots.<sup>56</sup> A further change

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51 Maintenance Command began to assume executive functions on 1 August 1938 (AMO N.589/38 as amended by AMO N.611/38). TNA, AIR 2/3317, Directorate of Equipment Reorganization 1938, S.37588/S.9. dated 26 August 1938 refers.

52 TNA, AIR 2/3088, Maintenance Command Establishment: 598007/37/F.1. dated 8th December 1938.

53 MOD AHB (RAF), un-referenced draft document, 'Maintenance Command – 40 Group and 14 MU Carlisle', p.1.

54 T.Stone, 'Ringing the Changes – An Historical Perspective', *RAF Logistics Branch Yearbook* (2009), pp. 103-107.

55 TNA, AIR 72/20, AMOs - Administrative, AMO 713 dated 7th November 1936 and Air Ministry Announcements, 'R.A.F. Stores Branch - Change of Title', *Flight*, 19 November, 1936, p.557.

56 R. Sturtivant *et al*, *Royal Air Force Flying Training and Support Units*, p.112.

followed a year later in 1938 when all Maintenance Command depots, irrespective of their functions, were re-designated as Maintenance Units (MU).<sup>57</sup>

### **Equipment Supply – 40 Group**

The formation of Maintenance Command (particularly 40 and 42 Groups) was critical to the successful outcome of the Expansion Programme in two key respects. Firstly, greater numbers of aircraft, with their complexity, significantly increased the size and range of the RAF spares inventory, a fact which would demand a far greater number of Stores Depots than the four which were in existence in 1934. The growing size of the inventory is illustrated by the number of aircraft types. In February 1935 this was thirty-five (including mark variants); by the outbreak of war in September 1939, the number had increased to sixty-nine (including mark variants). Moreover, during the same period, the number of aircraft manufacturing companies had increased from fourteen to twenty-one.<sup>58</sup> Responsibility for handling the equipment and spares required to support this growing commitment fell to Number 40 Group.

The growth in the number of depots started with the Air Estimates of 1937/38 and 1938/39, in which proposals were included to construct five new depots within 40 Group at Carlisle, Quedgeley, Hartlebury, Heywood and Stafford and one within 42 Group at Chilmark.<sup>59</sup> These new depots were significantly larger than the existing Stores Depots; the 40 Group depots, for example, each had a total floor space of 854,000 square feet, as compared with the 729,000 and 447,000 square feet of the pre-1934 Stores Depots at Ruislip and Milton respectively.<sup>60</sup> The individual size of the new depots is well illustrated by the example of Hartlebury, which covered an area of 350 acres. It provided covered-storage of approximately one and a quarter million square feet, later increasing to one and a half million square feet. Railway lines were laid to certain sites along with marshalling sidings capable of holding up to 100 trucks.<sup>61</sup> The estimated cost of the five new depots ranged from £1,330,000 to

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57 Ibid, p.112.

58 Thetford, *Aircraft of the Royal Air Force*, pp.406-407.

59 Air Ministry, *The Expansion of the Royal Air Force*, p.140.

60 Ibid, p.140.

61 Air Ministry, *Works*, pp.288-289.

£1,450,000 each.<sup>62</sup> Not all of these depots were built on green field sites; the site at Quedgeley, for example, had been the National Shell Filling Factory No 5 during the First World War.<sup>63</sup> Each of these new depots consisted of a headquarters' site with six, well dispersed sub-sites. The headquarters' site consisted of headquarters' offices, officers' mess and living accommodation, general engineering block, fabric repair block, carpenter's shop, timber store, transportation block, together with ancillary buildings. The sub-sites consisted of between three and five storage sheds along with a range of miscellaneous facilities such as warden's offices, canteens and sanitary blocks.<sup>64</sup>

The RAF was not alone in facing the logistics challenges presented by expansion. The US Army Air Force (USAAF) also went through a substantial expansion programme but in 1940, some six years later than Britain. The USAAF, however, struggled to cope with the substantial inflow of equipment to its logistics depots and these were soon overwhelmed, a factor not helped by the relocation of stocks eastwards from locations on the west coast of the United States following Japan's attack on Pearl Harbour in December 1941.<sup>65</sup> This led to significant confusion in stock records, a position which was not rectified until 1943. Similar to the RAF, the USAAF also experienced a shortage of depot storage space which led to continual efforts to acquire additional real estate through new-build or hirings.<sup>66</sup>

In parallel with this significant building programme, there remained continuous anxiety within the Air Ministry planning staff regarding vulnerability to enemy action. From as early as 1934, there was some concern that Germany was beginning to acquire the capability to mount an air attack on the United Kingdom, a point highlighted by Hyde who observed that '...the subject of air rearmament continued to excite controversy among the politicians and the public, as suspicions mounted that the Germans were secretly equipping themselves with military aircraft capable of striking at the heart of Britain'.<sup>67</sup> The

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62 Air Ministry, *The Expansion of the Royal Air Force*, p.140. The construction programme was overseen by the Air Ministry Directorate General of Works and the first of the new 40 Gp depots were constructed at Hartlebury and Carlisle in 1937, both of which opened in September 1938.

63 B.M. Kilcullen, *No.7 Maintenance Unit RAF Quedgeley- Pre-History & History* (Innsworth: Royal Air Force,1996), p.4

64 Air Ministry, *Works*, p.288.

65 W.F.Craven and J.L.Cate, *The Army Air Forces in World War II*, Volume Six, Men and Planes (Chicago (USA): University of Chicago Press, 1954), pp.xxii and 378.

66 Craven and Cate, *The Army Air Forces in World War II*, pp.378-380.

67 Hyde, *British Air Policy*, p.322.

fear was not unfounded - the range of German bombers by this time was capable of achieving just that, a point made by Hyde who relates how '... the increase in the range of bomber aircraft – ranges of up to 375 miles had now to be reckoned with – meant that the industrial areas in the north-east of England and the Midlands were well within reach of bombers based in north-western Germany'.<sup>68</sup> This trepidation influenced the design of the new depots where protection from enemy air attack was seriously considered from the outset. The sub-sites enabled stock to be dispersed over a wider geographical area, thereby minimising the complete loss of stock held at one location – single-site stockholding was largely the case with the four pre-1934 Store Depots. The storage sheds on the sites were built to three standards. The highest standard were fully protected with walls and roofs of concrete capable of withstanding small incendiary bombs and splinters; these buildings were designed for the storage of essential stores which were difficult to replace and of a flammable nature. The middle standard known as semi-protected was used to house essential stores which were difficult to replace but were of a non-flammable nature. The lowest standard known as non-protected were for non-vital stores which were easy to replace.<sup>69</sup>

Despite the ability to disperse stock throughout depot sites, the Air Ministry remained concerned about a significant weakness. Each of the former Stores Depots was responsible for a specific range of equipment in the RAF inventory. For example, the depot at Ruislip was entirely responsible for aero-engines – the loss of this single depot alone would have had catastrophic effects on the supply of aero engines to the RAF.<sup>70</sup> Stock needed to be dispersed between the depots to mitigate the risk of such a loss. The answer was straightforward and the depots were re-developed into Universal Equipment Depots (UED) where each would hold stocks of spares for the RAF's complete range of aircraft and ground equipment, from a simple nut and bolt to a complete aircraft engine. The redistribution of stock commenced in May 1939 and involved a prodigious amount of work for the depots concerned. It was not just a question of the physical movement of equipment; much reconfiguration of physical storage and materials handling facilities was required to accommodate

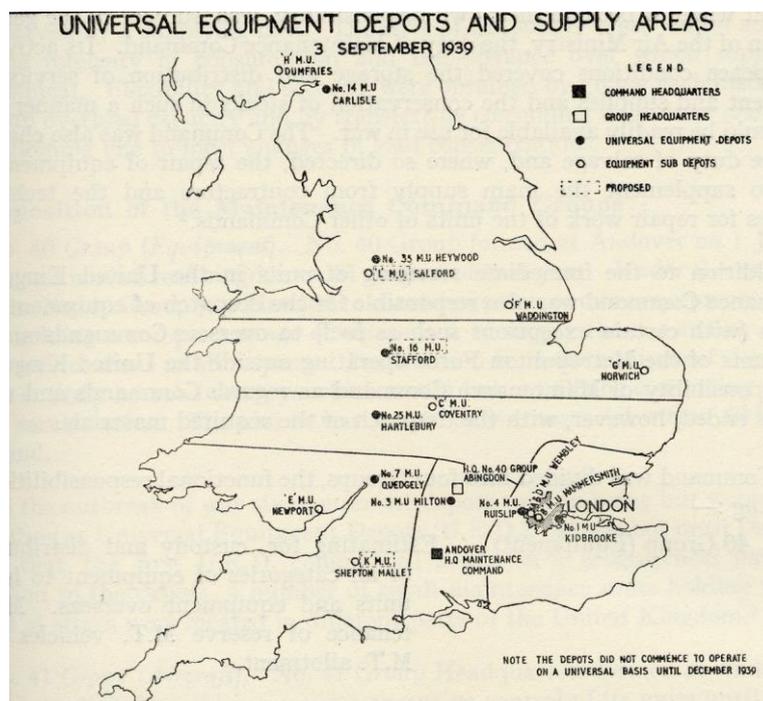
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<sup>68</sup> Ibid, p.319.

<sup>69</sup> Air Ministry, *Works*, p.288 and MOD (AHB), un-referenced draft document, *14 MU the Original Concept and Design – May 1938* (undated), p.3.

<sup>70</sup> TNA, AIR 29/960, Operational Record Book for No. 4 Stores Depot, Ruislip, January 1927 to December 1940.

a much wider range of equipment and stores. Another change was a move away from each depot having an RAF-wide responsibility to one of a defined geographical boundary. Essentially, each of the UEDs became responsible for the supply of equipment to all of the RAF units in an area spanning west to east across Britain, and was organised so that they could take on the workload of the depot to its north and south if there was any disruption due to air attack or sabotage (see Figure 3).<sup>71</sup> Delivery of equipment to RAF stations from the depots was made by road, rail or by post depending on the urgency of need, with an overall aim of achieving this within 48 hours.<sup>72</sup> The question of vulnerability from enemy action was taken seriously – well before the military capability of Nazi Germany was so clearly demonstrated during its invasion of Poland in September 1939.



**Figure 3**  
**Universal Equipment Depots and Supply Areas - 3 September 1939**<sup>73</sup>

Although the decentralization of equipment holdings by virtue of the UED concept, improved physical security and guaranteed a faster speed of supply to RAF units, it presented a fresh challenge with regards to maintaining an overall

<sup>71</sup> Air Ministry, *Maintenance*, p.37.

<sup>72</sup> Ibid.

<sup>73</sup> Source: Air Ministry, *Maintenance*, p.21.

record of the stock held. This was further complicated by the fact that the dispersal of stock to the UEDs in May 1939 had been done in haste and, for some time after, no exact stock record figure existed for the depots. Once the position stabilized, the challenge was how to ensure that fresh stock of a given item was not provisioned when there was already ample stock available at other depots. To address this, a Master Provisioning Office was set up at each of the depots with responsibility for the provisioning of equipment within given ranges for all depots; the operation of these offices and the complexity of provisioning is examined in more detail in Chapter Five.

### **Explosives and Fuel Supply – 42 Group**

The second significant feature of the Expansion Programme which had an impact on logistics was the increased requirement for explosives and fuel, a logistics' responsibility which fell to 42 Group. One of the early issues which surfaced at the beginning of the war was the increasing carrying capacity of bomber aircraft being introduced through the Expansion Programme. For example, the Heyford III bomber could carry a bomb load of 1,500 pounds (for a return journey range of 749 miles). By 1939, the Wellington IA bomber was able to carry three times the Heyford's bomb load. (4,500 pounds for a return range journey of 1,200 miles).<sup>74</sup> With the introduction of the Lancaster in 1941 the payload increased to 14,000 pounds albeit by then much heavier bombs ranging from 1,500 pounds to 8,000 pounds had been introduced.<sup>75</sup> By the end of the war, the RAF's range of bombs was extensive with numerous types ranging from general purpose bombs to anti-submarine weapons, depth charges and incendiaries. The size and shape of these weapons led to the need for new bomb trollies which were used both at the explosives depots and at airfields for transporting bombs from storage sites to the aircraft; throughout the war, eleven types of trolley were introduced.<sup>76</sup> In addition to this extensive arsenal, there was of course the requirement for bomb sights, the number of which increased as the need to improve bombing accuracy grew; between 1916

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<sup>74</sup> Richards, *Volume I – The Fight at Odds*, p19.

<sup>75</sup> Thetford, *Aircraft of the RAF*, p.42.

<sup>76</sup> Air Ministry (AHB), *The Second World War 1939-1945 Royal Air Force – Armament, Volume I, Bombs and Bombing Equipment* (London: Air Ministry, 1952), Appendix 18, p.434.

and 1945, twenty-six type/mark variants were introduced to service.<sup>77</sup> The size of the RAF's bomber fleet alone was planned to increase from a pre-expansion strength (i.e. before March 1934) of 316 aircraft to 1,360 as part of Scheme M by early 1942.<sup>78</sup>

Prior to 1939, the RAF's inventory of ammunition was predominantly .303-inch with five types in service by the outbreak of war. Over the years of the war up until the end of 1945, a further thirty types of ammunition were introduced consisting of a further five types of .303-inch rounds, four types of .5-inch rounds, twelve types of twenty millimetre and nine types of forty millimetre rounds. In addition, there were also ten new types of American designed ammunition introduced including .30-inch, .5-inch and 20 millimetres. The advent of aircraft launched rockets saw four types of cordite powered rocket motors. Perhaps the greatest increase of types on the explosives inventory was pyrotechnics. Between the beginning of 1941 and the middle of 1945, seventy six different types were introduced to service including (inter alia) fuzes, rockets, cartridges and flares.<sup>79</sup>

The first proposals for an expansion in the RAF's explosives storage capability were submitted to the Treasury in November 1936 and, as part of this, approval was sought to construct storage facilities for an anticipated six months' war demand of 98,000 tons of high explosive and incendiary bombs; the calculation was based on existing aircraft being able to carry 1,250 lb each with an expectation that, with the introduction to service of a new type of heavy bomber, the payload would increase to 3,000 lb.<sup>80</sup> Approval was subsequently granted for the storage of the 98,000 ton requirement although only three months reserve or 48,000 tons would be actually 'filled' at any one time.<sup>81</sup> By March 1938 it had been agreed that the authorized reserve storage would be 82,000 tons of high explosive and 16,000 tons of incendiaries.<sup>82</sup>

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77 Ibid, Appendix 15, pp.431-432.

78 Hyde, *British Air Policy*, Appendix VI.

79 Air Ministry (AHB), *The Second World War 1939-1945 Royal Air Force – Armament, Volume II, Guns, Gunsights, Turrets, Ammunition and Pyrotechnics* (London: Air Ministry, 1954), Appendices 6, 7 and 8, pp.198-203.

80 Air Ministry, *Works*, p.256.

81 Ibid, p.256.

82 Ibid, p.256.

Explosives, however, brought a very different storage and distribution requirement. The hazardous nature of these stores required quite demanding protective measures to be taken, not just in terms of protecting the local population from the effects of accidental explosion, but also reducing the effects of a chain reaction between adjacent stocks at a storage location in the event of a detonation. The bulk and weight of explosives (especially aircraft bombs) made road transport quite impractical for transporting any sizable quantity; individual bomb weights rose substantially from 500 lb. in 1936 to 22,000 lb. in 1944 and the use of the United Kingdom's rail network became a crucial component of Explosives distribution (see Chapter Seven, page 248).<sup>83</sup> Up until the commencement of the Expansion Programme, storage and distribution was relatively small-scale, with all demands for the supply of explosives being handled by Number 2 Stores Depot at Altrincham. As with 40 Group's experience, the rapid growth of the RAF (especially the Treasury approved increase in main and reserve explosives' holdings) led to the realisation that this limited and centralised arrangement would prove to be inadequate. At the heart of the revised planning for explosives' storage and distribution was the basic premise that main reserve holdings of munitions and their related ancillary equipment would be regionalized in three sections of the country covering Northern and Southern England and the Midlands.<sup>84</sup> The individual units required to hold this main stock were to be known as Ammunition Depots (AD) and it was proposed that five would need to be built.<sup>85</sup> Each was stocked using the Universal principle outlined earlier and were to hold high explosive bombs, incendiaries, bomb components, small arms ammunition, pyrotechnics and bomb filling materials. Deliveries of these stores were made by rail, direct from the ordnance factories. Whilst the inter-war practice of munition deliveries direct to RAF units from the main depot at Altrincham had sufficed, the anticipated increase in the number of bomber stations led to concern that the direct delivery concept would become an unmanageable burden on the ADs.

To provide an intermediate stockholding, it was agreed that up to seven smaller units to be known as Air Ammunition Parks (AAP), would be established to support a specific 'neighbourhood' of operational stations. The parks were to

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83 *Ibid*, p.256.

84 *Ibid*, p.256.

85 Air Ministry, *Maintenance*, p.24.

hold approximately one week's worth of stock (based on projected war consumption forecasts) for the units they supported, in addition to four day's holdings on each RAF station.<sup>86</sup> As far as transportation was concerned, the ADs delivered stock to the AAPs by rail; RAF units were then required to use their own transport to collect ordered stock. Geographically, all of the AAPs were situated in close proximity to the bases they served and were east of a line drawn approximately from Edinburgh to Southampton. The ADs were located west of this line to minimize the risk from enemy bombing.<sup>87</sup>

In terms of construction, the ADs were the most demanding as these were to be afforded the highest level of protection, both from aerial attack and to afford a level of concealment from aerial reconnaissance. The only practical solution was the construction of underground storage, using existing mine or quarry workings to minimise excavation requirements. Well over a hundred sites were investigated in 1937 following the advice of the Geological Museum, the Mines Department and various mining companies.<sup>88</sup> Many of those examined were completely unsuitable for a whole host of reasons including: limited size, wet conditions, insufficient overhead cover for defence protection, the proximity of existing active workings and poor access or proximity to rail transport. Five sites were eventually selected, the first four (2 MU Altrincham, 11 MU Chilmark, 21MU Fauld and 28 MU Harpur Hill) were granted approval for construction in March 1938, with the fifth unit, (31 MU Llanberis) in August 1939.<sup>89</sup>

The first of the ADs to be completed was Number 21 MU Fauld, based on a disused gypsum mine in Staffordshire. Similar to the 40 Group 'new builds', the size of the undertaking was considerable and provides a useful example of the complexity of these units. The preparation of the site necessitated the clearance and removal of back-fill, levelling of floors and the strengthening and lining of roofs with additional column supports being installed in areas of weakness. The design also included standard gauge railway sidings with a capacity for 100 wagons. From here, the bombs were transferred to

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<sup>86</sup> Air Ministry, *Works*, p.257.

<sup>87</sup> *Ibid*, p.274.

<sup>88</sup> *Ibid*, p.258.

<sup>89</sup> *Ibid*, pp.258-259.

trucks pulled by diesel locomotives on an adjacent narrow-gauge railway for movement to the underground storage, which was about a mile away. Within the underground areas, electric, battery-powered locomotives were used for haulage.<sup>90</sup> Overall, the cost of the construction, both under and above ground, amounted to £635,000.<sup>91</sup> Fauld also housed a Master Provisioning Office for the maintenance of stock records of ammunition and explosives at all the ADs. Demands from overseas theatres were also handled by this office which would route the demand to the depot holding the largest stock of the requested item. Stock from the home sites was then supplied directly to the overseas units. The construction requirements for the AAPs were more straightforward, with the majority being constructed above ground, with uncovered storage. As the parks were not intended to be used until war itself, it was accepted that safety distances between stocks could be considerably reduced from peacetime standards, thereby reducing the acreage required.<sup>92</sup> By just after the outbreak of war in September 1939, three of the five planned ADs had been constructed (Altrincham, Fauld and Chilmark), with the fourth (Harpur Hill) still under construction. Work on the AAPs was not as advanced, with only four of the seven units having been formed (91 MU Southburn, 92 MU Brafferton, 93 MU Swinderby and 94 MU Barnham).

Petroleum, oils and lubricants (collectively known as POL) also posed similar problems to explosives. The Expansion Programme of the mid-1930s brought a whole new challenge in terms of increased fuel requirements for the growing, and projected, numbers of aircraft entering service with the RAF. The engines of the new generation of aircraft which came into service used considerably more fuel than their predecessors. The rotary engined Avro 504 from the First World War, for example, used some six to nine gallons of fuel per hour, the Gloster Gladiator biplane fighter of the late 1930s used approximately thirty-five gallons per hour, whilst the Supermarine Spitfire used sixty gallons per hour.<sup>93</sup> With the introduction of the heavy, multi-engined bomber aircraft the fuel requirements increased even more. The four engined Lancaster bomber introduced to operational service in 1942 consumed some 215 gallons of fuel

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90 Ibid, p.63.

91 Ibid, p.63.

92 Ibid, p.257.

93 Source: Shuttleworth Collection, Engineering Hangar Aircraft Data Sheets.

per hour.<sup>94</sup> Estimating the fuel requirement was not an easy task and was made all the more difficult by the uncertain nature of the opening stages of a possible war and its later development. Early estimates suggested that the initial monthly requirement was likely to be in the region of 43,000 tons, increasing to about 70,000 and possibly 100,000 tons. In the opening stages of the war there were 100 RAF flying stations to be supplied – by the end of the war this number had dramatically increased to about 600 stations, forty of which were each consuming 3,000 tons or more each month.<sup>95</sup>

Volume was but one factor in the logistics 'equation' and the nature of the fuel itself soon proved to be just as critical. The octane ratings of some of the earlier fuels (mainly 77 and 87 octane), limited the maximum performance of aero engines. However, with the significant performance improvement that came with the introduction of 100-octane fuel in 1939, this grade was soon in demand. Substantial stocks first arrived in Britain from the Netherlands West Indies in June of that year.<sup>96</sup> By the end of the war, the total number of grades of aviation fuel had increased to six with eight different grades of oil.<sup>97</sup>

One of the immediate challenges was the question of fuel and oil reserves and this was to become an important area of development within the Expansion Programme. The first step came in July 1936 when the Air Council, in conjunction with the Petroleum Board, agreed a reserve figure for aviation fuel of three months' consumption (approximately 90,000 tons), which would be held in the existing oil companies' storage facilities.<sup>98</sup> It was also agreed that a similar reserve arrangement should be made for lubricating oil, in the region of 6,000 tons.<sup>99</sup> It is clear from surviving records that there was a very close working relationship between the Air Ministry and the oil companies to the extent that the companies even offered to build the additional tankage required at certain of their West Country installations; these were in fact built at Air Ministry expense although they were maintained and operated by the

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94 RAF LHCA Box 5 (POL), C.R. Scott-Jackson, Air Ministry (E.19) lecture notes for fuels training 'Provision of POL and Air Ministry POL Organisation' G.335387/HC/5/52/40 dated May 1952, p.1 refers.

95 Air Ministry, *Maintenance*, p.131.

96 The Netherlands (or Dutch) West Indies became the Netherlands Antilles in 1954.

97 Air Ministry, *Maintenance*, p.131.

98 Air Ministry, *Works*, p.270.

99 Air Ministry, *Works*, p.270.

companies as a result of the Robinson Committee report on the ownership of new manufacturing capacity for re-armament. Any spare capacity was soon pressed into service and disused tankage belonging to the Anglo-American Oil Company at Brixham was hired, providing capacity for a further 14,400 tons.<sup>100</sup> By August 1936, and with a clearer picture emerging of Germany's military position, the Committee of Imperial Defence directed that sufficient reserves of aviation fuels, motor spirit and lubricating oils should be established to meet the requirements for the first six months of a possible war with Germany. Consequently, the Air Ministry's reserve commitment increased to 290,000 tons of aviation fuel and 19,500 tons of lubricating oil.<sup>101</sup>

This was a significant increase in the reserve holding requirement and there was now a need to take a much wider look at the infrastructure required for storage and distribution. The Air Ministry decided early on that the construction of the new installations was best done by the oil companies, in light of their technical and engineering expertise. Moreover, given the fact that the companies were to operate the depots on the Air Ministry's behalf, it made sense for them to plan and design the works to suit their own methods of operating.<sup>102</sup> Overall, the work was shared between the four main companies based, as far as possible, on the proportion of fuel that they were supplying in 1937.<sup>103</sup> Of the new reserve total, 80,000 tons was already catered for within the oil companies' existing storage, leaving 210,000 tons requiring new installations.<sup>104</sup> In selecting the sites, there were three influencing factors. Firstly, the supply process itself. As a basic planning assumption it was agreed that the bulk of the fuel would be held in main reserve depots which, in turn, would supply smaller depots that would act as distribution centres for specific groups of RAF stations. The main depots were sited as close as possible to the oil companies' existing refineries or depots so that incoming supplies could be provided direct by ocean tanker and thence by rail to the distribution depots.

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100 Ibid, p.270.

101 Ibid, p.271.

102 Ibid, p.272.

103 The 4 main oil companies in 1937 and their proportion of RAF fuel supply were: Shell Mex & BP Ltd (48 per cent); Anglo-American Oil Co. Ltd (28 per cent); Trinidad Leasehold Ltd (20 per cent) and Carless, Capel & Leonard (4 per cent). Air Ministry, *Works*, p.273 refers.

104 Air Ministry, *Works*, p.273.

Secondly, as far as geographical location was concerned, the main reserve depots were situated to the west of a line drawn between Edinburgh and Southampton, the same principle as used for the siting of the ADs. However, due to the location of the main operational flying stations, the fuel distribution depots had to be located to the east of this line. In view of the varying degree of risk, the level of protection afforded to the installations varied, with the main depots designed to be afforded protection from a direct hit by a 4-lb incendiary bomb and the distribution depots able to withstand direct hit from a 25-lb incendiary or HE bomb.<sup>105</sup> The third planning factor was that of transport. As commented on earlier, the method of supply to the main reserve depots was to be ocean tanker so close proximity to adequate dock facilities was therefore essential. In practice, however, it proved difficult to find sufficient locations and alternative sites with facilities for input by rail, river barge or pipeline were also selected. Additionally, as onward movement from the reserve depots was to be by rail, the sites also had to be suitable for the construction of rail sidings from main lines. The distribution depots therefore had to be suitable for reception of fuel by rail but delivery to flying stations by road.<sup>106</sup>

In 1938 the reserve of fuel had been increased to 410,000 tons of aviation fuel (representing eight months' requirements) along with 26,000 tons of lubricating oil; by the end of 1938 these reserves had been virtually doubled to 800,000 tons and 50,000 tons respectively.<sup>107</sup> By the beginning of the war significant progress had been made with fuel installation construction, despite the many problems which had been faced as a result of the stringent siting requirements. In terms of overall numbers, the Air Ministry had in place a total of twenty-nine depots handling and distributing aviation fuel whilst the Petroleum Board had sixty-six.<sup>108</sup> This construction programme, along with the close working relationship which had been established between the Air Ministry and the Petroleum, enabled an effective fuel and oil supply system to be established by the outbreak of war in September 1939.<sup>109</sup>

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105 Air Ministry, *Works*, p.274.

106 *Ibid*, p.273-275.

107 *Ibid*, p.271.

108 Air Ministry, *Maintenance*, p.131. The Air Ministry total consisted of 14 Main Reserve Depots and 15 Distribution Depots. The Petroleum Board's range included 10 installations and 56 inland depots.

109 Petroleum Board, *Petroleum at War - British Oil Distribution in Wartime* (London: Wm.Clowes & Sons Ltd, 1945), p.3.

## Buildings and Infrastructure

A less obvious feature of the Expansion Programme which had an impact on logistics was infrastructure. With the expansion period came a dramatic increase in the number of RAF Stations; in 1934 there were fifty-two airfields in Britain and this had increased to eighty-nine by 1938. The rate of construction was rapid with seven stations being built in 1935-36, eight in 1936-37 and six in 1937-38.<sup>110</sup> Prior to the expansion period, most purpose-built main stores' buildings on RAF units were of a similar design, consisting of two rectangular shaped buildings, situated side-by-side, with a pitched gable-ended roof on each; one of the buildings usually had a double door receipt and despatch point with its floor opening out at lorry-bed level to facilitate the on/off loading of equipment. The opportunity was taken to introduce a new style of building and in 1934 the first of these appeared under Drawing Number 2056/34.<sup>111</sup> Of brick construction, the Stores complex was an 'E' shape when viewed from above and was approximately 125' wide by 103' deep with a steel-framed roof and gable ends. In addition to the standard facilities for items such as general spares and clothing, improved facilities were incorporated for the storage of aircraft engines and fabric. Careful consideration was also given to space requirements for the handling of equipment and the overall design permitted a logical flow from equipment receipt, into storage and through to issue.<sup>112</sup> In 1935, a revision to this basic design was produced (Drawing Number 4287/35), which was almost identical in floor-plan but was built of concrete with a flat roof and had steel-framed trestles either side of the central fabric store to support steel clad doors; this overall design was intended to add improved protection from incendiary bombs. The fabric store was later to become more commonly known as the Aerofoil Store in which large airframe components such as tailplane, wings and large control surfaces such as ailerons and flaps were kept.<sup>113</sup> There were a number of other purpose-built logistics buildings on RAF stations including oil and lubricant stores (one of the earliest variants was built to Plan 329/26) and pyrotechnic stores (to Plans

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<sup>110</sup> Terraine, *The Right of the Line*, p.37.

<sup>111</sup> P. Francis, *British Military Airfield Architecture – From Airships to the Jet Age* (Sparkford: The History Press, 1996), p.56.

<sup>112</sup> Air Ministry, *Works*, pp.44-45.

<sup>113</sup> Francis, *British Military Airfield Architecture*, p.56.

2847/38 and 5488/42); the latter served as a forward holding from explosives storage areas to store ready-to-use items such as flares.<sup>114</sup>

### **Fine Tuning of Logistics - The Work of the Jones Committee**

The final significant change which ‘fine-tuned’ the logistics process and organisation came about as part of a review of existing RAF administrative procedures which was commissioned by the Air Council in June 1938.<sup>115</sup> The RAF’s logistic procedures, both store-keeping and stores-accounting, which had been introduced in the early 1920s, were then nearly twenty years old and had been designed for a much smaller air force. The complexity, technology and sheer size of the new Service needed a system which would be flexible enough to meet the needs of a rapidly changing Service. The review was carried out by what was known as the Jones Committee, named after its Chairman, Brigadier-General H.A. Jones of the Imperial Tobacco Company.<sup>116</sup> The terms of reference for the review were:

To examine and report on the present system of administration in the Royal Air Force at Home in the light of the requirements of operational and general efficiency in peace and war, readiness for war, and economy, and to make recommendations.<sup>117</sup>

In broad terms, there were three aims to the review. Firstly, to ease the burden of administration on station, squadron and flight commanders so that they could concentrate on their operational and training responsibilities. Secondly, to reduce paperwork to the essential and, finally, to adopt a standard method of administration which would fit both peacetime and wartime requirements. Of particular note is that the committee’s composition included members from civilian organisations (London Passenger Transport Board, General Post Office and chartered accountants), a feature which suggests that the Air Ministry was alive to the benefit which could be gained by embracing commercial experience. The Committee started work in December 1938 and,

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<sup>114</sup> Francis, *British Military Airfield Architecture*, p.56.

<sup>115</sup> Air Ministry, *Maintenance*, p.13.

<sup>116</sup> TNA, AIR 2/8788, Report of the Committee on Royal Air Force Administration 1939, p.1. The other members of the committee were: Major MJH Bruce (London Passenger Transport Board); Air Vice-Marshal AGR Garrod OBE MC DFC (Director of Equipment, Air Ministry); Air Vice-Marshal AC Maund CBE DSO (HQ Fighter Command); Captain A Hudson OBE (General Post Office); Sir Harry Peat KBE (Messrs’ Peat, Marwick, Mitchell & Co. Chartered Accountants); Mr HJ Sanders (Messrs’ Peat, Marwick, Mitchell & Co) and Mr RC Chilver of the Air Ministry as the secretary.

<sup>117</sup> TNA, AIR 2/8788, Report of the Committee on Royal Air Force Administration 1939, p.1.

after twenty-four full meetings, submitted its final report on 2 August 1939. The work of the Committee was comprehensive and covered a wide range of administrative functions including: administrative training, administrative control by the Air Ministry, administrative control by Commands, Groups and Stations, the system of assessing and accounting for airmens' pay, equipment accounting, personnel administration and the inspection and maintenance of equipment.<sup>118</sup>

At the top level, one of the main issues of concern raised by the Committee was what was seen as serious shortages of equipment, especially engine and airframe spares. This was particularly evident in the local repair organisation where the shortages were holding up repair and maintenance work in station workshops. The Committee was quite clear though, that the shortages were not due to provisioning or distribution (i.e. the logistics organisation itself) but with production. The answer to this problem was not easy, but it was recommended that Equipment Inspectors or Liaison Officers (at squadron leader level) would make a significant difference. Essentially, these officers would be a form of 'trouble-shooter' and would visit units to investigate problems which had been reported and track these through the whole chain of command until the source of the problem had been identified. This could involve following through the process from Maintenance Units, Command and Group staffs and branches of the Directorate of Equipment.<sup>119</sup>

Although the shortages were not directly attributed to weaknesses within the Directorate of Equipment, the Committee did examine the equipment requisitioning procedure in detail and commented on what might be referred to today as widespread 'red tape', which was adding little value to the overall process. Essentially, all requisitions were being passed to the Finance staffs for detailed scrutiny and the process was, in effect, a complete duplication of the calculations already made by the Equipment Branches. Moreover, this verification was being applied to straightforward requisitions for low value items. The Committee recommended that the best way round this would be for the Finance staffs to be co-located with the Equipment Branches so that they could

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<sup>118</sup> Air Ministry, *Maintenance*, pp.13-14.

<sup>119</sup> TNA, AIR 2/8788, Report of the Committee on Royal Air Force Administration 1939, pp.38 & 46.

be continually aware of the policy changes involved and could discuss the more significant issues, face-to-face, as they arose. Such a closer involvement would also enable them to target those requisitions which needed closer scrutiny. Allied with this, it was also recommended that great benefit would be achieved if the Contracts Division was also co-located with the Equipment Division.<sup>120</sup>

The Committee also set in train the beginnings of de-centralised purchasing and provisioning. As will be deduced from the previous paragraphs, virtually all this activity was carried out at the Air Ministry by the Equipment Divisions within the Directorate General of Equipment. The only real procurement outside of this was the local purchase process, which had been delegated to the commanding officers of maintenance units, albeit with a limit of £25 per single purchase. The Committee observed that, within the Air Ministry, there were urgent demands for equipment, which were delaying work at units, which could actually be met by using LPO but were outside the current financial limit. The answer to this was quite simple and it was recommended that the LPO powers of commanding officers at the maintenance units be increased to £100.<sup>121</sup>

The Committee next turned its attention to operations at Command, Group and Station level. The organisational structure of the RAF had been redefined in 1935 to include Commands and within these, Groups. The Groups in turn were responsible for a given range of RAF Stations. However, with the increase in Commands (and a corresponding increase in Groups) in 1936 and the rapidly increasing number of stations, command and control was becoming more difficult. As far as logistics was concerned, the Committee observed that virtually all the coordination was being carried out at Command level. With the wide geographical distribution of the units under their control, it was virtually impossible for the Command Equipment staffs to even visit all the units let alone exercise sufficient supervision. The latter was particularly important, as many Equipment Officers were inexperienced. As a result, the Committee recommended that Equipment Officers should be established at all Group Headquarters.<sup>122</sup>

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<sup>120</sup> Ibid, pp.38, 46 and Appendix A.

<sup>121</sup> TNA, AIR 2/8788, Report of the Committee on Royal Air Force Administration 1939, p.39 & 46.

<sup>122</sup> Ibid, pp.53-54.

At Station level, the changes were more wide ranging. The Committee quickly recognized that whilst there was careful regulation and coordination of the supply process from the point at which equipment was ordered from industry down to its eventual arrival at the Main Stores of an RAF station, there was a general lack of coordination and control at the point where it was issued – invariably a squadron. Essentially, there was no dedicated expertise to look after the logistics' interests of each squadron. Consequently, each of the flights and technical sections within squadrons was acting independently when it came to demanding and returning equipment. Moreover, much of this work was being carried out by misemploying technical non-commissioned officers. Given the problems which were being experienced with equipment shortages, this was clearly an area that needed addressing. The Committee recommended that an Equipment Section should be established in each squadron, consisting of an Equipment Branch flying officer, a corporal and two or more equipment assistants, depending on the size of the squadron.<sup>123</sup>

The new Sections would be responsible for all the equipment work of the squadron, demanding and receiving all items required both for maintenance and for flight stocks within 'Lock-Ups' as they were known; the latter was a sub-store of ready-use items such as wheels and tyres, sparking plugs and aircraft general spares which experience had shown had to be kept on-hand for quick replacement in aircraft. To maintain the mobility of flights, their respective equipment was kept in dedicated storage 'bins' and equipment in day-to-day use such as opened tins of paint would be kept by flights in their own hangars.<sup>124</sup> Whilst these changes to squadrons might appear purely functional and making better use of the right tradesmen, there was a more important, underlying achievement. The Committee stated 'the organisation which we recommend would have the great advantage of making each squadron independently mobile in war'.

There would be a responsible member of the Equipment Service in each squadron who would supervise all the equipment administration of the squadron if it was moved to another station or to a satellite landing ground'.<sup>125</sup> The

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123 TNA, AIR 2/8788, Report of the Committee on Royal Air Force Administration 1939, pp.58-59.

124 Ibid, p.59.

125 Ibid, p.60.

recommendation was not just a theoretical aspiration of an Air Ministry strategist but was based on actual operating experience during the Abyssinian crisis of 1935 when Equipment Officers were attached to each deployed flying squadron. There were difficulties in finding suitable officers for the task, as the posts did not of course then exist. Moreover, the officers appointed were not familiar with the equipment or the Squadron personnel; with the workload at its greatest, it was not the best of times for an Equipment Officer to master these basics. A permanently appointed officer could build up this expertise and knowledge over a period of time, thereby making it much easier for him to respond during times of crisis.<sup>126</sup>

There was also a significant change to logistics' accounting concepts which, in time, would bring a more cost-effective and logical approach. From the very early days of the RAF, one of the prime concerns of logistics' accounting had been the question of propriety and safeguarding the 'public purse' from loss or improper use of stores or equipment. This had led to the complicated situation of both the Equipment Officer and the Accountant Officer having a shared role in maintaining the stores stock record. The Committee quickly recognized that the system in place had become over-complicated and involved a much larger amount of work than systems in use elsewhere to meet similar requirements. Indeed, they commented in their report that:

...any unprejudiced person with some experience of public and commercial accounting practice would be left with the impression that there are certain features of the system at present in use which involve an expenditure of effort which is out of all proportion to the needs of the situation.<sup>127</sup>

The real difficulty here was the division of responsibility for accounting between the Equipment Officer on the one hand and the Accountant Officer on the other. The result of this arrangement was that the overall stores record of items held in stock was being kept in duplicate. Each movement of stock was being recorded from the transaction voucher in two separate records (i.e. the Tally cards kept in the Equipment Section and the other the Main Stock Ledger in the Accounts Section), kept by two separate bodies of people in two separate

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<sup>126</sup> Ibid, p.60.

<sup>127</sup> Ibid, p.99.

places. It took little persuasion that this position needed changing and it was recommended that, in the place of the two sets of records, only one stock record should be maintained and this by the Equipment Officer.<sup>128</sup> Various safeguards were put in place to ensure propriety, including the requirement that the records were kept separate from the physical stock and those personnel actually handling it. There were many other recommendations regarding changes of accounting practice from issues of fuel to visiting aircraft through to Airmen's Record of Kit. They are too numerous to discuss in any detail in this thesis but, suffice to say, they all contributed to a much needed overhaul of logistics administration. In this respect, the recommendations of the Jones Committee were far-reaching and formed an important part of the Expansion Programme.

## Conclusion

The period from 1934 through to the outbreak of the Second World War in September 1939 was highly significant for RAF logistics in three distinct areas. First, the RAF's *War Manual* of 1928 had carried forward the lessons learned from the First World War and incorporated, inter alia, the important concept of additional elements required to support expeditionary operations: a Port Detachment, an Aircraft Depot and Air Stores Parks. These remained a key part of logistics doctrine throughout the period 1939 to 1945 and enabled the RAF's Equipment organisation to achieve *logistical reach* throughout the majority of overseas campaigns. The second significant point was the formation of Maintenance Command. With two of its Groups (40 and 42) providing specialist management for equipment, POL and explosives, a clear focus and responsibility was established for stores and supplies. The third point was the fine tuning of logistics which took place through the work of the Jones Committee; the driving force for much of this work came from within the Air Ministry, with the significant input of commercial expertise to help optimize the management of the RAF's supply chain.

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<sup>128</sup> Ibid, p.99.

The analysis which took place in the lead-up to the report on RAF administration, took a fresh look at how logistics was organised and administered and made many forward thinking recommendations for change which would prove important for RAF operations during the Second World War.

## Chapter Three: The People of Logistics I - Manning the RAF's Supply Chain 1934-1945

### **Introduction**

The one vital component which kept RAF logistics operating throughout the nineteen twenties, thirties and forties was people. This twenty-five year period was without the technical sophistication of twenty-first century supply chain operations – the movement of equipment required sheer physical effort, without the convenience of mechanical handling aids such as fork lift trucks or automated conveyor belts; stock control required pen and paper, along with a plethora of clerks, an environment devoid of computerised stock control systems. Without the right quantity and quality of people, the logistics operation could not have functioned as required, with a detrimental effect on the delivery of air power. As the size of the RAF and the accompanying volume of equipment required supporting it increased as a result of the Expansion Programme, so too did the number of people required to operate its supply chain. This chapter considers who these people were and the manning of the RAF's supply chain. It considers the societal construct of the logistics' discipline in general terms and then focuses on five main groupings: officers, airmen, the Women's Auxiliary Air Force, civilians and the contribution from the Dominions, Colonies and Allied nations.

### **Societal Construct**

From the date of its formation, the RAF recruited and trained military personnel for employment within a specific professional discipline and thereafter assigned them to various types of organisation such as squadrons, wings, groups, formation headquarters or RAF stations as required; for officers, this was a specialist branch and for other ranks a specific trade which formed part of a Trade Group. In the case of logistics, commissioned officers were part of the Stores Branch (renamed Equipment Branch in 1936), whilst other ranks (hereafter referred to as airmen or airwomen) were allocated to a range of

different trades depending on their specialisation<sup>1</sup>; the number of logistics-related trades for men grew from just two in 1920 to five by the end of 1945 and for women, from one in 1939 to four by the end of 1945. From 1920 until the middle of 1939, the military population of the RAF Stores/Equipment Branch and related trades was an all-male preserve because the WRAF had been disbanded on 1 April 1920, following completion of their final wartime role as part of the Forces of Occupation in Germany. It was not until 1940, following the formation of the Women's Auxiliary Air Force (WAAF), that military females were once again employed in RAF logistics.<sup>2</sup>

It was not necessary for RAF logistics to operate with purely military staff so extensive use was made of civilians throughout large parts of the supply chain; a number of activities did not require military skills, especially at the equipment depots where much of the activity (especially manual handling and warehousing) was not vastly different from civilian practice. Consequently, RAF logistics came to rely on large numbers of civilians, a number of whom faced similar dangers to their Service colleagues during the Second World War. The final component of the societal construct of RAF logistics was its use of personnel from the Dominions, the Colonies and Allied nations, both within the United Kingdom and overseas. At many overseas bases, and where the local operational situation permitted, local labour was often used, especially for manual work such as the loading and unloading of freight at ports and within overseas stores' depots and similar units. On the whole, this arrangement was ad hoc but, in the case of West Africa, a specific corps was formed from which RAF logistics benefited. Within the United Kingdom, extensive use was also made of personnel from the colonies as well as from Australia, Canada, New Zealand, Rhodesia, and Poland.

Logistics was a discipline which touched on virtually all aspects of RAF operations and this saw a requirement for officers, airmen and airwomen of the Equipment Branch and related trades (including the Dominions, Colonies and Allied nations) to be employed throughout the Service. By November 1943, the

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<sup>1</sup> Prior to 1923, non-commissioned personnel were referred to using the Army convention of Other Ranks. This was changed to Airmen (and later Airwomen when the WAAF was introduced) from January 1923 onwards. TNA, AIR 72/5, AMWOs 1923: Order 185 - Use of the Term "Airmen" (415971/23) dated 4 January 1923 refers.

<sup>2</sup> Air Ministry (AHB), Air Publication 3234, *The Second World War 1939-1945 Royal Air Force - The Women's Auxiliary Air Force* (London: Air Ministry, 1953), p.1 and K. Bentley Beauman, *Partners in Blue* (London: Hutchinson, 1971), p.50.

overall size of the RAF had reached 822,190 personnel, of which 54,830 (6.7 per cent) were from the Equipment Branch and related trades.<sup>3</sup> The greatest concentration, as might be expected, was within the units of Maintenance Command; of the 54,830 recorded as employed within the seven RAF commands and the Tactical Air Force (TAF) on 29 November 1943, just over 70 per cent (38,867) were working within Maintenance Command units.<sup>4</sup> As a proportion of the Command itself, the Equipment Branch and related trades made up 37 per cent of its total strength at the same date; this was by far the greatest concentration of these personnel in any single formation, with a figure ranging from between just 1.5 and 3.7 per cent for the other commands and TAF. The detailed breakdown is shown in Table 3.

Formation	Total No of Personnel	Total No of Equipment Branch & Trade Personnel	Percentage of Formation
Technical Training Command	174,706	2,551	1.5%
Bomber Command	158,693	3,536	2.2%
Flying Training Command	145,556	2,650	1.8%
Maintenance Command	104,906	38,867	37%
Fighter Command	100,471	3,056	3%
Coastal Command	70,945	1,807	2.5%
TAF	33,948	1,140	3.4%
Balloon Command	32,965	1,223	3.7%
<b>Total</b>	<b>822,190</b>	<b>54,830</b>	<b>6.7%</b>

**Table 3 -  
Breakdown of Equipment Branch and Trade Personnel by Formation Grouping  
November 1943<sup>5</sup>**

Within Maintenance Command, the Equipment Branch and personnel from related trades were employed within a wide range of functional areas across the various units, with the greatest number working within repair and salvage units (primarily within No 43 Group). The breakdown by type of unit, from June 1940 to March 1945 is shown in Table 4.

<sup>3</sup> TNA, AIR 20/2025, Service Personnel: Strength Returns September 1939 to June 1946: DRG. No.101/0.EST.(PLANS) 29.11.43 - RAF Home Commands – Comparative Size dated 29 November 1943.

<sup>4</sup> Source: TNA, AIR 20/2024, RAF Personnel Establishments by Command and Function June 1940 to December 1945: LM4674/D.O.Est dated 9th August 1945.

<sup>5</sup> Source: TNA, AIR 20/2024, RAF Personnel Establishments by Command and Function June 1940 to December 1945: LM4674/D.O.Est dated 9th August 1945 and TNA, AIR 20/2025, Service Personnel: Strength Returns September 1939 – June 1946: Graph and data labelled RAF Home Command – Comparative Size.

Type of Unit	Jun 1940		Jun 1942		Sept 1943		Mar 1945	
	Units	No of Personnel	Units	No of Personnel	Units	No of Personnel	Units	No of Personnel
Command HQ					1	525	1	547
Group HQs	5	534	9	2,809	4	1,480	4	1,659
Repair & Salvage	10	6,169	23	15,615	28	27,830	27	28,945
Ammunition Depots	9	1,818	19	3,665	22	7,920	27	8,440
Equipment Depots	18	2,741	25	9,596	42	13,170	49	19,044
Aircraft Storage	23	3,581	28	8,414	22	5,950	55	7,516
Miscellaneous Units			14	4,241	24	5,523	58	7,633
<b>Total</b>	65	14,843	118	44,340	143	62,398	221	73,784

**Table 4 -  
Distribution of Equipment Branch and Trade Personnel Within Maintenance Command  
June 1940 to March 1945<sup>6</sup>**

## Officers

The growth of the RAF Stores Branch was quite slow throughout the inter-war period up to and including 1935, a situation which was entirely consistent with the wider, limited growth of the Service resulting from the Government's Ten Year Rule and its financial restrictions.<sup>7</sup> This limited growth is quite clearly reflected in the officer population throughout this period; from the 245 officers in the Branch in 1920, the total number increased very slowly to only 319 by 1935 – a growth of only seventy four officers over a fifteen year period.<sup>8</sup> Despite this relatively small number, their employment was widespread and Stores Officers were serving on the staff of all the HQ units in Britain and overseas, as well as on each flying squadron and training establishment. Additionally, and with the RAF providing pilots to serve on board Royal Navy aircraft carriers from about 1923 onwards, a Stores Branch officer (usually a flight lieutenant) was also provided as part of this commitment. Of the four carriers that were active in 1930 (HMS Eagle, Hermes, Courageous and Glorious), a Stores Branch officer was serving in the RAF HQ element on each.<sup>9</sup>

<sup>6</sup> Source: TNA, AIR 20/2024, RAF Personnel Establishments by Command and Function June 1940 to December 1945: LM4674/D.O.Est dated 9th August 1945.

<sup>7</sup> W.K. Wark, *The Ultimate Enemy* (Oxford: Oxford University Press, 1985), p.24.

<sup>8</sup> RAFC Library, *Monthly Air Force Lists 1920-1935* (London, 1920-1935).

<sup>9</sup> RAFC Library, *Monthly Air Force List January 1930* (London, 1930), Columns 1650-1654 and James, *The Paladins*, p.126.

Notwithstanding this employment diversity, the early development of the wider RAF was largely influenced by Sir Hugh Trenchard's vision as set out in his scheme for the Permanent Organisation of the Royal Air Force.<sup>10</sup> As far as officers were concerned, the aim was to train these initially as pilots during a two year course at the Royal Air Force College Cranwell, before posting them to a Service squadron. After five years' service, officers were then required to 'select the particular technical subject they will make their special study during their subsequent career such as navigation, engines or wireless'.<sup>11</sup> This cadre of officers formed what was known as the General List (General Duties (GD)) and was intended to obviate what was seen as the 'danger of developing technical branches which were out of touch with fighting and flying requirements'.<sup>12</sup> It is clear from the Air Ministry Monograph on Manning Plans and Policy that any growth in officer numbers was closely governed by the Treasury and it was therefore inevitable that the RAF populated the General List with predominantly young and well qualified officers filling flying and technical appointments.<sup>13</sup>

Trenchard's vision in this respect was idealistic in that an air force would always need a cadre of various specialists apart from aviators who, because of their very specific focus, would not necessarily need to have the immediate 'connection' with the flying and fighting dimension but, nonetheless, would still be capable of providing the required level of support without necessarily becoming out of touch with the front line of air power delivery. It was not surprising, therefore, that the Service realised that drawing Stores Officers from the General List was not the best use of highly technically qualified officers. Consequently, when it was announced that a Stores Branch was to be formed in 1920, it was made quite clear in the Air Ministry Weekly Order that such officers '...would not be required to fly'.<sup>14</sup> Even so, the medical standards required for Stores Officers were still fairly stringent and it was required that they:

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10 TNA, AIR 1/17/15/1/84, The Formation of the RAF on a Peace Basis – Draft and Print of Lord Trenchard's Memorandum. November 1919 – July 1920.

11 Ibid, Paragraph 6, p.5.

12 TNA, AIR 72/10, AMWOs 1928: Order 426 - The Constitution of the General Duties Branch, dated 21 June 1928 and Air Ministry (AHB), The Second World War 1939-1945 Royal Air Force, Monograph, *Manning Plans and Policy* (undated), p.2.

13 Air Ministry, *Manning Plans & Policy*, p.2.

14 TNA, AIR 72/1, AMWOs 1919: Order 1158 – Stores Officers (A.24294) dated 21 October 1919, Paragraph 3.

...labour under no constitutional or mental disease or weakness, imperfection or disability which might interfere with the efficient discharge of their duties in any climate in peace or war.<sup>15</sup>

The notable point in the constitution of this new branch was the clear intention that officers would be recruited from men who had been commissioned from the ranks and that the Branch would form a separate list (with separate scales of pay and pension and terms of service) from the General List of the RAF. In addition to Stores duties at RAF units, it was intended that officers of the new Branch would also form the greater part of the officer personnel of stores depots, aeroplane repair depots and the Stores Section of the Directorate of Equipment at the Air Ministry.<sup>16</sup> However, the Weekly Order did make it quite clear that the higher commands of depots and higher appointments in the Directorate of Equipment, would be filled by officers on the RAF General List, except where senior Stores officers 'have shown themselves by outstanding merit to be specially fitted for command of a depot'.<sup>17</sup>

Towards the end of 1923 the conditions of entry to the Stores Branch were revised and it was decided that stores' duties in the future would only be filled by officers on permanent commissions. Vacancies in the Branch were to be considered on a twice-yearly basis and filled by existing air force officers who had applied to transfer from their existing branch; on the whole, these were GD branch officers who had become permanently unfit for flying duties or officers holding short service commissions in the GD or Accountant Branches. Selections were restricted to officers not above the rank of flying officer.<sup>18</sup> By 1927, the number of applications from within the Service was not sufficient to meet vacancies in the Branch and the source of applicants was widened to include civilians.<sup>19</sup> By 1928, with the RAF in its tenth year of operation, the Air Council directed that an enquiry be undertaken into requirements for officers in the RAF.<sup>20</sup> The Stores Branch completed its review by the first half of 1930 with the results announced in the Air Ministry Weekly Orders of July 1930.<sup>21</sup>

<sup>15</sup> TNA, AIR 72/2, AMWOs 1920: Order 657 - Medical Standards of Fitness for Officers (Stores, Medical, Dental and Chaplains).

<sup>16</sup> The requirement for Stores Officers to serve in posts on the staffs of area and group HQs was formalised by TNA, AIR 72/2, AMWOs 1920: Order 727 – Headquarters Staffs – Stores Duties (247400/20).

<sup>17</sup> Ibid, Paragraph 2.

<sup>18</sup> TNA, AIR 72/5, AMWOs 1923: Order 621 – Conditions of Entry into the Stores Branch for Stores Duties (432081/23) dated 11 October 1923.

<sup>19</sup> TNA, AIR 72/5, AMWOs 1927: Order 437 – Conditions of Entry into the Stores Branch (763749/27) dated 6 January 1927.

<sup>20</sup> TNA, AIR 72/10, AMWOs 1928: Order 426 – The Constitution of the General Duties Branch dated 21 June 1928.

<sup>21</sup> TNA, AIR 72/13, AMWOs 1930: Order A.428/1930 – The Constitution of the Stores Branch (40809/30 – 8.7.30) dated 8 July 1930.

This fresh look at the Branch officer requirements introduced significant changes, although the needs of the Expansion Programme five years later would show that the 1930 Review was not particularly forward thinking, especially in terms of its reliance on the employment of sizable numbers of retired officers – such a policy later came to be viewed as incompatible with the demanding needs of modern warfare. Overall, the Branch established what it referred to as a ‘cardinal point of policy’ to provide:

...a nucleus of officers of high administrative capacity and wide experience capable not only of the efficient administration of the complicated material of the service in time of peace but also of the adaptation of the peace organisation to meet the varying needs of war.<sup>22</sup>

Additionally, the review identified that this nucleus would need to be formed of men who made the Branch their permanent career and, whilst in junior ranks, would need to be given ample opportunity to gain wide experience within different types of unit. It was also observed that such a career would need to be sufficiently favourable to attract good quality and well educated men. With these requirements as a baseline, the review came to the conclusion that the new vision could not be realised if the constitution remained as it was. In keeping with a general principle established for the GD Branch, the new solution adopted was broadly a half and half mixture; just over one half (mainly the more senior ranks and positions) would be made up of officers who did not make the Branch their permanent career, whilst the remainder would be made up by employing men who did make Stores work their permanent career and drawn from three main sources: firstly, employing a limited number of Warrant Officer (WO) Storekeepers in junior staff posts at HQs; secondly, allocating a large number of junior officer posts at home and some overseas to be filled by retired officers under civilian terms of service drawn primarily from retired officers of any branch of the RAF as well as from the Royal Navy and the Army; thirdly, a new scheme was to be introduced whereby a limited number of commissions in the Stores Branch would be offered to WOs of any trade.<sup>23</sup> The commissioning of WOs proved to be a successful and fruitful source of officers for the Branch (especially during the years of the Second World War) although

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<sup>22</sup> Ibid, p.28, Paragraph 2.

<sup>23</sup> Ibid, pp.28-29, Paragraphs 4-7.

the intake was initially limited to five per year.<sup>24</sup> Indeed, during the period 1 September 1939 to 1 September 1945, commissioned WOs accounted for an average of 25 per cent of the total number of Equipment Branch officers serving on permanent commissions during the war years; a detailed breakdown by year is shown in Table 5.

	Sep 1939	Jun 1940	Sep 1940	Sep 1941	Sep 1942	Sep 1943	Sep 1944	May 1945	Sep 1945
<b>Permanent Commission</b>	323	323	318	312	310	295	269	258	256
<b>Cranwell Cadet</b>	11	11	11	11	11	11	11	11	11
<b>Commissioned Warrant Officer</b>	103	115	110	106	102	102	95	95	94
<b>Total</b>	437	449	439	429	423	408	375	364	361

**Table 5 -  
Ratio of Commissioned Warrant Officers to Permanent Commissions Equipment Branch  
September 1939 to September 1945<sup>25</sup>**

The policy of employing retired officers, whilst initially a valuable source of experience, soon appeared at odds with the new type of officer which the Expansion Schemes of 1934 to 1938 identified as being required for a war of the future. These retired officers were employed both at home and overseas, on a pay scale of just over £200 plus a Civil Service bonus<sup>26</sup>; this was particularly attractive to those demobilized from regular service following the First World War who wished to remain working in a military environment. From the RAF's perspective, a retired officer was cheaper to employ than a regular officer; a flight lieutenant, for example, was paid just over £442 per annum.<sup>27</sup> The numbers concerned were not insignificant and in 1936, for example, of the forty-two RAF stations which had Equipment Officers on their personnel establishments, 48 per cent were retired military officers filling Civilian Stores Officer appointments.<sup>28</sup>

24 TNA, AIR 72/13, AMWOs 1930: Order A.429/1930 - Appointment of Warrant Officers to Commissioned Rank in the Stores Branch (40809/30 - 8.7.30) dated 8 July 1930.

25 These figures represent actual rather than estimated requirements. RAFM, Air Ministry ADM (Stats), *Royal Air Force Personnel Statistics 3 September 1939 - 1 September 1945* (May 1946), Table LI, pp.165-173.

26 TNA, AIR 72/13, AMWOs 1930: Civilian Order Supplement (No.13/1930) 383 - Appointment of Civilian Stores Officers (33336/30) and AIR 72/14, AMOs 1931: Order A.17 - Duties of Civilian Stores Officers.

27 James, *The Paladins*, Table 21, p.262.

28 RAFC Library, *The Air Force List 1936* (London, 1936), Columns 158-299. Of a total of seventy seven Equipment Officers on unit establishments, thirty-seven (48 per cent) were retired.

The changing nature of the RAF, which started to emerge from the beginning of the Expansion Programme, brought new challenges for the Stores Branch. The introduction of new and more complex aircraft types began to expand dramatically the size of the RAF's inventory; this required careful management to ensure that stock was available in the right place and at the right time. This professional challenge, coupled with the opening of new RAF Stations (most of which were established with a Stores Section) and Equipment Depots (predominantly manned by Stores personnel), required more Stores Officers to manage the supply chain. The most expedient means of achieving this was to increase the use of Civilian Stores Officers as a temporary substitution, for posts which were eventually intended for filling by a regular officer; by early 1938, with the Branch having become the Equipment Branch, there were 170 of these substitution officers throughout the Service, in addition to the existing Civilian Stores Officers already employed.<sup>29</sup> The fact that the majority of these were ex-military enabled them to be accepted within the Stores organisation without any notable resentment from their RAF colleagues. The policy though, came under criticism just after the Abyssinian crisis in 1936 when the Air Ministry was unable to provide additional uniformed Equipment Officers as part of the British re-enforcement in the Middle East.<sup>30</sup>

In parallel with the review of RAF administrative procedures, which was commissioned by the Air Council in June 1938, the composition of the Equipment Branch was subject to a dedicated review and part of this was to find the best means of achieving an additional 840 Equipment Officers which had been identified as being required under Expansion Scheme 'L' (approved on 27 April 1938).<sup>31</sup> In the course of the review, it became clear that the population of Equipment Branch Civilian Stores Officers was an issue of significant concern in three respects. First, the number of available retired officers was by this time beginning to dry up, mainly on account of their age. Second, the practical demands of the Expansion Programme were by now quite clear. Although the commanders-in-chief of the RAF's functional commands commented that the Civilian Stores Officers had fared favourably, they had reservations regarding

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29 TNA, AIR 2/3414, Substitution Officers in Equipment Branch of RAF – Replacement by Serving Officers, dated 21 Sep 1938: Undated note from DGE (AVM AGR Garrod).

30 AIR 2/1923, Report on the Equipment Aspect of the Emergency, 1935-1936, in the Middle East Command (S.23991/I dated 30 October 1936).

31 Air Ministry, *Manning Plans & Policy*, p.12.

their longer term suitability. Indeed, the Commander-in-Chief of Bomber Command commented that:

...increased strain is approached when Equipment Sections are asked to work for prolonged periods under conditions prevailing in expansion e.g. shortage of personnel, constant changes of equipment, moves of units and general lack of experience in subordinate personnel.<sup>32</sup>

Anecdotal evidence, suggests that this situation did not go un-noticed by those joining the Service, even in the late 1930s. One such officer was Pilot Officer (later Air Vice-Marshal) Donald Hills who started his Equipment Officer training course at RAF Kidbrooke on 23 January 1939. Hills was one of many Equipment Officers who, expecting to have completed a six month training course, found themselves posted prematurely in order that front-line manning requirements could be met. Thus, towards the end of March 1939, Hills found himself posted to RAF Tangmere. This was one of the more active units at this time and was home to Numbers 1 and 43 Squadrons of Fighter Command, both of which had been recently re-equipped with the Hurricane Mark 1 fighter aircraft. The station was also the base of No 217 Squadron of Coastal Command, operating the Anson Mk 1 aircraft. Despite the station's up-to-date aircraft complement, Tangmere's Equipment Section had been run by Civilian Stores Officers (both retired military officers) throughout the 1920s and 1930s. Hills replaced a retired Royal Navy commander, while a flying officer (commissioned from the rank of warrant officer in 1933) took over from a retired Army colonel. Both of these Civilian Stores Officers had shaped things to suit their own pace of life as Hills recalled '...these two retired officers had run the supply and equipment section stores for an active flying station for many years and very largely at their convenience'.<sup>33</sup> Such a comment suggests that personal comfort rather than the exigencies of the Service were predominant.

Third, and perhaps the most significant concern, the growing threat of war was prompting the need for officers who were young and fit enough to meet the demands of modern warfare. The Review made the observation that the

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<sup>32</sup> TNA, AIR 2/3414, Substitution Officers in Equipment Branch of RAF – Replacement by Serving Officers, dated 21 Sep 1938: Note from CinC Bomber Command (undated).

<sup>33</sup> RAF LHCA, Audio Collection: Transcript of a Taped Interview with Air Vice-Marshal ED Hills CB CBE RAF (Retired) at 16 MU, RAF Stafford, dated December 2004.

existing position was considered to be 'no longer safe or sound' and commented that:

...the majority of them, owing to their having reached the age when their energy tended to flag, were not only unsatisfactory in peace but would be quite unfitted for the increased responsibilities which would fall upon them in war.<sup>34</sup>

This perceived vulnerability was of particular concern to the Director General of Equipment (DGE), Air Vice-Marshal A.G Garrod, who believed that his organisation would 'break down in war unless sufficient regular Equipment Branch officers were provided'. In particular, he believed that:

...regular officers needed to be available to meet the requirements of any Continental or overseas contingent proposal; that Equipment Branch posts on operational stations in the UK should be filled entirely by regular officers in peace and by at least one regular officer in war and that no civilianized Equipment post should be established at any RAF station that has less [sic] than two regular Equipment officers in addition to the civilianised post.<sup>35</sup>

The outcome of various meetings to discuss this issue was the introduction of a policy which effectively put a stop to any further recruitment of retired officers and that an increased effort would be made to replace a substantial proportion of Civilian Stores Officers with regular officers, with operational stations as a priority. There was still a place for retired officers (mainly within the Air Ministry and at certain Equipment Depots), but the total population was to be limited to a maximum of seventy five. The recruitment of regular officers to meet the overall shortfall was met by entering 150 short service officers (four years active list service, followed by six years in the Reserve) in 1938-1939<sup>36</sup>; the estimate in May 1938 was that the Branch establishment by 1 April 1939 would consist of 650 officer posts, of which 579 would be regular officers with seventy one retired officers (subsequently revised to seventy-five)<sup>37</sup>; the actual figures achieved for regular officers was considerably less by September 1939 as the figures in Table 6 show. The

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<sup>34</sup> Air Ministry, *Manning Plans & Policy*, p.12.

<sup>35</sup> TNA, AIR 2/3414, Substitution Officers in Equipment Branch of RAF – Replacement by Serving Officers, dated 21 Sep 1938: Note by DoF dated October 1938.

<sup>36</sup> Short service officers were introduced as a temporary measure and promulgated by TNA, AIR 72/23, AMOs 1939: Order A.59 – Short Service Officers (Equipment Branch) – Conditions of Service (774577/38 – 9.3.39) dated 9 March 1939.

<sup>37</sup> TNA, AIR 2/3090, Scheme of Short Service Officers Entry into Equipment Branch dated 6 May 1938: note by DoF dated May 1938 and TNA, AIR 72/23, AMOs 1939: Order A59 - Short Service officers (Equipment branch ) Conditions of service (774577/38 -9.3.39) dated 9 March 1939.

impact of this on retired officers was quite dramatic and required 120 of them to have their appointments terminated by the middle of 1939.<sup>38</sup>

The proposal was submitted to and approved by the Treasury in late June 1938; despite the arguments which had been articulated regarding preparedness for war, the Treasury approved the measure 'with some reluctance' and were of the opinion that 'retired officers will in many instances be particularly well equipped for the class of duties to be performed and, as at present advised, they can find no reason why the employment of such officers should not continue to be the normal policy of the Air Council'.<sup>39</sup> It was a stipulation of Treasury approval that the additional provision for war requirements was to be made via the RAF Volunteer Reserve (RAFVR)<sup>40</sup>; this had been formed in August 1936 primarily for pilots, but was expanded to include Equipment Officers in January 1938<sup>41</sup>, in light of the Air Ministry's need to meet the forecast increase in requirement. In May 1939, the Air Council also decided to introduce an Equipment Branch in the Auxiliary Air Force (AAF)<sup>42</sup>; the AAF had originally been formed in 1924 and was intended solely for home defence. There were also a small number of Equipment officers in the RAF Reserve of Officers. By the outbreak of war in September 1939 the RAF logistics' organisation could call on 722 officers in its main Equipment Branch, with a further total of 322 officers in the Equipment Branches of the Auxiliary Air Force, RAFVR and RAF Reserve of Officers.<sup>43</sup>

The replacement of retired officers on units, however, took time to address. Even by January 1939, there was still a significant reliance on them, a position exacerbated by yet more RAF stations having opened during the Expansion Programme; of the seventy-four stations then operating, the proportion of retired Equipment Officers then employed had risen to 56 per cent.<sup>44</sup> The literature provides little evidence to show how this position changed after 1939, but the increase in newly commissioned Equipment Branch officers appearing in the Air Force List from 1940 to 1945 suggests that the proportion

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38 Ibid, Enclosure 2A, p.3.

39 Ibid, Enclosure 19B - Treasury Chambers letter E.17550/4 dated 28 June 1938.

40 Ibid.

41 Air Ministry, *Manning Plans & Policy*, p.15.

42 TNA, AIR 2/4011, Formation of RAuxAF Equipment Branch dated May 1939: Air Ministry letter 887665/39/S.11.(c) dated May 1939.

43 Air Ministry, *Manning Plans & Policy*, Appendix 5.

44 RAFC Library, *The Air Force List January 1939* (London, 1939). Of a total of 156 Equipment Officers on unit establishments, eighty-seven (56 per cent) were retired.

of retired officers in the Branch would have reduced to the required level relatively quickly. The target establishment for recruitment to the Branch changed quite frequently throughout the war and rose from an estimated 2,500 in October 1940 to a peak estimate of 5,178 in August 1944.<sup>45</sup> The actual officer population of the Branch, however, is difficult to analyse with any degree of accuracy due to a paucity of surviving records in the National Archives. The records that do survive suggest that the actual manning level never reached the required establishment level throughout the war; the manning figure in October 1940 was 519 short, whilst the position in August 1944 was 550 below the establishment. Figures for the intervening months indicate a continual problem with manning with the greatest shortfall of 1,225 in July 1941.<sup>46</sup> The variation in the total Equipment Branch officer population (by theatre of operation) from June 1940 to September 1945 is detailed in Table 6.

	Jun 1940	Sep 1940	Sep 1941	Sep 1942	Sep 1943	Sep 1944	May 1945	Sep 1945
<b>United Kingdom</b>	1252	1646	2523	2564	3095	3331	3209	3201
<b>Mediterranean</b>	113	140	276	550	787	724	789	739
<b>SE Asia</b>	48	42	70	213	319	493	682	679
<b>West Africa</b>	-	-	-	26	48	38	30	23
<b>Special Duty Overseas</b>	17	20	74	194	197	140	107	91
<b>Total Overseas</b>	178	202	420	983	1351	1395	1608	1532
<b>Grand Total</b>	1430	1848	2943	3547	4446	4726	4817	4733

**Table 6 -  
Strength of the RAF Equipment Branch Officers (Male) by Theatre 1940 to 1945<sup>47</sup>**

As far as promotion was concerned, the pre-Expansion Scheme Air Force was still very much a career and promotion was largely regulated by examination. In 1930, promotion for Stores Officers was governed by specialist examinations, with this being required to reach the ranks of flight lieutenant (minimum of three years seniority in rank) and squadron leader (minimum of four years seniority in rank). The examination for flight lieutenant (Examination E) consisted of four papers, each of three hours duration covering Store Keeping & Stores Administration, Stores Accounting, Organisation & Administration and Aircraft, Engines & MT; a 50 per cent pass was required in each paper. The requirement for squadron leader (Examination F) was even

<sup>45</sup> Air Ministry, *Manning Plans & Policy*, Appendix 8.

<sup>46</sup> RAFC Library, *Monthly Air Force List 1945* (London, 1945) and this thesis, Appendix 1.

<sup>47</sup> RAFM, Air Ministry, *Royal Air Force Personnel Statistics*, Table VIII, pp.86-91. Figures not available by theatre for 1939.

more challenging with additional papers covering Hygiene & Sanitation along with Imperial Geography. The pass mark was still 50 per cent but the papers amounted to thirteen and a half hours.<sup>48</sup> The outbreak of war saw promotion examinations for officers temporarily suspended but with a complex set of arrangements introduced to govern the mixture of officers serving which included those on permanent regular commissions and those on temporary commissions for the duration of the war only. For junior officers, promotion through the ranks from pilot officer to flight lieutenant was automatic following satisfactory completion of a minimum period of time in each rank.

## Airmen

In the early years of the RAF, the range of trades in which airmen were employed was broadly similar to what had been established in the RFC; these reflected the technology of the aircraft which the RAF was operating at the time, with a diverse set of specific skills such as propeller maker, blacksmith and coppersmith. Initially, there were five Trade Groups in the new RAF, of which I to III were all Technical, Group IV was Administrative and Group V was Non-Technical; the latter was unskilled and the lowest paid of the Trade Groups. Stores workers were employed in the trade of Clerk (Stores) (Trade Group IV) with additional support provided by airmen of the Aircraft Hand (General Duties) (Trade Group V)<sup>49</sup>; although the RFC had a trade of Storeman and this transferred across to the RAF in the Muster Roll of April 1918<sup>50</sup>, the trade inexplicably disappears from the RAF Trade Structure of 1919.<sup>51</sup> The fact that the trade appears in statistical summaries suggests that the omission is most likely to be as a result of an editorial oversight in the published Trade Structures. As far as pay was concerned for the Stores Trade, the lowest adult rank of Aircraftman Second Class earned three shillings and six pence per day; his equivalent rank in Trade Group I was paid four shillings per day<sup>52</sup>; pay included food, uniform and accommodation.<sup>53</sup> By 1934 the number of trades had

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48 TNA, AIR 72/13, AMOs 1930: Order A.543. Promotion Examinations – Officers (General Duties and Stores Branch) (31076/30) dated 28 August 1930.

49 Air Ministry, *Manning Plans and Policy*, Appendix 10 and James, *The Paladins*, Table 19, p.260.

50 TNA, AIR 10/851, Royal Air Force Muster Roll dated 1 April 1918.

51 Air Ministry, *Manning Plans and Policy*, Appendix 10 and James, *The Paladins*, Table 19, p.260.

52 James, *The Paladins*, Table 19, p.260.

53 RAF LHCA, Box 8 (Supply/Logistics Trade), Recruitment Pamphlet 'Are You Satisfied' dated August 1919, p.6.

been simplified, enabling a reduction from sixty one in 1919 to thirty three, but still classified within five Trade Groups.<sup>54</sup>

The nature of stores work was driven by two basic requirements. Firstly, the need for accounting, a factor which dominated many of the procedures which had been consolidated within the first issue of the RAF's Instructions for Store Accounting and Store Keeping (Air Publication 830) issued in 1921.<sup>55</sup> The purpose of accounting, according to the regulations, was that the process constituted a record of past transactions and provided data for the estimation of future requirements (part of the provisioning process).<sup>56</sup> What the regulations do not make clear is that an accurate record of stock held was not just an administrative imperative, it was critical in supporting RAF operations – if demands for equipment were to be met quickly, it was essential that the Stores organisation knew what stock it held and where it was located. Secondly, there was also a basic principle within the regulations which stipulated that 'the work of the accounting section should be distinct from the physical store work and should not be under the store holder'.<sup>57</sup> This was an important point in that individuals responsible for the accounting of equipment (Store Accounting) did not have access to the stock itself and those responsible for the physical handling of stock (Store Keeping) did not have access to the stock account; this made pilfering all the more difficult as differences in the stock account and stock on the shelf could not be easily adjusted and would be detectable during random stock checks or stocktaking.

In practice, this general requirement was achieved by separate work places for each area, overseen by an Accountant Officer and a Stores Officer; the paper stores accounts were progressively transferred to the day-to-day responsibility of Accountant Officers between 1920 and 1921<sup>58</sup>; this division of responsibility remained until late 1939 when, as a result of the work of the Jones Committee (see Chapter 2, Page 83), responsibility for the accounting function was transferred from the Accountant Officer to the Equipment Officer,

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<sup>54</sup> Air Ministry, *Manning Plans and Policy*, Appendix 10.

<sup>55</sup> TNA, AIR 10/844, Instructions for Store Accounting and Store Keeping (Amendment Lists 1-17) dated August 1921.

<sup>56</sup> *Ibid*, Chapter I, Section I, Paragraph 1, p.11.

<sup>57</sup> *Ibid*, Chapter I, Section II, Paragraph 4, p.11.

<sup>58</sup> *Ibid*, Appendix III and IV, pp.195-199 and TNA, AIR 72/4, AMOs 1920: Order 37 - Transfer of Stores Accounting Duties to Accountant Officers (292316/20).

primarily due to the fact that stock accounting was being duplicated in both areas. From the formation of the RAF in 1918, unit stores were manned by a combination of airmen of the Clerk (Stores) trade (Trade Group IV), with assistance being provided by Aircrafthands (General Duties) (Trade Group V).<sup>59</sup> This remained the case until October 1920 when a new trade of Storekeeper was introduced in Trade Group III.<sup>60</sup> Following the renaming of the officers specialist branch from Stores to Equipment in 1936, the trade of Storekeeper followed suit and was renamed Equipment Assistant in April of 1937, but transferred to Trade Group IV.<sup>61</sup>

The clerical support for stores work was provided by the Trade of Clerk (Stores), who provided the accounting function under the direction of the Accountant Officer although the title changed to just 'Clerk' in July 1921; airmen in this newly named trade were thereafter allocated for specific duties such as pay accounting, stores accounting and medical duties.<sup>62</sup> Although the reason is not given in Air Ministry records, sub-classifications for Clerks were re-introduced again in June 1924 and saw the introduction of the trade of Clerk (Store Accounting) (the other two were Clerk (Pay accounting) and Clerk (General Duties)).<sup>63</sup> This arrangement endured until April 1935 when it was merged with the trade of Clerk (Pay Accounting) to become the single trade of Clerk (Accounting); the reason for this amalgamation is not evident from the Air Ministry announcement, but it is likely that such a move was part of the on-going simplification of the RAF's trade structure.<sup>64</sup>

By 1937 the volume of equipment flowing into the RAF Supply Chain as a result of the Expansion Programme, had started to increase substantially. This continued to grow exponentially throughout the war years - receipts of equipment in Maintenance Command alone rose from 316,000 tons in the period April to December 1940 to a peak of 1,248,000 tons in 1944. The number of issues too rose dramatically from 211,000 tons to 1,051,000 in the

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59 TNA, AIR 72/1, AMWOs 1919: Order 908 – Warrant Officers, Non Commissioned Officers and Other Airmen of the Royal Air Force – New Rates of Pay and Allowances, and Accounting Instructions (A.17721-8th August, 1919).

60 TNA, AIR 72/2, AMWOs 1920: Order 885 - Storekeepers – New Trade Classification (169105/20-14th October, 1920.)

61 TNA, AIR 72/21, AMOs 1937: Order A.114 - Regrouping and Renaming of the Trade of Storekeeper (530993/36 - 22.4.37) dated 22 April 1937.

62 TNA, AIR 72/3, AMWOs 1921: Order 570 - Airmen Clerks – Abolition of Existing Sub-Classifications (343697/20) dated 14th July 1921.

63 TNA, AIR 72/6, AMWOs 1924: Order 473 - Airman Clerks (403189/23) dated 5th June 1924.

64 TNA, AIR 72/19, AMOs 1935: Order A.96 - Training of Clerks, Accounting (262169/33 - 25.4.35) dated 25 April 1935.

same period.<sup>65</sup> This increase in activity brought with it a requirement to manually process large volumes of paperwork such as requisitions, invoices, and issue vouchers. Given this, it soon became clear to the Air Ministry that the equipment accounting function had become a far more specialized and demanding activity and that the ubiquitous Clerk (Accounting) trade needed to be revised. Consequently, and as a 'wartime only measure', the trade reverted to its pre-1935 position of Clerk (Equipment Accounting) and Clerk (Pay Accounting), both within Trade Group IV, in September 1940.<sup>66</sup> Numbers employed within the trade were never sizeable when compared to the eventual number of Equipment Assistants and the approved establishment rose from just 2,202 in June 1941 to a wartime peak of 5,103 in October 1944.<sup>67</sup> The trade was open to both men and women from the outset and by late 1944 the proportions of male and female in the trade were not far short of half and half.<sup>68</sup> Thus, at the outbreak of war there were just two logistics related trades within the RAF's much simplified Trade Group structure: Clerk (Accounting) and Equipment Assistant.<sup>69</sup>

It was not just the increase in the volume of equipment being handled by the RAF's supply chain which led to an increased demand for personnel. The growth in the number of RAF units and formations was just as demanding. Most, if not all, flying stations had an Equipment Section on site, each of which had at least forty logistics' airmen on their establishment.<sup>70</sup> Armitage relates how in Britain alone, there were only fifty-two airfields in 1934, but this had risen to eighty-nine by 1938, with a further 389 constructed between 1939 and 1945.<sup>71</sup> The growth of the number of units overseas also increased significantly as a result of the campaigns in North Africa, the Middle East, Italy and North-West Europe, all of which saw substantial numbers of new squadrons, specialist units

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65 Air Ministry, *Maintenance*, p.166.

66 TNA, AIR 72/24, AMOs 1940: Order A.703 – Clerk, Equipment Accounting, and Clerk, Pay Accounting, Group IV – Re-introduction (592918/36 - 26.9.40) dated 26 September 1940.

67 See this thesis, Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entries for June 1941 and October 1944. Figures for the period before June 1941 do not appear to have survived within TNA, RAFM or MOD(AHB).

68 See this thesis, Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entries for June 1941 and October 1944.

69 Air Ministry, *Manning Plans & Policy*, Appendix 11. There remained five main Trade Groups and a Medical Group but the total number of trades had increased from thirty three in 1934 to forty one in September 1939.

70 The personnel establishment for Equipment Sections varied, depending on the role of the unit in question. A post-war (1956) work study into the Equipment Squadron at RAF Binbrook, a unit which had changed very little in the ten years after the war, shows that the establishment consisted of three officers, forty two airmen and eight civilians. TNA, AIR 20/10488, Royal Air Force Binbrook Equipment Squadron Study Report, Appendix U to Part I – Comparison of Existing Establishment & Experimental Establishment of the Equipment Squadron refers.

71 Armitage, *The Royal Air Force*, p.69.

and operating bases established. Within Maintenance Command's 40 Group, where the greatest proportion of Equipment personnel were concentrated, the number of units performing a logistics-related function rose from just ten in February 1939, to twenty-three in December 1940 and to a wartime peak of forty-two units in December 1944.<sup>72</sup> The proportion of other ranks employed at the 40 Group units rose to 18,696 by 31 December 1944, representing some 41 per cent of the work force.<sup>73</sup> At Number 16 Maintenance Unit Stafford, the number of airmen serving on 31 December 1944 totalled 4,564<sup>74</sup>; whilst these would not have been all logistics tradesmen, the predominant storage and distribution nature of the unit's work would have demanded a substantial proportion. This increase in the number of units led to the need for a sizeable population of Equipment Assistants, with the approved establishment figure (RAF and WAAF combined) rising from 13,011 in June 1941 to a peak of 31,068 in August 1945.<sup>75</sup>

Whilst receiving and issuing equipment was a relatively straightforward operation (largely governed by standard processes), the means by which equipment was first acquired (the provisioning process) was less straightforward and required considerably more analysis of stock consumption and the forecasting of future requirements. The finer detail of this is discussed in Chapter Four of this thesis but, suffice it to say at this point, there was a requirement for dedicated manpower to meet the growing size of the task. The growth of the RAF inventory and the vast quantities of equipment being ordered from industry brought a requirement for the establishment of Master Provisioning Offices at a number of the depots and this generated a requirement for substantial numbers of clerks to carry out this manually-intensive work. By 1945, ten MPOs had been formed which, between them, were by then responsible for the provisioning of 813,263 line items of equipment.<sup>76</sup> This task led to the formation of the trade of Clerk, Provisioning within Trade Group IV in October 1942; this was open to both men and women from the outset, although both sexes had been unofficially employed in this role

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<sup>72</sup> Air Ministry, *Maintenance*, Chapter 8, Diagram 18, p.152.

<sup>73</sup> *Ibid*, Appendix 17, p.452.

<sup>74</sup> Air Ministry, *Maintenance*, Appendix 17, p.452.

<sup>75</sup> See this thesis, Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entries for June 1941 and August 1945.

<sup>76</sup> Air Ministry, *Maintenance*, Chapter 8, p.160.

from some four months earlier in June 1942.<sup>77</sup> These clerks, as described by Dodimead in 1945, were not ‘...as you might well imagine from their designation, a species of amateur grocer...theirs is the job of providing for the requirements of units. They work usually at M.U.s, have no actual physical contact with equipment, but [in their training] must learn the purpose and routing of the necessary forms and vouchers, and how to keep adequate records’.<sup>78</sup> The nature of their duties was limited to processing great volumes of paperwork – essential in order that equipment was re-ordered when required and brought to account when it was received.

Initially, these clerks were employed at both the MUs and RAF stations but, by December 1943, the Air Ministry decided that the provisioning clerks would only be employed at the MUs and that there was sufficient expertise on RAF stations for the lower-level part of the procurement operation to be performed by the local Clerks (Equipment Accounting).<sup>79</sup> Although new trade itself was not officially constituted until October 1942, the Air Ministry personnel records show that an establishment figure of 728 (RAF and WAAF) had been set as early as June 1942; in time, this figure rose to a peak of 2,829 in September 1944.<sup>80</sup> Similar to the position with Clerks (Equipment Accounting), the proportions of male and female in the trade were broadly half and half throughout the war.

The final part of RAF supply chain operations which required specialists in the form of dedicated trades was the area of movements. The formation of the Deputy Directorate of Movements (RAF) in 1942 led to a much clearer professional focus of the movements discipline and, in turn, this led to the formation of two new trades. The first of these was the trade of Clerk, General Duties (GD) (Movements Control) which was introduced as a wartime (non-substantive) trade in 1942.<sup>81</sup> These clerks were established for duties in connection with the movement of personnel and/or freight by road, rail, sea and inland waterways. The second of the trades came about as a result of the

77 TNA, AIR 72/26, AMOs: Order A.1048 – Clerk (Provisioning), Group IV – Introduction, Duties, etc. (A.151663/41/S.10(d) -1.10.42.) dated 1 October 1942 and this thesis, Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entry for June 1942.

78 E.H. Dodimead, ‘It’s Not All a Matter of Form’, *Royal Air Force Journal*, Volume 3, Number 9 (September 1945), 343-344.

79 TNA, AIR 72/27, AMOs 1943: Order A.1275 – Clerk (Provisioning), Group IV – Introduction, Duties, etc. (A.151663/41/S.10(d) -16.12.43) dated 16 December 1943.

80 See this thesis, Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entries for June 1942 and September 1944.

81 TNA, AIR 72/26, AMOs 1942: Order A.482/42 (Supplement).

introduction of and growth in a series of specialist organisations in the form of embarkation offices, embarkation staff or port detachments, all of which had a very similar role, which was the loading and unloading of stores, as well as the embarkation and disembarkation of personnel, mainly at the sea ports in the United Kingdom and overseas at increasingly more locations as the war progressed; this miscellany of units were renamed Embarkation Units during the autumn/winter of 1941/1942. On the outbreak of war there were just three such units; by 1940 a further fifteen had been formed, followed by an additional eighteen in 1941, fifteen in 1942, eleven in 1943, fourteen in 1944 and a further twelve in 1945, bringing the total number of units formed during the war years to eighty-nine.<sup>82</sup>

Initially, these units were staffed by Equipment Assistants and Aircrafthands from Trade Group V, but the specialist nature of working with shipping soon demanded a dedicated trade for this very specific aspect of logistics. Consequently, the all-male trade of Embarkation Assistant was introduced in November 1943.<sup>83</sup> Airmen already working at Embarkation Units who wished to be re-mustered to the new trade were required to take a three-part trade test comprising written tests of theoretical and practical knowledge along with an oral test of practical knowledge.<sup>84</sup> The work of the Embarkation Assistants was quite different from that of Equipment Assistants at RAF flying stations. A short article published in the Royal Air Force Journal in September 1945 on the School of Administrative Trades related how the training course for this trade taught its students '...something about ships, includes the calculation of tonnage, systems of stowage, the various forms relating to stowage, and so on'.<sup>85</sup> To facilitate the easy identification of movements' staff in the often busy and congested embarkation areas, distinguishing armbands in scarlet cloth for wear above the right elbow were introduced for both officers and other ranks in 1940.<sup>86</sup>

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82 Data compiled from TNA catalogue headings for AIR 29/1, AIR 29/2, AIR 29/4, AIR 29/5, AIR 29/6, AIR 29/7, AIR 29/8, AIR 29/9, AIR 29/10, AIR 29/11, AIR 29/12, AIR 29/13, AIR 29/14, AIR 29/15, AIR 29/16, AIR 29/17, AIR 29/18 & AIR 29/19.

83 TNA, AIR 72/27, AMOs 1943: Order A.1110. – Embarkation Assistant, Group III – Introduction of New Trade (A.567648/43/S.10(d) - 4.11.43) dated 4 November 1943.

84 Ibid, Appendix, Paragraphs 1 to 3.

85 Dodimead, 'It's Not All a Matter of Form', 344.

86 TNA, AIR 72/24, AMOs 1940: Order A.847/40. Armlets Movement Control – Introduction (709678/37 - 14.11.40) dated 14 Nov 1940.

The sizeable growth in air transport also required dedicated support as, by the end of the war, Transport Command (established in March 1943) comprised twelve Groups, fifty-eight squadrons and over 3,000 aircraft.<sup>87</sup> The movements' trades were rationalised in August 1945 when the trades of Clerk (GD) (Movements Control) and Embarkation Assistant were replaced with the single trade of Clerk (Movements Control), still largely charged with the previous duties, but a further new trade was also created, Air Movement Assistant, exclusively to handle the movement of personnel and/or freight by air. Both of these trades were part of Trade Group IV.<sup>88</sup> This development of the airmen's logistics trade structure between 1918 and 1945 is summarised in Table 7.

Year	Trades	Remarks
1918	<ul style="list-style-type: none"> <li>• Storeman</li> <li>• Clerk (Stores)</li> </ul>	<ul style="list-style-type: none"> <li>• Both trades defined in AMWO 908/1919</li> </ul>
1920	<ul style="list-style-type: none"> <li>• Storekeeper</li> <li>• Clerk (Stores)</li> </ul>	<ul style="list-style-type: none"> <li>• Introduced by AMWO 885/1920</li> </ul>
1921	<ul style="list-style-type: none"> <li>• Storekeeper</li> <li>• Clerk</li> </ul>	<ul style="list-style-type: none"> <li>• Trade rationalised by AMWO 570/1921</li> </ul>
1924	<ul style="list-style-type: none"> <li>• Storekeeper</li> <li>• Clerk (Store Accounting)</li> </ul>	<ul style="list-style-type: none"> <li>• Trade rationalised by AMWO 473/1924</li> </ul>
1935	<ul style="list-style-type: none"> <li>• Storekeeper</li> <li>• Clerk (Accounting)</li> </ul>	<ul style="list-style-type: none"> <li>• Trade rationalised under AMO A.96/1935</li> </ul>
1937	<ul style="list-style-type: none"> <li>• Equipment Assistant</li> <li>• Clerk (Accounting)</li> </ul>	<ul style="list-style-type: none"> <li>• Introduced by AMWO A.114/1937</li> </ul>
1940	<ul style="list-style-type: none"> <li>• Equipment Assistant</li> <li>• Clerk (Equipment Accounting)</li> </ul>	<ul style="list-style-type: none"> <li>• Introduced by AMO A.703/1940</li> </ul>
1942	<ul style="list-style-type: none"> <li>• Equipment Assistant</li> <li>• Clerk (Equipment Accounting)</li> <li>• Clerk (Provisioning)</li> </ul>	<ul style="list-style-type: none"> <li>• Introduced by AMO A.1048/1942</li> </ul>
1943	<ul style="list-style-type: none"> <li>• Equipment Assistant</li> <li>• Clerk (Equipment Accounting)</li> <li>• Clerk (Provisioning)</li> <li>• Clerk (GD) (Movements Control)</li> <li>• Embarkation Assistant</li> </ul>	<ul style="list-style-type: none"> <li>• Introduced by AMO A.482/42</li> <li>• Introduced by AMO A.1110/1943</li> </ul>
1945	<ul style="list-style-type: none"> <li>• Equipment Assistant</li> <li>• Clerk (Equipment Accounting)</li> <li>• Clerk (Provisioning)</li> <li>• Clerk (Movement Control)</li> <li>• Air Movement Assistant</li> </ul>	<ul style="list-style-type: none"> <li>• Introduced by AMO A.869/1945</li> <li>• Introduced by AMO A.869/1945</li> </ul>

**Table 7 -  
Development of Airmen's Logistics Trade Structure 1918 to 1945**

<sup>87</sup> Ministry of Defence (MOD), AP 3003, *A Brief History of the Royal Air Force* (Norwich: HMSO, 2004), p.173.

<sup>88</sup> TNA, AIR 72/24, AMOs 1945: Order A.869 – Introduction of New Trades of Clerk (Movement Control), Group IV, and Air Movements Assistant, Group IV: Obsolescence of Trades of Clerk (GD)(Movement Control), Group IV, and Embarkation Assistant, Group III (A.788955/45/S.10(m)-30.8.45) dated 30 August 1945.

As with the rationale to commission warrant officers, the Air Ministry soon found that there was merit in encouraging suitable and experienced airmen to apply for commissions - most of them had useful, practical experience in the logistics' environment and were already familiar with the rules and regulations of stock control. From 1941 onwards, numbers of ex-airmen who were commissioned began to increase quite significantly and by 1942, the majority of officers entering the Branch were ex-airmen; the detailed breakdown for the years 1939-1945 is shown in Table 8.

	1939	1940	1941	1942	1943	1944	1945	Totals	% of Total
<b>Direct Entry</b>	228	627	970	35	12	1	2	1875	46
<b>Ex-Airmen</b>	11	137	299	365	831	358	159	2160	54
<b>Total</b>	239	764	1269	400	843	359	82	4035	-

**Table 8 -  
Equipment Branch Entry (Male) 1939 to 1945<sup>89</sup>**

It is not clear why there was such a marked change in the inflow of ex-airmen, although an Air Ministry communication to all Commands and Groups in early December 1942 shows that there was a particular demand for Equipment Officers at this time and that the normal entry requirements had been revised; receiving units were asked to ensure that all airmen be made aware of the recruiting requirement and that, whilst educational qualifications and the type of character required were essential, business qualifications or knowledge of equipment regulations were an asset but not essential.<sup>90</sup>

Promotion during the 1920s and early 1930s was a relatively slow affair, primarily due to the limited growth in the size of the Service. The academic Ian Philpott, for example, states that a man could be promoted to corporal within twelve years but could then spend the next twelve years to pensionable age in the rank.<sup>91</sup> With the growth in the size of the Service from 1935 onwards, especially the increase in the number of squadrons being formed, the position began to improve. Promotion examinations at this time for ranks up to and including sergeant for storekeepers and clerks were set by the School of Stores Accounting and Store Keeping. By 1939, with the imminent prospect of war, it

<sup>89</sup> Air Ministry, *Royal Air Force Personnel Statistics*, Table LVIII, pp. 182-185.

<sup>90</sup> TNA, AIR 2/6520, Qualifications for Airmen in Equipment Branch, Air Ministry Outgoing Cypher Message dated 3rd December 1942.

<sup>91</sup> Philpott, *The Royal Air Force, Volume II*, p.341.

had become clear that a substantial increase in personnel numbers would be required, albeit for a relatively short duration. Shortly after the outbreak of war the Air Ministry introduced a flexible approach to promotion whereby station commanders were empowered to promote individuals to the rank of corporal with group commanders able to promote to the rank of sergeant to fill specific vacancies in the personnel establishments of units within their command. Promotion to the ranks of flight sergeant and warrant officer, though, was carried out by the RAF Records Office, based on recommendations submitted by units on a half yearly basis. In all cases though, promotions were on a temporary basis for the duration of the war and subject to review on its termination.<sup>92</sup>

### **The Women's Auxiliary Air Force**

Women (as part of the Women's Auxiliary Army Corps) had played an important part in the RFC logistics' organisation throughout the First World War, and just after, into the early days of the RAF as part of the WRAF; the latter had three logistics related trades: Clerk – Stores; Storewoman (Technical) and Storewoman (non-Technical).<sup>93</sup> However, by April 1920 (just under two years from its formation) the WRAF had been completely disbanded, since there was no perceived peacetime requirement and a backdrop of 'contracting in Defence spending'.<sup>94</sup> Although the need for a women's reserve was the subject of much discussion during the early 1930s, the lengthy titled Women's Reserve Sub-Committee of the Manpower Sub-Committee of the Committee of Imperial Defence had made it quite clear that the formation of a reserve of women in peace was 'neither desirable nor necessary'.<sup>95</sup> By the time of the Munich Crisis of 1938, the unfolding geopolitical tension prompted much detailed thought regarding the provision of personnel in the event of war and it was inevitable that the question of women's involvement would be re-considered. The Air Ministry Monograph describes how:

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92 TNA, AIR 72/23, AMOs 1939: Order A.451 - Rules Governing Classification, Promotion and Trade Testing of Airmen during the War (30.10.39) dated 30 October 1939.

93 B.E.Escott, *Women in Air Force Blue – The Story of Women in the Royal Air Force from 1918 to the Present Day* (Guildford: PSL, 1989), Appendix E, p.298.

94 J.A. Crang, 'The Revival of the British Women's Auxiliary Services in the Late Nineteen-Thirties', *Historical Research*, Volume 83, Number 220 (May 2010), 343-357 (p.344) and 153

95 *Ibid*, p.2.

By 1938, however, it was realized that, in any future war, manpower would have to be supplemented by woman-power, cabinet policy was reversed and, in April, the Air Ministry was informed by the War Office of a scheme for a Women's Supplementary Reserve to provide trained women to replace soldiers on mobilization in non-combatant duties.<sup>96</sup>

The initial intention was that the Auxiliary Territorial Service (ATS), formed in late 1938, would be used to provide personnel for all three services, with specific companies attached to the Royal Navy, the Army and the RAF; in the case of the latter, the requirement for the 'core' logistics trade of Equipment Assistant was included as one of nine trades 'suitable' for the employment of women. The cultural, organisational and training differences of the three services were underestimated and it soon became clear that the Army-orientated ATS approach would not work. This led to the formation of a dedicated service for the RAF, formed as the Women's Auxiliary Air Force (WAAF) and constituted by Royal Warrant on 28 June 1939.<sup>97</sup> On its formation, there were already 1,734 members employed in six trades: Cooks, Clerks, Mess Orderlies, Motor Transport Drivers and Equipment Assistants.<sup>98</sup>

From the outset, the primary purpose of the WAAF was to replace (or substitute) men with women, thereby releasing males for front-line duty. The extent of this substitution was the responsibility of the Air Ministry Standing Committee to Consider the Substitution of WAAF for RAF Personnel (hereafter referred to as the Standing Committee), formed in August 1940.<sup>99</sup> Charged primarily with keeping substitution under review, the Standing Committee was also required to identify where substitution could be increased, as well as recommending trades, previously closed to women, where substitution could be implemented. This work was particularly time consuming and it is evident that it was carried out thoroughly, with a close working relationship maintained not just with the heads of the RAF Commands, but also with the respective professional heads of specializations (DGE in the case of the Equipment specialization) and with the Director of the WAAF (DWAAF); from its inception in 1940 to the

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96 Ibid.

97 TNA, AIR 72/23, AMOs 1939: Order A.550/1939, The Women's Auxiliary Air Force (A.31826/39 – 22.12.39) dated 22 December 1939.

98 B.E.Escott, *Our Wartime Days – The WAAF* (Stroud: Alan Sutton, 1995), p.105.

99 TNA, AIR 2/6097, WAAF Standing Committee to Consider Further Substitution of RAF Personnel by WAAF Personnel: Enclosure 21A - Memorandum by A.M.P – Substitution of W.A.A.F for RAF Personnel dated 6th August 1940 (A.96084/40).

submission of its fifth and final report in early 1945, the Standing Committee had met on no fewer than seventy one occasions.<sup>100</sup>

Substitution, in keeping with a WAAF wide policy, was controlled by a percentage limit. For example, in June 1942, the limit for airwomen employed as Equipment Assistants in Trade Group IV was set at 66 2/3 per cent. At the Equipment Depots, where there was a requirement to move a greater number of heavy items on a regular basis, the substitution level was drastically reduced to twenty per cent.<sup>101</sup> At locations other than depots, it was soon found that the substitution ratio was being exceeded and this led to many airwomen having to do 'far too much heavy lifting', presumably as a result of there being fewer men to do such work; as a result, the ratio was reduced to 50 per cent to ensure that sufficient male personnel were available for heavy lifting duties.<sup>102</sup> As the war progressed, opportunities for the employment of airwomen in the logistics' discipline began to broaden beyond the Equipment Assistant trade which was the sole opportunity for women in this specialization at the outbreak of war. The introduction of the Clerk (Equipment Accounting) trade in Trade Group IV in September 1940 saw this opportunity opened to WAAFs at the same time as RAF personnel.<sup>103</sup> Similarly, the trade of Clerk (Provisioning), introduced in October 1942, had also been open to both men and women from the outset.<sup>104</sup>

The one area which made little use of airwomen was the movements' specialization, largely due to the physical nature of the work involved. Although the trade of Clerk (GD) (Movements) Control had been introduced for men in 1942, it was not until nearly two years later in July 1944 that women began to be employed in this trade, and then in only relatively small numbers.<sup>105</sup> Opportunities in the trade of Embarkation Assistant, which had been introduced in November 1943 for males only, were even more limited and the trade remained closed to women throughout the war; the personnel statistics,

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100 TNA, AIR 14/1009, Standing Committee to Consider Further Substitution of RAF Personnel by WAAF Personnel: 5th and Final Report (G.106522) dated 1945, p.1.

101 Air Ministry, *The Women's Auxiliary Air Force*, p.94.

102 TNA, AIR 14/1009, Standing Committee to Consider Further Substitution of RAF Personnel by WAAF Personnel - 3rd Interim Report dated 1942, pp.4-5.

103 TNA, AIR 72/24, AMOs 1940: Order A.703 – Clerk, Equipment Accounting, and Clerk, Pay Accounting, Group IV – Re-introduction (592918/36.-26.9.40).

104 TNA, AIR 72/26, AMOs 1942: Order A.1048 – Clerk (Provisioning), Group IV – Introduction, Duties, etc. (A.151663/41/S.10(d).-1.10.42.) and this thesis, Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entry for June 1942.

105 See this thesis Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entries for July 1944 to November 1945.

however, do show that four WAAFs were working in the trade (in an un-established capacity) in November 1945.<sup>106</sup> Again, the physical demands of the work were the limiting factor, although DWAAF had asked for women to be given the opportunity to work in Embarkation Units as early as 1942 before the new trade was formally established; the Standing Committee, however, were of the opinion that most of the work was unsuitable and that due to the relatively small numbers working in the Embarkation Units, substitution was not worthwhile.<sup>107</sup>

Airwomen were paid considerably less than their male counterparts, irrespective of whether they were carrying out identical duties. For the most junior non-commissioned rank, Aircraftman/Aircraftwoman 2<sup>nd</sup> Class, a male was paid four shillings and three pence per day, whereas a female was paid only two shillings and ten pence per day in Trade Group IV. For the most senior non-commissioned rank, Warrant Officer, a male was paid fifteen shillings a day, with females paid only ten shillings per day in Trade Group IV.<sup>108</sup> This pay differential was in line with the government's pre-war policy of sex differentiation where women who were public employees could not normally earn more than 80 per cent of a similarly qualified man doing the same job; this policy was applied to women in the armed forces, though women were only awarded two thirds of men's rate of pay.<sup>109</sup> Another differential between men and women at this time was liability for overseas service, with airwomen employed only in Britain until May 1944 when the first draft proceeded to the Mediterranean theatre, followed by subsequent drafts to the Far East in October 1944. Following the invasion of the Continent in 1944, growing numbers of Airwomen joined the Supreme Headquarters Allied Expeditionary Force and 2<sup>nd</sup> Tactical Air Force as part of those formations as they advanced through France, Belgium and into Germany. The WAAF logistics trades formed part of these

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<sup>106</sup> See this thesis Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entry for November 1945.

<sup>107</sup> TNA, AIR 14/1009, Standing Committee to Consider Further Substitution of RAF Personnel by WAAF Personnel - 3rd Interim Report dated 1942, p.4.

<sup>108</sup> TNA, AIR 72/26, AMOs 1942: Order A.1209 – Temporary Consolidation of Substantive Pay and War Pay of Airmen, Airwomen and V.A.D (Mobile) Women Nursing Members: Qualifying and Contributory Allotments for Family and Dependant's Allowance (A.408691/42/F.2(b)-12.11.42), Appendix I, Tables III and VI. Examples quoted are for Aircraftman/Airwomen with over two years' service and Warrant Officers with over five years' of service.

<sup>109</sup> H. L. Smith, 'The Womanpower Problem in Britain During the Second World War', *The Historical Journal*, Volume 27, Number 4 (December 1984), 925-945 (p.926); H. Smith, 'The Problem of "Equal Pay for Equal Work" in Great Britain during World War II', *The Journal of Modern History*, Volume 53, Number 4 (December 1981), 652-672 (p. 654); Escott, *Women in Air Force Blue*, p.169 and H. L. Smith (ed), *Britain in the Second World War – a Social History* (Manchester: Manchester University Press, 1996), p.13.

drafts but all were volunteers.<sup>110</sup> The development of the WAAF logistics' trade structure is detailed in Table 9.

Year	Trades	Remarks
1939	<ul style="list-style-type: none"> <li>Equipment Assistant</li> </ul>	<ul style="list-style-type: none"> <li>Introduced by AMWO A.114/1937, renaming the trade of Storekeeper. This was the only logistics trade initially open to women on the formation of the WAAF.</li> </ul>
1940	<ul style="list-style-type: none"> <li>Equipment Assistant</li> <li>Clerk (Equipment Accounting)</li> </ul>	<ul style="list-style-type: none"> <li>Introduced by AMO A.703/1940 dated 26 September 1940 as a wartime only requirement.</li> </ul>
1942	<ul style="list-style-type: none"> <li>Equipment Assistant</li> <li>Clerk (Equipment Accounting)</li> <li>Clerk (Provisioning)</li> </ul>	<ul style="list-style-type: none"> <li>Introduced by AMO A.1048/1942 dated 1 October 1942.</li> </ul>
1944	<ul style="list-style-type: none"> <li>Equipment Assistant</li> <li>Clerk (Equipment Accounting)</li> <li>Clerk (Provisioning)</li> <li>Clerk (GD) (Movements Control)</li> </ul>	<ul style="list-style-type: none"> <li>Introduced by AMO A.482/42. Women were only employed in this trade from July 1944.</li> </ul>

**Table 9 -  
Development of WAAF Logistics Trade Structure 1939 to 1944**

The employment of females as Equipment Officers was not immediately available as an opportunity on the formation of the WAAF and took longer to be introduced. Despite this, there was soon a growing interest in commissioning and there is evidence that a number of WAAF Equipment Assistants were viewed as suitable, as a letter from the Air Officer Commanding (AOC) Number 6 Group at Abingdon to the Air Ministry on 1 February 1940 shows:

...is there any chance of members of the Women's Auxiliary Air Force being made Equipment Officers? Many airwomen who are working in the Equipment Section, and who are of potential officer type, after a period of training would make capable and efficient junior Equipment Officers.<sup>111</sup>

It was not until a year later in April 1941, however, that the employment of WAAF officers for equipment work was actually discussed by the Standing Committee. The DGE's view at the time was that only junior posts in certain commands were suitable but he was opposed to female Equipment Officers being employed on operational stations as they would be required to accompany squadrons if they were required to go overseas. Additionally, DGE stipulated that such substitution should only be permissible within Flying

<sup>110</sup> Air Ministry, *The Women's Auxiliary Air Force*, p.105 and 121.

<sup>111</sup> TNA, AIR 2/6097, Enclosure 1A – 6G/WAAF/1/Air dated 1 February 1940 refers.

Training, Technical Training and Balloon Commands.<sup>112</sup> Consequently, the Substitution Committee only approved the substitution of RAF equipment officer posts up to and including flight lieutenant rank in the proportion of 50 per cent.<sup>113</sup> There was a limiting factor in this move in that, as these WAAF officers would be required to complete the explosives' course, which included being taught about the effects of gas and chemical weapons, they would need to be volunteers.<sup>114</sup> Despite the level of interest in commissioning by Equipment Assistants which Air Officer Commanding 6 Group indicated a year earlier, the initial take up was 'disappointingly small' and resulted in a note being issued to all RAF Commands and Groups in the United Kingdom in May 1941, subsequent to the Air Ministry Order (AMO) announcing the Equipment Officer requirement.<sup>115</sup> Candidates for potential employment as WAAF Equipment Officers, whether from airwomen volunteers or from civilian applicants, were required to have passed the School Certificate examination (or to have reached that standard) and 'to possess business or industrial experience, preferably in an administrative or managerial capacity'. Unlike their male counterparts, the AMO stated that a 'knowledge of card index systems, stores records and the handling of stores would also be an advantage'. It was also suggested that energy and drive were essential attributes.<sup>116</sup> In due course the numbers grew and by 1 July 1943 there were 280 WAAF Equipment Officers serving<sup>117</sup>; by October 1945, this figure had increased to 438.<sup>118</sup> In July 1941, Maintenance Command alone had identified that approximately 100 officers of the Equipment Branch could be substituted by WAAF officers.<sup>119</sup> Opportunities for WAAF Equipment Officers to serve overseas arose slightly earlier than for Equipment Assistants, with the first officer joining the RAF Delegation in Washington, USA probably in late 1943 or early 1944.<sup>120</sup> Alongside Equipment Assistants, female Equipment Officers were also posted to the Far East from June 1944 onwards and also as part of Supreme Headquarters Allied Expeditionary Force and 2<sup>nd</sup>

112 TNA, AIR 2/9247, WAAF Proposal to Have Equipment Officers: Paragraph two of the minutes of the 17th meeting held on 7th April 1941 and Bentley Beaman, *Partners in Blue*, p.183.

113 Air Ministry, *The Women's Auxiliary Air Force*, pp.94-95.

114 Ibid.

115 TNA, AIR 2/9247, Women's Auxiliary Air Force: Personnel (Code B, 77/1): Proposal to have Equipment Officers, Enclosure 1A and Air Ministry, *The Women's Auxiliary Air Force*, p.25.

116 TNA, AIR 72/25, AMOs 1941: Order A.838.-Women's Auxiliary Air Force – Selection of officers (A.158391/41.-16.10.41).

117 Bentley Beaman, *Partners in Blue*, p.183 and Air Ministry, *The Women's Auxiliary Air Force*, p.95.

118 RAFC Library, *Monthly Air Force List January 1945* (London, 1945).

119 TNA, AIR 2/9247, Women's Auxiliary Air Force: Personnel (Code B, 77/1): Proposal to have Equipment Officers, MC/C. 10885/8/WAAF, Enclosure 18BB refers.

120 Air Ministry, *The Women's Auxiliary Air Force*, p.113.

Tactical Air Force as part of those formations as they advanced through France, Belgium and into Germany.<sup>121</sup>

The WAAF made a significant contribution to the RAF's logistic effort, let alone the service as a whole; their employment allowed the RAF to divert large numbers of men to other combatant duties, especially overseas. Of the three Services, the RAF made the greatest numerical use of women in its ranks. The differences in the peak figures for the WRNS, ATS and WAAF are marked - the WRNS reached a peak of 8.6 per cent in December 1944, the ATS achieved 7.35 per cent in 1943 and the WAAF 15.51 per cent in 1943, broadly twice the level of the Navy and Army.<sup>122</sup> The lower figures for the Navy and Army can be explained by the fact that, as women did not go to sea and were not combatants, the opportunities for substitution were greatly limited. Given that the sole intention of employing both WAAF officers and airwomen was in a substitution capacity, the question arises as to how effective this policy actually was. This was a time, however, where the extent to which women in full-time employment, despite many of the traditional male occupations which they had filled during the First World War, was still very limited. This was largely influenced by male attitudes. A typical, if not rather blunt comment in the early 1940s which illustrates this outlook (albeit in reference to female pilots in the Air Transport Auxiliary), was made by Charles Grey, the editor of the *Aeroplane* magazine:

There are millions of women in the country who could do useful jobs in war. But the trouble is that so many of them insist on wanting to do jobs which they are quite incapable of doing. The menace is the woman who thinks that she ought to be flying in a high-speed bomber when she really has not the intelligence to scrub the floor of a hospital properly, or who wants to nose around as an Air Raid Warden and yet can't cook her husband's dinner.<sup>123</sup>

From the qualitative perspective, the employment of airwomen proved to be successful although it took some time for some of the barriers to be broken down and for airwomen to be given full opportunities to demonstrate their ability. Beryl Escott, in her book on the WAAF, comments that 'the airmen with whom they worked tended to regard WAAF's as a novelty, treating them sometimes

<sup>121</sup> Air Ministry, *The Women's Auxiliary Air Force*, pp.14-126.

<sup>122</sup> L.Noakes, *Women in the British Army – War and the Gentle Sex, 1907-1948* (Abingdon: Routledge, 2006.), p.131.

<sup>123</sup> Adrian Lee, 'Heroism of the Spitfire Girls', *Daily Express*, 20 June 2012.

with hostility and more frequently with amusement and leg pulling'.<sup>124</sup> Given time to show what they were made of, it appears that the WAAFs soon fitted in with their male counterparts. Indeed, Escott comments how 'at first there were comments about women doing men's work, but realising that we could do the job as well as they, the airmen soon absorbed us'.<sup>125</sup> The key to acceptance appears to be competency, as Katharine Bentley Beaumont in her book on the WAAF observed:

In most of the other trades no difficulties were found in having airwomen NCOs giving orders to airmen. If the WAAF knew their job the airmen recognised the fact.<sup>126</sup>

The perception regarding officers was quite different. It appears not to have been a question of ability but the acceptance by men of being placed under the direct authority of women. Commissioned rank, even at the most junior level, brought with it a command responsibility for those working under their charge. For men and especially civilians, the acceptance of a female superior proved to be difficult. It was an attitude which, despite the needs of unity in time of war, actually impeded the extent to which female Equipment Officers were employed throughout the RAF's supply chain; this effectively reduced the numbers of male Equipment Officers who could have been released for more urgent duties elsewhere. For example, towards the end of the war, the 50 per cent substitution rate for WAAF Equipment Officers at civilian manned units had to be reduced to 33 1/3 per cent because civilian foremen and labourers objected to being controlled by WAAF officers.<sup>127</sup> On units where there was a greater WAAF population, the picture was quite different as illustrated by the case of No 210 Maintenance Unit at Romsey, an Equipment Park in 40 Group. This unit was manned almost entirely by WAAFs and was commanded by a WAAF squadron officer (Equipment) from 1944 to 1946; as far as is known, this was the first female station commander.<sup>128</sup>

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<sup>124</sup> Escott, *Women in Air Force Blue*, p.100.

<sup>125</sup> *Ibid.*, p.171.

<sup>126</sup> Bentley Beauman, *Partners in Blue*, p.168.

<sup>127</sup> TNA, AIR 14/1009, Standing Committee to Consider Further Substitution of RAF Personnel by WAAF Personnel: 5th and Final Report (G.106522) dated 1945, p.2.

<sup>128</sup> Air Ministry, *The Women's Auxiliary Air Force*, p.95.

It was not just a conceptual difficulty as the visual presence of a female officer also appears to have had an impact. An anecdotal example of this is provided by the experience of Hilda Rothnie who joined the WAAF in November 1941 aged 22 as a voluntary recruit, completing her basic training at RAF Bridgenorth and then Equipment Trade training at Bridlington. Following this, she was posted to No 7 Air Gunners School at RAF Stormy Down, primarily working in the airframe storage section but also in the clothing and rations' areas. After reaching the rank of corporal she was selected for commissioning and attended the Officer Training Unit at Grange-Over-Sands in October 1942. Following Equipment Officer training at Loughborough she was commissioned as an Acting Section Officer and posted to No 14 Balloon Centre and then to 951 Balloon Squadron at RAF Barnwood as the first woman to be in charge of a Station Equipment Section. When touring her various outlying storage sites it was not unknown for her to be greeted by '\*\*\*\*\*', *it's a woman*' when she appeared in battledress.<sup>129</sup>

The wider literature on the women's services is less informative and it is difficult to ascertain if such attitudes towards officers were unique to the WAAF. The secondary sources regarding the Women's Royal Naval Service (WRNS) and the Army's ATS make no reference to such attitudes towards officers.<sup>130</sup> Perhaps the most illuminating data on the performance of WAAF's can be found in the findings of an Air Ministry survey which was carried out in early March 1945 to inform the work of the Royal Commission on Equal Pay in relation to the employment of WAAF's. The survey, sent out to the Commander-in-Chiefs of the RAF Commands, posed two questions. Firstly, 'how does the work of women compare in quality with that of men?' and, secondly, 'how far, when women are nominally interchangeable with men, are they actually so as regards the ranges of uses to which they may be put?'<sup>131</sup> The surviving responses (apart from Bomber Command) on the National Archives file are missing their covering letters so it is not possible to attribute the comments to a specific Command.

<sup>129</sup> RAF LHCA, Personal reminiscences of service with the WAAF Equipment Branch (H.M. Rothnie) detailed in a letter dated 4th January 1989.

<sup>130</sup> M.H. Fletcher, *The WRNS: A History of the Women's Royal Naval Service* (London: Batsford, 1989), U. Stuart Mason, *Britannia's Daughters – The Story of the WRNS* (London: Leo Cooper, 1992), C. Lamb, *I Only Joined for the Hat: Redoubtable Wrens at War* (London: Bene Factum Publishing, 2007), C. Harris, *Women at War in Uniform 1939-1945* (Stroud, 2003) and Noakes, *Women in the British Army*.

<sup>131</sup> TNA, AIR 14/1009, Substitution of WAAF for RAF Personnel: Reports and Policy 1942 Sept. - 1945 June, Enclosure 4A - Air Ministry Letter S.104783/S.11. dated 7th March 1945.

Nonetheless, the returns provided are almost unanimous in their views regarding airwomen working in logistics' trades.

On the whole, it would appear that women working in a clerical capacity and as Equipment Assistants were viewed as 'equal to, if not superior to that of airmen personnel'<sup>132</sup> and were more 'painstaking than men over routine duties'.<sup>133</sup> Almost all comment on the need for men to be available for heavy lifting, with one in particular observing that women 'are of course physically handicapped where manual labour is concerned' and that in Equipment Sections 'there must always be male labour for the heavier work and for continuous work when exposed day by day to the elements'.<sup>134</sup> On the other hand, WAAF officers were 'loth [sic] to accept full responsibility for work entrusted to her' and they 'do not do well as Officers i/c [in charge] sections'.<sup>135</sup> Another return comments that WAAF officers were 'equal to men in junior ranks but not interchangeable as they cannot be employed in command of small units where the CO is responsible for the defence organisation'.<sup>136</sup> The view of the Air Ministry is limited to the rather bland statement that 'women did good work as equipment officers'.<sup>137</sup> Despite this rather mixed male perception of female ability, the works of Escott and Bentley Beaman do not indicate that this compromised their job performance.<sup>138</sup>

It is the quantitative perspective, however, which provides a more objective indication of the contribution made by the WAAF. At its height in 1943, the WAAF reached a total strength of 182,000, consisting of 6,000 officers and 176,000 airwomen; this represented approximately 15 per cent of the combined total personnel strength of the RAF and WAAF.<sup>139</sup> The contribution from the logistics' perspective is particularly noteworthy as far as Equipment Assistants are concerned. Although detailed personnel figures by specific trade prior to June 1941 do not appear to have survived, those from this

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132 Ibid, Enclosure 6K.

133 Ibid, Enclosure 6E.

134 Ibid, Enclosure 6J.

135 Ibid.

136 Ibid, Loose document G.78143(g). Appendix "A" (Officers).

137 Air Ministry, *The Women's Auxiliary Air Force*, Chapter 12, p.95.

138 Bentley Beaman, *Partners in Blue*, Escott, *Women in Air Force Blue*, Air Ministry and *The Women's Auxiliary Air Force*.

139 TNA, AIR 14/1009, Substitution of WAAF for RAF Personnel: Reports and Policy 1942 Sept. - 1945 June - Standing Committee to Consider Further Substitution of RAF Personnel by WAAF Personnel, 5th and Final Report (G.106522) dated 1945, p.1 and Air Ministry, *Manning Plans and Policy*, Chapter 9, p 203.

date to the end of the war show that the requirement for WAAF Equipment Assistants at this time rose from 1,907 to a peak of 7,112 in June 1945. From March 1942 the trained strength began steadily to exceed the establishment figure from, initially the low hundreds, to 2,354 in March 1944; this made a substantial contribution towards addressing the virtually continual manning deficit in this trade for men.<sup>140</sup>

## Civilians

At unit level the RAF had employed civilians in a variety of roles, predominantly in administrative tasks. One of the earliest specialist roles which civilians played in logistics was instituted in June 1925 through the introduction of a civilian storekeeper with the post title of Station Warden and one clerk, to a specific number of RAF stations. The duties these individuals were to be responsible for were primarily a range of domestic services such as the supply of utilities (solid fuel, electric, gas, and water), administering building repairs, the monthly inspection of barrack furniture (and repair where required) and the storage, issue and receipt of barrack equipment. These tasks were not key to the military task of the unit but, nonetheless, were all part of providing basic living requirements for the personnel living on RAF units. The significance of this initiative was that it initially released fifty-six RAF logistic tradesmen (Storekeepers, Clerk (Stores Accounting) and Clerk (GD)) from non-directly military tasks for employment elsewhere.<sup>141</sup>

The greatest concentration of civilians was at the equipment depots. In the pre-war period, most of the MUs were manned by civilian personnel and they were relatively free to come and go within the constraints of their contracts of employment. It was inevitable that, as part of the wider consideration regarding manpower during the Expansion Programme, that the manning of the MUs in a period of emergency or actual war needed addressing, especially the issue of an almost complete dependence on a civilian workforce. The MUs were acknowledged as being a critical component of the RAF's supply chain – they were the vital storage and distribution link between the manufacturing output of industry and RAF consumers - any disruption in this process by civilian staff

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<sup>140</sup> See this thesis, Appendix 5 - RAF Equipment Assistant Trade Shortfall Resolution June 1941 to November 1945 and Appendix 2 - Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entries for June 1941, March 1945 and June 1945.

<sup>141</sup> TNA, AIR 72/7, AMWOs 1925: Order 499 – Stores Administration and Accounting – Introduction of Civilian Station Wardens (432715/23).

was perceived as having serious consequences. Preliminary estimates were that at the equipment MUs, this increase was likely to be some seven to eight times the peacetime workload and at the ammunition depots even greater.<sup>142</sup> In terms of manpower numbers, it was estimated that over the next two to three years, some 10,000 additional civilian employees would be required.<sup>143</sup>

The Air Ministry had been grappling with this issue for some time prior to 1937 and had started to formulate options to mitigate the risk. Whilst the early records of this issue avoid any direct reference, the general tenor of the various documents is one of a general uncertainty as to the loyalty which could be expected from the civilian workforce on the outbreak of war and a fear of the impact of specific activities such as disaffection, sabotage or industrial action.<sup>144</sup> There appears to be no mention in Air Ministry correspondence at this time regarding any unease amongst the civilian workforce regarding the risks from enemy bombing. The RAF was effectively looking towards a means of securing the provision of civilian labour and then being able to transfer manpower as required to meet service needs. Overall, four options emerged from the ongoing debate which were eventually incorporated into a short summary paper by AMSO.<sup>145</sup> The first option considered was the complete manning of all of the MUs by military staff which would afford the greatest mitigation, but was soon discounted on the grounds of cost and the large numbers of military staff required. The second option was for the partial manning of the MUs by military personnel, but it was considered that mixed establishments had a number of disadvantages, not least of which was that the 'moral influence' of a small proportion of military was likely to be negligible. The third option was to man the MUs with reservists who had completed a period of regular service and could be given a long service reserve engagement. It soon became apparent, however, that there were insufficient men within the reserve to meet the requirement and that it would be unlikely that authorisation would be given for extending reserve commitments, let alone the potential financial impact. The fourth option, and one that had been considered as early as 1935, was to actually ask existing civilian employees if they would accept, voluntarily, an

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142 TNA, AIR 2/2220, Civilian Employees at Depots in War: Enclosure 2A, Civilian Employees at Maintenance Units – Control in War, Paragraph 2.

143 Ibid, Civilian Employees at Depots in War: Enclosure 2A, Civilian Employees at Maintenance Units – Control in War, Paragraph 4.

144 Ibid, Civilian Employees at Depots in War: Enclosures 2A, 18A and 18B.

145 Ibid, Civilian Employees at Depots in War: Enclosure 18B, 8th Progress Meeting. Civilian Employees at Maintenance Units- Control in Emergency and War (Memorandum by A.M.S.O)(draft).

obligation of reserve service in the event of war or declared emergency. AMSO was clearly concerned about this risk as one of his early comments shows:

I consider that its importance is so great in relation to the efficiency of the Royal Air Force immediately before war and during war, that a somewhat detailed statement should be placed before the Air Council.<sup>146</sup>

In a memorandum following the 8<sup>th</sup> Progress Meeting considering this issue, AMSO expanded on his earlier view:

Without in any way casting doubt on the patriotism of the average civilian employee, I consider that the consequences of a breakdown of the maintenance organization during the critical days immediately before and on the outbreak of war are so grave that the Royal Air Force cannot be left dependent upon the loyal fulfilment of the moral obligation of such a large number of persons to remain at their posts of duty on the outbreak of an emergency. The position of the Royal Air Force is different from the other Services, and little or no time for preparation may be available before the outbreak of war. It is therefore necessary that, for the Royal Air Force, there should exist a means of securing immediately the hold over their civilian employees that the other services may be satisfied to secure by the introduction of special legislation when war breaks out.<sup>147</sup>

These comments are one of very few made by a senior RAF officer who was not a logistician, which acknowledge how critical a specific component of the supply chain was to the employment of air power.

By this stage, the civilian manpower estimates had begun to mature and it was forecast that on the completion of Expansion Scheme 'L' (31<sup>st</sup> March 1940), the total civilian staff of the MUs would be in the order of 20,000 of whom only about 2,500 were in established grades, the balance of about 17,500 representing various industrial grades employed on a weekly basis. The final paper was prepared for AMSO's consideration and onward transmission in January 1939 but the drafting staff officer suggested that:

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146 TNA, AIR 2/2220, Civilian Employees at Depots in War: Enclosure 18B,8th Progress Meeting. Civilian Employees at Maintenance Units-Control in Emergency and War (Memorandum by A.M.S.O)(draft), Paragraph 1.

147 TNA, AIR 2/2220, Civilian Employees at Depots in War: Enclosure 18B,8th Progress Meeting. Civilian Employees at Maintenance Units-Control in Emergency and War (Memorandum by A.M.S.O)(draft), Paragraph 12.

You may, however, wish to withhold its reference to the Air Council for the time being in view of the discussion at recent Progress Meetings...when S of S [Secretary of State]. said that he felt it would be much better to include civilians employed by the Air Ministry in the schedule of Reserved Occupations than to ask them to join the Reserve.<sup>148</sup>

The issue was eventually discussed in conference by the Ministry of Labour and the Schedules of Reserved Occupations was amended in favour of Air Ministry demands.<sup>149</sup> The Expansion Schemes brought a significant increase in civilian manpower requirements and saw close cooperation between the Air Ministry and the Ministry of Labour. In February 1939 the Air Ministry estimated that it would require an additional 905 storekeeping grades with 793 required at depots (Equipment, Ammunition, Packing and Aircraft Storage) and 112 at RAF units.<sup>150</sup>

There was one further dimension to the employment of civilians in logistics, albeit one which involved very small numbers. In July 1941, the Air Ministry announced the formation of a Civilian Technical Corps (CTC), established under the Defence (Civilian Technical Corps) Regulations 1941. This was a uniformed organisation and was established as a body of 'civilian craftsmen in certain skilled trades for the purpose of maintaining and repairing armaments and equipment'.<sup>151</sup> The number of CTCs employed in the logistics' organisation was small with, on average, no more than two per month in the trades of Equipment Assistant (RAF) and Clerk (Equipment Accounting) (RAF) between November 1941 and December 1944; the only exception is five CTCs employed as Equipment Assistants in July 1943.<sup>152</sup> Given that the Corps was formed with an engineering intent in mind, the fact that it fielded personnel in Equipment trades attracts comment. There is, however, nothing in the original announcement nor wider correspondence which sheds any light on this except, perhaps, for an organisational diagram in the convening Air Ministry Order which shows that a CTC Reception Depot was established at Bridlington with Equipment and accounting Sections; although not certain, it is likely that this is

148 TNA, AIR 2/2220, Civilian Employees at Depots in War: Enclosure 18A, Memorandum to AMSO from Air Ministry S.9 dated 3 January 1939.

149 M.M. Postan, *History of the Second World War – British War Production* (London: HMSO,1952), p.96.

150 TNA, AIR 2/1973, Storage Units and Stores Depots Conversion from Peace to War Organisation – Personnel Aspects: Enclosure 36A - Air Ministry letter S.40229/S.3 dated 8 February 1939.

151 TNA, AIR 72/25, AMOs 1941: Order A.547 - The Civilian Technical Corps (23.7.41).

152 See this thesis, Appendix 2: Non-Commissioned Personnel in Logistics Trades June 1941-November 1945 – entries for November 1941 to December 1944.

where these CTC Equipment tradesmen were employed.<sup>153</sup> The lack of any adverse comments on this scheme regarding integration within the RAF, would suggest that there were no significant issues with its acceptance by military staff.

### **Overseas Manpower Assistance**

Up until the summer of 1941, the RAF had managed to recruit sufficient numbers of men to meet its needs from United Kingdom sources. However, from the autumn of 1941, a general shortage of manpower had developed which prompted a more concerted effort to extend recruiting operations overseas. The coordination of this rested with the Overseas Manpower Committee and the programme drew personnel from five of the Dominions, twenty-five of the Colonies and from eight European Allied nations (Norwegians and Yugoslavs also served with the RAF but as part of their own native air forces).<sup>154</sup> The number of Equipment Officers provided from the Dominions was relatively small, rising from just six in September 1941, to a peak of sixty-eight in September 1944, before gradually declining to sixty-two in September 1945 - the greater proportion was provided by Canada. Detailed analysis of the data shows that the total number of Dominion officers in the RAF Equipment Branch barely touched 1.5 five per cent of its total size (excluding WAAF officers) in any one year from 1941 to 1945. The breakdown by nation and year is shown in Table 10.

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153 TNA, AIR 72/25, AMOs 1941: Order A.547 - The Civilian Technical Corps (23.7.41). Appendix C.

154 TNA, AIR 20/2025, Service Personnel: Strength Returns Sept 1939 to June 1946. The Dominion countries were Australia, Canada, South Africa, Southern Rhodesia and New Zealand. The Colonies were the Bahamas, Barbados, Bermuda, British Guiana, British Honduras, Ceylon, Cyprus, Falkland Islands, Fiji, Gambia, Gibraltar, Gold Coast, Hong Kong, Jamaica, Kenya, Leeward Islands, Malta, Mauritius, Nigeria, Northern Rhodesia, Seychelles, Sierra Leone, Straits Settlements, Trinidad & Tobago and the Windward Islands. The European Allied nations were Belgium, Czechoslovakia, Denmark, France, Greece, Holland, Poland and Russia.

	Sep 1941	Sep 1942	Sep 1943	Sep 1944	May 1945	Sep 1945
Canada	2	15	39	56	57	51
Australia	3	4	11	11	9	10
New Zealand	1	1	1	1	1	1
Total	6	20	51	68	67	62
RAF Equipment Branch Size	2943	3518	4375	4726	4817	4733
% of RAF Equipment Branch	0.20%	0.57%	1.17%	1.44%	1.39%	1.31%

**Table 10 -  
Numbers of Dominion Officers Employed in the RAF Equipment Branch by Country of Origin September 1941 to September 1945<sup>155</sup>**

The picture for officers from the Allied nations is more limited due to the scarcity of surviving data but presents a position very similar to the Dominions. In the ten month period from June 1944 to May 1945 (excepting August and November 1944), the total number of Allied officers serving in the Equipment Branch varied between just twenty-four and thirty-five. Further analysis of the data shows that the total number of Allied officers in the RAF Equipment Branch barely exceeded 0.7 per cent of its total size (excluding WAAF officers) during this period. The breakdown by nation and year is shown in Table 11.

	Jun 1944	Jul 1944	Sep 1944	Oct 1944	Dec 1944	Jan 1945	Feb 1945	Mar 1945	Apr 1945	May 1945
Belgium	1	1	1	1	1	1	1	1	3	1
Czechoslovakia	3	3	3	3	3	3	3	8	4	7
France	1	1	1	1	1	1	1	1	1	1
Norway	1	1	2	2	2	3	3	3	3	3
Poland	18	18	18	18	18	19	22	22	22	23
Total Allied	24	24	25	25	25	27	30	35	33	35
RAF Equipment Branch Size	4519	4566	4726	4811	4884	4866	4896	4933	4922	4817
% of RAF Equipment Branch	0.53%	0.53%	0.53%	0.52%	0.51%	0.55%	0.61%	0.71%	0.67%	0.73%

**Table 11 -  
Numbers of Allied Officers Employed in the RAF Equipment Branch by Country of Origin June 1944 to May 1945<sup>156</sup>**

<sup>155</sup> Air Ministry, *Royal Air Force Personnel Statistics*, Table XV, pp.108-109, TNA, AIR 202025 - Service Personnel: Strength Returns Sept 1939 to June 1946 and this thesis, Appendix 1.

<sup>156</sup> TNA, AIR 20/1016, R.A.F. personnel: analyses by country of origin 1944 June 1945 May: Analysis of Officers by Country of Origin June 1944 to May 1945 and this thesis Appendix 1.

The position regarding personnel from the Dominions and Allied nations within the other ranks of the logistics trades was not too dissimilar from the officer situation. The extent of the employment from both sources was limited to the trades of Equipment Assistant and Clerk (Equipment Accounting) only, with no females employed in either trade. More extensive and detailed data has survived for other ranks and, with the unexplained omission of the six month period from May to October 1942, covers from November 1941 through to November 1945; there is a significant difference in this data from that of the officers in that nations of origin are not shown and the respective headings are either Dominion or Allied. The availability of data for Dominion airmen precludes an exact year/month comparison with their officers detailed in Table 11 but, taking figures for November of each year rather than September (due to the May-October 1942 omission), the percentage of Dominion other ranks in the equivalent RAF trades, only just exceeded 1.5 per cent during the period, a position almost identical to the officer situation. The breakdown is detailed in Table 12.

	Nov 1941	Nov 1942	Nov 1943	Nov 1944	Nov 1945
Dominion (Equipment Assistant & Clerks (Equipment Accounting))	234	234	234	234	173
RAF (Equipment Assistant & Clerks (Equipment Accounting))	14,856	16732	20154	21656	23233
% of RAF Equivalent Trades	1.56%	1.40%	1.16%	1.08%	0.74%

**Table 12 -  
Numbers of Dominion Other Ranks Employed in Logistic Trades as a Percentage of the  
Equivalent RAF Logistics Trades November 1941 to November 1945<sup>157</sup>**

Turning to the airmen tradesmen from the Allied nations, data availability does enable an exact month/year comparison as with their officers. The picture here is quite different and the percentage figure for Allied other ranks is broadly half of the officer contribution (See Table 13).

<sup>157</sup> Data taken from this thesis Appendix 2 (Trained Strength) and Appendix 3. Comparison excludes WAAF numbers as airwomen were not recruited from the Dominions for logistics trades.

	Jun 1944	Jul 1944	Sep 1944	Oct 1944	Dec 1944	Jan 1945	Feb 1945	Mar 1945	Apr 1945	May 1945
Allied (Equipment Assistant & Clerks (Equipment Accounting))	53	52	41	51	53	52	52	41	51	50
RAF (Equipment Assistant & Clerks (Equipment Accounting))	21224	21301	21420	21488	21832	21907	21983	21915	22049	22151
% of RAF Equivalent Trades	0.25%	0.24%	0.19%	0.24%	0.24%	0.24%	0.24%	0.19%	0.23%	0.23%

**Table 13 -  
Numbers of Allied Nation Other Ranks Employed in Logistic Trades as a Percentage of  
the Equivalent RAF Logistics Trades June 1944 to May 1945<sup>158</sup>**

Although the data used for comparison is not exactly matched and, in some cases there are gaps, the data in Tables 10 to 13 shows that the numbers of officers and other ranks from the Dominions and Allied nations was small when viewed as a percentage of the size of the RAF Equipment Branch and trades at the time; this observation is also true of their employment in the RAF as a whole.<sup>159</sup> It could be argued that the employment of personnel from the Dominions and Allied nations was perhaps more of a political gesture than any earnest contribution towards Equipment Branch and trade manning. Indeed, as early as the spring of 1940, comments had been received from the Colonies and from His Majesty's Representatives in foreign countries that 'it would be advisable to give active encouragement to the numerous British subjects who had enquired about the possibility of enlisting in the Royal Air Force'.<sup>160</sup> Despite the small numbers, it was acknowledged by the Air Ministry that there were benefits such as high motivation and that those from the Air Forces of Allied nations were in many cases already trained and therefore familiar with Service discipline. The numbers of Equipment Assistants, along with their WAAF counterparts, also made a small contribution towards addressing the continuous manning deficit in the RAF's Equipment Assistant trade from January 1942 to November 1945.

<sup>158</sup> Ibid.

<sup>159</sup> Air Ministry, *Manning Plans and Policy*, p.236.

<sup>160</sup> Ibid, p.219.

A lack of any qualitative data regarding the employment of personnel for the logistics' discipline from the Dominions and Allied nations makes it difficult to draw informed conclusions regarding value to the Service. However, the personnel from Canada and Poland (both officers and airmen) made a very specific contribution in terms of expeditionary logistics' capability as part of the Air Stores Parks (see Chapter Eight). Two parks were formed, each consisting entirely of Canadian and Polish personnel; No 406 (Canadian) in July 1943 and No 408 (Polish) in September 1943.<sup>161</sup>

As far as personnel from the colonies were concerned, men had been recruited from the West Indian colonies since 1940. However, a more concerted effort was made in the spring of 1944 but with those selected being actually enlisted before they left their country of origin; of the thirty-three Trades targeted for recruitment that of Equipment Assistant was included. The numbers involved were reasonably sizeable: by February 1945 some 17,788 colonial airmen were serving in the RAF or RAFVR, local RAF forces overseas, enrolled in the WAAF in the Middle East and the Aden Protectorate Levies.<sup>162</sup> The surviving personnel records do not show any detailed breakdown of those serving in the Equipment Branch and Trades and it is not therefore possible to make any comparable analysis to the Dominion and Allied nations' contribution. There is greater detail, in a broader sense, regarding what were termed as local RAF forces in West Africa. In the autumn of 1942, the Inspector General of the RAF reported that the Service was not making as much use as it could do of native manpower in West Africa. Consequently, in April 1943, the Director General of Manning despatched a mission to this region to investigate in more detail. At the time of the visit, the scale of local employment was quite sizeable and some 7,500 West Africans were employed as civilians by RAF units, with at least 1,200 of them in direct substitution for British airmen.<sup>163</sup> As a result of this visit, the mission recommended that this situation should be formalised and that a properly constituted force, to be known as the West African Air Corps (WAAC) should be formed.

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<sup>161</sup> TNA, AIR 29/787, Operational Record Books for 401, 406, 408 and 418 Air Stores Parks; Sturtivant et al, *Royal Air Force Flying Training and Support Units*, p.66.

<sup>162</sup> Air Ministry, *Manning Plans and Policy*, pp.217-221 and Appendix 6.

<sup>163</sup> Air Ministry, *Manning Plans and Policy*, p.223.

The scheme was initially opposed by the Army who feared it would have an impact on their recruitment of literate Africans for the Royal West African Frontier Force. An interesting compromise was reached in which the recruitment of illiterates was not restricted but literates were restricted to 100 per month, a restriction which was subsequently lifted in April 1944.<sup>164</sup> With Army opposition overcome, the WAAC was formed in January 1944 and was placed under the jurisdiction of the Air Council. Command and control was not an easy task as the Corps' four constituent units of the West African colonies of Nigeria, Gold Coast, Sierra Leone and Gambia were separated by immense distances, let alone the cultural, linguistic and educational standards. The initial number of recruits was expected to be in the region of 6,600 of whom it was intended that some 3,600 would be in substitution for 2,400 RAF airmen and 3,000 from among or in place of the men who were being employed as civilians.<sup>165</sup> On the whole, recruitment was voluntary and apparently little difficulty was experienced in finding suitable candidates. The WAAC reached its peak strength of nearly 5,000 in December 1944.<sup>166</sup> In terms of trade structure, the WAAC was very similar to the RAF with four groups named A to D. As far as the logistics' function was concerned, the clerical aspect was represented in Group B with the trades of Clerk Stores Accounting and Clerk Storeman, with the manual side covered by the trade of Storeman in Group C.<sup>167</sup>

The Indian Air Force also made a contribution to RAF logistics through personnel from its own Equipment Branch and Trade; these were placed under the operational control of the RAF. It is not clear exactly where these personnel served although it is highly likely that they were employed within the extensive number of RAF stations and units which developed in India and Burma. Initially, the numbers were not sizeable but rose from seventy-four officers and men in September 1941 to 1,489 officers and men in September 1945.<sup>168</sup> This growth, set against the total number of IAF ground crew is shown in Table 14.

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<sup>164</sup> Ibid, p.223.

<sup>165</sup> Ibid, p.224.

<sup>166</sup> Ibid, p.224.

<sup>167</sup> Ibid, p.224, footnote (2).

<sup>168</sup> TNA, AIR 20/2025, Service Personnel: Strength Returns Sept 1939 to June 1946: RIAF Personnel (Equipment) and Total Trained Groundcrew Summary compiled by Air HQ (India) Command Statistics Section dated 13 July 1946.

	Sep 1941	Sep 1942	Sep 1943	Sep 1944	May 1945	Sep 1945
Equipment Officers	2	8	48	50	52	56
Equipment Trade Other Ranks	72	194	986	1032	1063	1433
Total	74	202	1034	1082	1115	1489
Total IAF/RIAF Trained Ground Crew (officers and other ranks in each year)	1450	3978	18703	21296	22862	22318

**Table 14 -  
Numbers of Indian Air Force Equipment Branch Personnel Serving Under RAF  
Operational Control 1941 to 1945<sup>169</sup>**

In recognition of the IAF's contribution to the war effort, His Majesty the King Emperor (George VI) granted the prefix 'Royal' to the IAF in April 1944.<sup>170</sup>

## Conclusion

The RAF relied on a wide range of personnel within its supply chain. The inter-war period was dominated by the limitations of the Ten Year Rule and this led to very limited change in the numbers of personnel working within RAF logistics during this period. The beginning of the Expansion Programme saw a marked change, with a number of significant policy changes to reflect the likely requirements of a future conflict. Within its commissioned ranks, the policy of employing substantial numbers of retired Equipment Officers had sufficed but was soon seen as flawed in light of the demands which would be placed on the supply chain in war. As far as airmen were concerned, these formed the largest component of logistics' manpower and also provided an experienced pool from which most of the Equipment Branch's officer cadre was drawn throughout the war. A valuable, numerical addition came with the introduction of the WAAF and this made a significant contribution towards abating RAF personnel shortages, especially for Equipment Assistants. The true potential of employing WAAFs, however, was never fully exploited due to prevailing social attitudes towards women, especially in officer roles where the substitution rate at the MUs was significantly constrained by the intransigent attitude of civilian foremen and labourers; many of these attitudes during the first half of the twentieth century appear to have been predominantly influenced by the stereotypical

<sup>169</sup> TNA, AIR 20/2025, Service Personnel: Strength Returns Sept 1939 to June 1946: RIAF Personnel (Equipment) and Total Trained Groundcrew Summary compiled by Air HQ (India) Command Statistics Section dated 13 July 1946. It is not clear from the data source if the totals consisted of entirely Indian personnel or if some posts were filled by RAF personnel on secondment.

<sup>170</sup> TNA, AIR 72/29, AMOs 1945: Order A.404. Indian Air Force – Grant of Prefix "Royal" (C.25294/45/P.U.S – 19.4.45) dated 19 April 1944.

roles of men and women and appear to have gone well beyond the protective view that women should not be employed on combatant duties or brought into harm's way.

One part of the supply chain which was quickly recognized as being of concern was the reliance on an almost total civilian manning of the MUs. This was obviated by including the civilian posts in the Schedule of Reserved Occupations. The significant point here, however, was the high-level recognition of the critical role of civilians in this part of the RAF supply chain. Personnel from the Colonies, Allies and other countries overseas also made an important contribution although greater use was made of foreign personnel overseas on a local basis than those who were commissioned or enlisted actually into the Equipment Branch and related trades.

## Chapter Four: The People of Logistics II - Organisation, Recruitment and Training 1920-1945

### Introduction

Whilst the concept of a supply chain is often perceived as a logical and a linear connection of functions from supplier to customer, they are invariably complex structures with a mixture of organisations and specialisations; this provides a particular coordination challenge, and demands what the contemporary logistics discipline describes as supply chain management. This is a wide ranging activity but one of the key activities, as described by Lysons and Farrington, is the need for 'a systems approach to viewing the supply chain as a whole and managing the total flow of goods inventory from the supplier to the ultimate consumers'.<sup>1</sup> As the war progressed, the supply chain became more complex with a corresponding effect on the nature of Supply Chain Management (SCM). Although the term would not have been recognized by the Air Ministry in 1939, the Ministry most certainly did recognize the need for effective SCM and it was within this department that the top-level of control of RAF logistics was embedded within its Directorate of Equipment (DofE). This chapter examines how logistics was organised from a managerial perspective, and how logistics personnel were recruited and trained.

### Organisation

#### The Air Ministry's Directorate of Equipment

The DofE had been a component of the Air Ministry (under the Department of the Chief of the Air Staff (CAS)), from its origins following the passing of the Air Force Bill in the House of Commons in November 1917.<sup>2</sup> At this time, however, the span of responsibilities which could be broadly classified as logistics in nature, were under the control of two separate directorates - the DofE responsible for aircraft designs, engines and spares and the Directorate of Aircraft Supplies (manned almost entirely by civilians) which was under the

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<sup>1</sup> Lysons and Farrington, *Purchasing and Supply Chain Management*, p.95.

<sup>2</sup> Grey, *History of the Air Ministry*, p.75.

Department of the Director-General of Supply & Research; in 1922, this latter organisation was renamed the Department of the Air Member for Supply & Research (AMSR). To rationalize this divided responsibility for logistics, the DofE was transferred to AMSR's charge in 1924. By 1930, the former Directorate of Aircraft Supplies had become a Deputy Directorate (renamed to Deputy Directorate of Stores) alongside a Deputy Directorate of Equipment, both under the DofE.<sup>3</sup> This arrangement sufficed up until the beginning of the Expansion Programme which marked the beginning of a number of changes for the DofE. The first of these, although strictly speaking not as a direct result of expansion, came in 1934 when the Department of the Air Member for Supply and Research was replaced by two new departments - the Department of the Air Member for Research and Development and the Air Member for Supply and Organisation (AMSO); the DofE was moved from the command and control of AMSR to that of AMSO.<sup>4</sup>

The beginning of the following year, however, saw four further reorganisations and increases in the size of the DofE which were directly as a result of the Expansion Programme. The second change is significant in that it shows the Directorate was forward thinking in terms of preparedness for a possible war with its formation of a third Deputy Directorate which, inter alia, was to be responsible for the planning requirements and organisation for maintenance and supply services in war. The three sub-divisions of the DofE were all renamed as Deputy Directorates of Equipment: DDE (Aircraft); DDE (General) and DDE (Supply and Movements).<sup>5</sup> The role of the DofE at this time was the operational control of equipment organisations across the Service, equipment accounting policy, logistics' planning, managing scales of equipment, the coordination of equipment issues (especially those for priority requirements) and the provisioning of spares; the detail of the latter is described in more detail later in this chapter.<sup>6</sup> The total size of the Directorate at this time was approximately 206 personnel. Surviving manpower records for this area of the Air Ministry are inconsistent in the level of detail between military and non-military personnel, but the proposals for change submitted to the Treasury

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3 Ibid, p.103, 110, p.129 and End Charts – The Organization of the Air Ministry, 1921 & 1930.

4 Ibid, p.135 and TNA, AVIA 15/113, Proposed Re-Organization of the Directorate of Equipment 1939.

5 Ibid, p.134 and End Charts – The Organization of the Air Ministry, 1930 and TNA, AIR 2/1704, Directorate of Equipment: Proposed Increases of Staff in 1936 (S.37505), Enclosure 17a, S.37505/S.1 dated 19 June 1936.

6 TNA, AVIA 15/113, Proposed Re-Organization of the Directorate of Equipment 1939, Office Memorandum 76/40.

indicates that around 80 per cent of the DofE in the mid-1930s were civilians; this ratio remained broadly consistent within the Directorate throughout the war.<sup>7</sup>

The next change was implemented in 1936 and came about as a result of the substantial increase in workload as a result of the Expansion Schemes, along with the accompanying build-up of reserves. The additional workload was most acutely experienced within those DDEs responsible for aircraft, aero engines, MT and Equipment Depot administration. Overall, the proposal required additional staff to reinforce those branches along with reorganization and strengthening of the new DDE (Supply & Movements as a full title but abbreviated to just 'S'). The proposals concerning the third DDE were particularly significant and saw the wider development of its component branches: the E12 branch was to be responsible for producing the general maintenance plans for specific theatres of war; the E 13 branch responsible for the preparation of unit equipment tables which listed every item of equipment in the RAF's vocabulary of stores to be provided for each unit in accordance with plans and agreed rates of consumption and E14, a new branch which was to be responsible for working out the organization of various units from depots to squadrons in the field. Additionally, this branch was to produce mobilization plans and to arrange exercises to test unit capability and readiness.<sup>8</sup> In total, the increase in staff within DofE amounted to seventy seven additional personnel (80 per cent civilian & 20 per cent military) and was approved by the Treasury on 8 July 1936.<sup>9</sup> Overall, this change represented a 37 per cent increase in the size of the DofE. Further proposals were submitted and approved between November 1936 and April 1937 for extra staff to meet the additional work required to support aircraft of the Fleet Air Arm, the introduction of the Balloon Barrage Scheme and the Drawing Office within the E1 branch.<sup>10</sup>

By 1938, the sheer scale of the Expansion Programme had led to a substantial increase in the volume of work within the DofE to the point where its director commented that it was working at '...excessive pressure'.<sup>11</sup> This situation led to the formulation of a case to seek approval for reorganization and

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<sup>7</sup> TNA, AIR 2/1704, Directorate of Equipment: Proposed Increases of Staff in 1936 (S.37505), Enclosure 17a, S.37505/S.1 dated 19 June 1936.

<sup>8</sup> Ibid.

<sup>9</sup> Ibid, Enclosures 17a and 21a.

<sup>10</sup> Ibid, Enclosures 24a, 28a and 35a.

<sup>11</sup> TNA, AIR 2/3317, Directorate of Equipment Reorganization 1938, Enclosure 13A - Letter to H.M. Treasury S.45106/S.1. dated 17 August 1938.

an increase in the numbers of staff. In his letter to the Treasury, the Director of Equipment proposed to increase the number of branches working specifically on aircraft and their equipment to eight and the formation of a fourth DDE. This arrangement, he stated, would result in a more logical grouping of branches - DDEs 1 and 2 responsible for aircraft and all the equipment and materials used in their operation; DDE 3 responsible for supplies, clothing, fuels & lubricants, transport, movements and barrack services with DDE 4 responsible for equipment policy and plans. The addition of a fourth DDE, and an increase in the number of branches working in direct support of aircraft, brought with it a significant increase in supervisory responsibilities and an additional post of an air commodore was sought (to be titled Principal DDE (Aircraft)) to oversee the work of DDEs 1 and 2 and to act as a deputy to the Director of Equipment.

It was not just the introduction and quantities of new aircraft which led to workload increases. Within DDE3, the E10 Branch responsible for MT had experienced a similar exponential increase in workload. The RAF had a total vehicle fleet size of just 2,000 in 1935 but this had risen fivefold to 10,000 by 1937 with a notable increase in the variety of specialised types to around 187, the latter of which now included winches for barrage balloons and associated vehicles for their operation. The number of vehicles held in reserve had also risen from just a few hundred in the early 1930s to over 5,000 in a similar timeframe. As with aircraft, this all required contracts with manufacturing companies, the total number of such arrangements having risen from just a few in the early 1930s to ninety contracts by 1938.<sup>12</sup> The large proposed increase of 40,000 personnel, to swell the ever growing size of the RAF, also had a direct impact on the logistics support required, with additional clothing, equipment and furnishings for the additional domestic and work accommodation being built at units.<sup>13</sup> Within E13, responsible for POL, the sheer numbers of aircraft and vehicles entering service required much greater quantities of fuels, oils and lubricants for day-to-day use, let alone reserve stocks. All this required considerably more work with the petroleum and distributing companies.<sup>14</sup> The plans function within DDE4 (E16 Branch) had perhaps one of the more

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<sup>12</sup> Ibid, Part I, p.5.

<sup>13</sup> Ibid, Part I, p.6.

<sup>14</sup> Ibid, Part I, p.7.

challenging tasks, with the requirement to reflect new types in the War Equipment Schedules. A schedule was required to be drawn up for each type of operational aircraft and formed the basis for the provisioning of war reserve and detailed the holdings of spares which were required to be held throughout the RAF's supply chain in locations such as the MUs, the ASPs, RAF stations and flying squadrons. This was complicated work – the average schedule contained up to 5,000 different items. By 1938, some eighteen schedules had been produced with more to follow with further new types of aircraft coming into service.<sup>15</sup> All in all, a complex picture, but one which illustrates the significant impact which the Expansion Schemes had on RAF logistics. The overall result was that the Director of Equipment had, not only to reorganise his directorate to meet this challenge, but also had to seek approval for a further increase of sixty eight personnel, thereby raising the total establishment from 347 to 476 by December 1938.<sup>16</sup> The approval was subsequently endorsed by the Treasury and promulgated in September 1938.<sup>17</sup>

In addition to the Directorate of Equipment, the Expansion Programme also saw a much wider growth in the size of the Air Ministry. As part of this, the Government had acquired Berkeley Square House in London. Situated on the east side of Berkley Square, by early 1939 this building housed most of the staff of the Directorate of Equipment. Their stay in London was brief and the Directorate was soon moved out of London as part of the Government's evacuation plans; work on the whole idea of evacuation had started as early as 1931, when the Imperial Defence Sub-Committee had set up an 'Evacuation Sub-Committee'. As part of this, plans had been evolved to move the seat of Government out of the capital for fear of air attack; a key part of this was the intention also to move out various ministries and disperse them throughout the country. Consequently, shortly after the outbreak of war in September 1939, the majority of staff in the Directorate of Equipment (those within DofE 1 and DofE 2) relocated to Harrogate in North Yorkshire.<sup>18</sup>

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<sup>15</sup> Ibid, Part I, pp.8-9.

<sup>16</sup> Ibid, Note from DofE to HM Treasury S.1(d) dated 9 December 1938.

<sup>17</sup> Ibid, Enclosure 3A – Office Memorandum 126/38 – Reorganization of Directorate of Equipment dated 21 September 1938.

<sup>18</sup> The majority of staff within DofE 3 remained in London due to their much closer working relationships with other Air Ministry Directorates. The E11 section with its extensive responsibility for movements worked closely with the Directorate of Organization, the Air Staff, War Office and the Ministry of Shipping; the staff of E 14 and E 16, responsible for much of the planning function, worked closely with the Directorate of Organization and E 19 worked on a regular basis with the Petroleum Board. TNA, AIR 2/4236, Proposed Re-organization of the Directorate of Equipment – 1939. Enclosure 11A - Letter to the Treasury S.B. 860/S.1 dated 15 February 1940, p.5 refers.

The last of the major changes to the DofE occurred in early 1940. During 1939, with a much clearer view of the impact of the Expansion Programme and an initial estimate of what additional workload a war might bring, the size and role of the Directorate of Equipment was reviewed by the Air Ministry; the aim was to strengthen the Directorate for war. There were a number of factors which the Director of Equipment believed had contributed to this including: 'the increased tempo of work during war time; the continued multiplication of types of equipment and the continued increase in the complexity of aircraft; the despatch of a force to France, the Empire Training Scheme and the expansion of the Dominion Air Forces; the assumption by the Government of control over industry and transport and the increasing use of American equipment and the move of most of the Directorate to Harrogate'.<sup>19</sup>

The move of DofEs 1 and 2 to Harrogate had by this time created a number of administrative difficulties. Notwithstanding the diversity in section responsibilities, much of the day-to-day work of the DofE as a whole was inter-dependant, both internally and externally. With use of the telephone restricted, much of the routine work had to be conducted in writing which increased the time taken. This situation invariably led to much time spent travelling between London and Harrogate – this proved particularly time consuming for the Director whose attentions were divided between the two locations. As part of this change, the Director of Equipment also highlighted the point that his existing title no longer reflected the size of his responsibility which, he claimed, was larger than of other directors within the Air Ministry and sought an amendment in his title to Deputy Director-General; the title chosen was in line with the hierarchy within the Directorate of Maintenance, where Lord Nuffield was the Director-General and his direct subordinate the Deputy Director-General.<sup>20</sup> The review submitted proposals to AMSO for a reorganization in structure along with increases to staffing levels which would see the Directorate increase in size at the outbreak of war to 941 across thirty-five branches; these proposals were eventually approved by AMSO on 5 April 1940.<sup>21</sup>

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19 TNA, AIR 2/4236, Proposed Re-organization of the Directorate of Equipment – 1939. Enclosure 11A - Letter to the Treasury S.B. 860/S.1 dated 15 February 1940, p.1.

20 Ibid, pp.7-8.

21 TNA, AVIA 15/113, Proposed Re-Organization of the Directorate of Equipment 1939.

Another innovation at this time was the concept of utilising the experience of senior civilian industrialists. Shortly after the expanded DofE was approved, the Secretary of State for Air, Sir Kingsley Wood, commented to AMSO that, as several senior positions in the Quartermaster General's Department at the War Office were filled by civilians with extensive industrial experience, then at least one of the new Directors of Equipment should be a civilian businessman. This proposal was not well received by the Director of Equipment who argued that such an appointment would not be good for the morale of the Equipment Branch and that someone brought in from outside could not possibly have the breadth of experience required unless he had served in at least one of the lower positions in the Directorate. The Director General put forward a counter-proposal of attaching a business advisor (in addition to his Directors) who would have no specific executive responsibility but would be free to roam the RAF's entire Supply system and to advise on how things could be improved. Thus, on 26 March 1940, it was proposed to AMSO that Brigadier Jones (former chairman of the Jones Committee) should be appointed as the Business Advisor to DDGE. This proposal, however, never came to fruition as Sir Samuel Hoare replaced Sir Kingsley Wood on 3 April 1940 and his suggestion went with him. This should not be seen as resisting exposure to wider experience and the official history of the RAF's Maintenance Organization shows that, from its formation in 1938, its HQ staff had studied industrial practice. For example, railway General Managers were consulted on railway issues (including the layout of sidings and branch lines); the petrol chiefs with regard to the fuel depots; the Automobile Association for road routeing; Harrods for quick delivery service and Selfridges for post order business and office systems, to name but a few.<sup>22</sup> As with the RAF's approach to its earlier review of administration, this collaboration was another example of the Air Ministry remaining alive to the benefits of examining and potentially using commercial practice.

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<sup>22</sup> Air Ministry, *Maintenance*, pp.34-35.

## Maintenance Command

The Headquarters element of Maintenance Command remained at RAF Amport (near Andover, Hampshire) throughout the war. However, the progressive growth in the number of its units led to increasing command and control difficulties. On the outbreak of war, 40 Group had fifteen various types of units in operation, with this total increasing to twenty-three by December 1940 and to thirty by December 1941. In February 1941 there were some twenty self-accounting units in the Group along with a large number of other premises which had been hired to accommodate overflow stock from the main sites – sixteen of these were directly controlled by the Group HQ at Amport. By this stage of the war, the Group's personnel strength was 450 officers, 4,700 other ranks and 16,600 civilians.<sup>23</sup> This significant growth in units, along with the scale of the work, resulted in a number of command and control issues for the Group HQ. The geographical dispersal of the units, coupled with the challenges of wartime communication and facilities for travel, had made it increasingly difficult for the Group commander to maintain regular contact with his units to meet one of the Command's aims of ensuring standardization and efficiency across all of their units. As a result, HQ Maintenance Command decentralized an element of its direct control by introducing what were called Universal Equipment Wings (UEW). From 1 June 1941, the six main UEDs of 3, 7, 14, 16, 25 and 35 MUs each became responsible for the functional control and administration of a specific number of units within its area.<sup>24</sup> Two further UEWs were formed: Number 65 based on 65 MU at Handforth and Number 55 (Barrack and Clothing) Wing which was based at Derby and became responsible for the Barrack and Clothing Depots which had been formed following a conference at HQ 40 Group on 3 October 1940 which considered the problems which had resulted from the large volume of stores which were

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23 TNA, AIR 2/8078, Reorganisation of NO. 40 Group, CinC Maintenance Command to Under Secretary of State, Air Ministry (M.C/S.5750) dated 8 February 1941 and TNA AIR 2/8185, Reorganisation of Maintenance Command, Memoranda E.40/42 – RAF Equipment – Storage and Distribution Organisation in the United Kingdom (S.81906) dated 24 June 1942.

24 Each of the UEWs was responsible for a range of locations within a specific geographically defined area: No 3 UEW covered South East England; No 7 UEW covered South West England and South Wales; No 14 UEW covered Northern England and Scotland; No 16 UEW covered part of the Midlands from Latitude 52° 30' North to Latitude 53° 00' North; No 25 UEW covered part of the Midlands from the northern boundary of Nos 3 and 7 UEWs north to Latitude 52° 30' North; No 35 UEW covered North East and North West England from Latitude 53° 30' North to a line just south of Carlisle and No 61 UEW covered the Northern part of the Midlands from Latitude 53° 00' North to Latitude 53° 30' North. TNA, AIR 2/8455, Equipment Dispersal at Depots – Proposals by Maintenance Command 1941, CinC Maintenance Command to AOC in Chief RAF Commands, RAF Equipment Storage and Distributive Organisation at Home (MC/S.9383) dated 11 April 1942, Appendix B – Location of Equipment Depots & Parks and Limits of their Areas of Operation.

then flowing in to the UEDs.<sup>25</sup> Operating experience during 1942 and 1943 showed that the seven Wing structure, along with 55 (Barrack and Clothing) Wing, still proved unwieldy for HQ 40 Group to control and in August 1944 the Air Ministry agreed to a proposal from 40 Group to reduce the number of wings to three: Number 55 Wing with its HQ in the Municipal Buildings at Derby from 9 September 1944; Number 56 Wing with its HQ at RAF Annan and Number 57 Wing with its Headquarters at Molton House at Milton. The previous Wing structure was disbanded with effect from 6 November 1944.<sup>26</sup>

The command and control situation for 42 Group, with its HQ at Burghfield Common near Reading, proved to be more straightforward than that experienced by 40 Group. On the whole, this was due to the smaller number of units which the HQ had to control and administer. Throughout the war years, the number of 42 Group units in the United Kingdom storing and distributing explosives was roughly half the number of units controlled by 40 Group and did not necessitate the introduction of a lower-level wing structure. The supply of fuel, which was direct from commercial depots to units, did not require an intermediate 42 Group depot structure. The growth in work in this respect represented an increase in coordination and administration for the Group HQ staff charged with the responsibility for POL supply. Although Maintenance Command remained part of the RAF's Home Command structure in Britain throughout the war, its 40 and 42 Groups retained professional control for overseas units through the HQs of the overseas command structure.<sup>27</sup> In terms of personnel, 40 Group grew to be a sizable organization and by the end of 1944 it was just under 45,000 strong. Of this total, 25,320 or in the region of 56 per cent were civilians. The balance of Servicemen and civilians throughout the units was quite interesting. Of its forty-seven units at the time, seventeen were purely Service manned, whereas only five depots were purely civilian manned, albeit they were largely managed and always commanded by uniformed officers. The lion's share of manpower at this time was at the seven AEDs

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<sup>25</sup> Air Ministry, *Maintenance*, p.136.

<sup>26</sup> *Ibid*, p.149. Broadly speaking, 55, 56 and 57 Wings covered the geographical areas of the Midlands, Northern England & Scotland and Southern England (including the South East and South West) respectively.

<sup>27</sup> The overseas command structure was complex and evolved as the emphasis on the different theatres of war changed. In September 1939 the structure consisted of: RAF Middle East; RAF in Palestine & Transjordan; British Forces in Iraq; British Forces in Aden; RAF Mediterranean; Air Forces in India and RAF Far East. By January 1945 the structure was based on two main groupings: Mediterranean Air Forces and Air Command South East Asia. Richards, *Royal Air Force 1939-1945, Volume 1*, Appendix III and Hilary St G Saunders, *Royal Air Force 1939-1945, Volume III – The Fight is Won* (London: HMSO, 1954), Appendix IV refer.

which, between them, employed 27,757 people or some 62 per cent of the Group's total strength. On the cessation of hostilities in 1945, the number of 40 Group MUs and sub-units had risen from twelve on its formation to 159 and were operated by 72,400 officers, airmen and WAAFs and 48,650 civilians, male and female.

The Group's reliance on civilian employees was equally pronounced at the AEDs and across the seven MUs ran at about the same level, give or take a few per cent, as it did across the Group as a whole. However, whilst 3, 7, 14, 25 and 35 MUs were largely civilian manned, 16 and 61 MU were predominantly Service manned; in the case of 16MU Stafford, there were only twenty-five civilians out of a total unit strength of 4,688 people. It is not clear why the latter policy was pursued although post-war it is believed it was due to a combination of needing a pool of uniformed Suppliers in this country on which to be able to draw for manning overseas depots and to ameliorate the unlikely, but possible, threat of Civil Service strike action.

## **Recruitment**

Recruitment was fundamental to maintaining the required numbers of personnel in the logistics' discipline throughout the war years. The literature provides little comment on recruitment during the 1920s and 1930s. However, the financial controls on the size of the Service and the fact that a career in the military, especially against the backdrop of the United Kingdom's recession and stagnation in the 1920s and the depression of the early 1930s with unemployment running at three million, would have made the military a very attractive proposition; this suggests that the manning levels would not have been difficult to maintain. One of the RAF's recruitment pamphlets available for the general public in 1919, capitalized on this economic backdrop with the enticing title of 'Are you satisfied? If not - why not try the Royal Air Force!' Having caught the attention of a potential recruit, the pamphlet wasted little time in highlighting the downside of civilian life:

...there are other things just now which are not too pleasant for the civilian. Houses are very scarce and rents are high. Food is dear. Clothes cost more than double than they did before the war. Travelling is expensive. These conditions will probably last for some years.<sup>28</sup>

The RAF's authorized manpower (not actual strength) during the period from 1920 up to 1935 remained predictably stable. For officers below air rank, the total fluctuated by only a few hundred either side of 3,300, whilst for airmen the total was in the region of 24,000 (plus or minus 3,500 from 1920 to 1928 and then dropping markedly to 19,000 (up to a maximum plus of 432) from 1929 to 1935.<sup>29</sup> Broadly speaking, this position reflects the challenges brought about by the Government's Ten Year Rule. The Expansion Programmes from 1934 onwards saw the size of the Service increase substantially. At the outbreak of war in September 1939, the strength of the RAF was 115,200 officers and men, along with 58,100 reservists and auxiliaries who were immediately available. Additionally, there were also 1,734 WAAFs who had been mobilised on 28 August 1939.<sup>30</sup> The manpower situation immediately after the outbreak of war remained healthy, a point made by the Air Ministry in its narrative on manning:

There was an abundance of volunteers for the Royal Air Force and the Women's Auxiliary Air Force immediately after the outbreak of war, and large numbers of men and women were enlisted or enrolled even though, for the majority, no training facilities were immediately available.<sup>31</sup>

Notwithstanding this comfortable position, the RAF resumed recruiting on 28 September 1939 with a view to building up a pool of people from which it could draw. Following a medical examination and interview, accepted candidates were attested into the Service but were returned to their civilian occupation until they were required. This process was known as the RAF Deferred Lists and was maintained throughout the war providing a 'valuable pool of men available for absorption into the Service as and when they were required'<sup>32</sup>; for ground trades, the size of this list reached a peak of approximately 63,000 in March 1941, progressively reducing to the low

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28 RAF LHCA, Box 8 (Supply/Logistics Trade), Recruitment Pamphlet 'Are You Satisfied' dated August 1919.

29 John James, *The Paladins*, Table 7, p.247. These figures do not include those serving in India as these were paid for separately by the Government of India.

30 Air Ministry, *Manning Plans and Policy*, p.47.

31 Air Ministry, *Manning Plans and Policy*, p.47.

32 Ibid, p.47.

hundreds in 1945.<sup>33</sup> Irrespective of the encouraging numbers of volunteers, the British Government introduced the National Service (Armed Forces) Act on 3 September 1939 which imposed a liability for military service on all male British subjects aged between eighteen and forty one who were normally living in the United Kingdom; the introduction of the National Service (No.2) Act in December 1941 extended the liability to persons of either sex, for the Armed Forces, Civil Defence or in industry, with the upper age limit being extended to fifty one.<sup>34</sup>

As far as the logistics' discipline was concerned, it had long since been recognized that there was merit in recruiting individuals with civilian experience in business or stores' work. For officers entering the Equipment Branch on Permanent Commissions this was an explicit requirement in the official conditions of entry:

They must have had not less than five years' business or industrial experience in the employment of one or more companies or firms of standing.<sup>35</sup>

The requirements for officers entering on Short Service Commissions was similar but without a minimum time period of experience, requiring them:

...to possess sufficient business or industrial experience to render them suitable for the equipment branch.<sup>36</sup>

In this era of pre-Automatic Data Processing in logistics, there was little to differentiate between the civilian and military practices of store keeping and stock control except, perhaps, the scale of operation and the nature of the equipment and stores which were handled. It therefore made sense to populate the Branch and Trade with people who were both familiar with and comfortable working within this environment. The paucity of detailed Equipment Branch officer data precludes any specific analysis regarding recruitment and only broad-brush deductions can be made from the overview at Appendix 1. This

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<sup>33</sup> Ibid, Appendix 15.

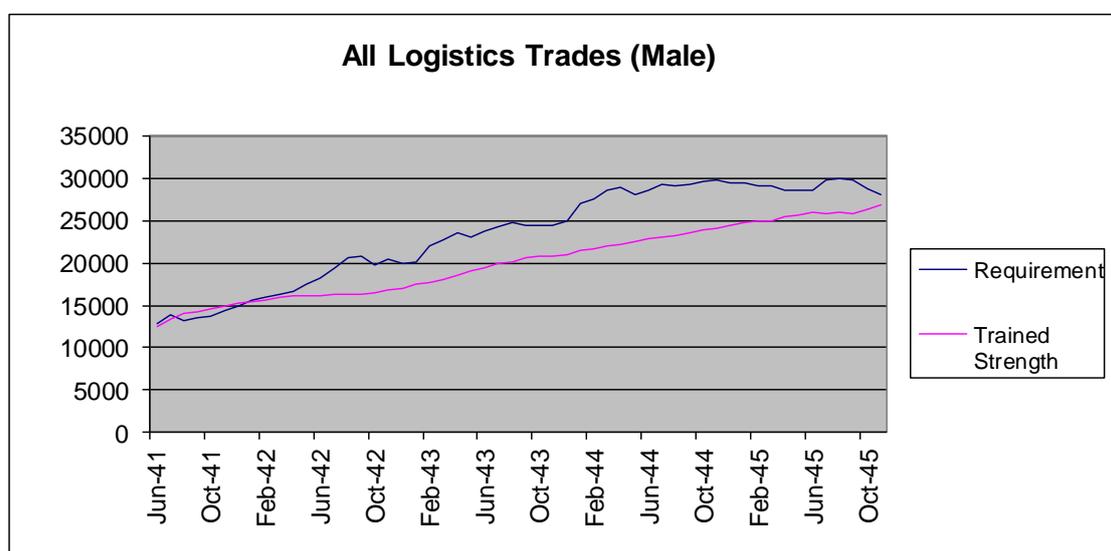
<sup>34</sup> Ibid, p.48 and 59.

<sup>35</sup> TNA, AIR 2/3090, A.M. Pamphlet 17 (11th Edition) dated March 1938 – Conditions of Entry and Service in the Equipment Branch of the Royal Air Force on a Permanent Commission, p.2, Paragraph 2(iii). The five year business or industrial experience requirement was also specified for those entering the Equipment Branch of the RAFVR (RAF Yearbook 19 38, p.79 refers).

<sup>36</sup> TNA, AIR 72/23, Air Ministry Order A.59 – Short Service Officers (Equipment Branch) – Conditions of Service (774577/38.) dated 9 March 1939.

shows that recruiting operations never managed to meet the Branch requirement, albeit that from January 1942 onwards Equipment Officers drawn from the WAAF, Dominions and Allied/Foreign sources began to mitigate this shortfall although not in any sizeable numbers.

As far as the recruitment of airmen for all five of the logistics' trades introduced by the end of 1943 was concerned, recruitment proceeded reasonably well until early 1942 when the trained strength started to fall considerably short of the requirement figure<sup>37</sup>; this shortfall fluctuated from there on but the gap between the two was never closed before the end of the War in September 1945. This overall position for males is shown in graphical form in Figure 4.



**Figure 4 -  
Comparison of Overall Trained Strength against Requirement - All Logistics Trades  
(Male) June 1941 to October 1945<sup>38</sup>**

Whilst each of the trades had their own periods of difficulty in terms of trained strength against requirement, the most notable problem was experienced by the trade of Equipment Assistant which failed to meet its requirement figure from June 1941 and then by a significant amount from May 1942 onwards. It is likely that this shortfall was largely as a result of the manpower shortages which were being experienced at this time. The RAF's overall manpower requirement for the first two years of war had been estimated

<sup>37</sup> Trained strength and requirement data for the two trades introduced in 1945 (Clerk (Movement Control) and Air Movement Assistant) are not available in the RAFM, IWM or TNA.

<sup>38</sup> Source: This thesis, Appendix 2.

as 219,000 in November 1939. By the beginning of 1941, this estimate had risen substantially and the RAF's Director of Manning had revised this to a total requirement of 750,000 men and 50,000 women by 1 January 1942. To meet this target, the Director estimated he required an additional 273,000 men in ground appointments.<sup>39</sup> This growth, however, attracted the attention of the Prime Minister who 'declared that the ratio of ground services to first line air strength was deplorable and getting worse every day'.<sup>40</sup> Consequently, the requirement for ground personnel was reduced by 66,000 men to 207,000, but the total for women was increased by 47,000 to a new total of 97,000.<sup>41</sup> The priority was for technical trades as these directly contributed to maintaining aircraft availability. It was not surprising, therefore, that the Equipment Trades struggled to recruit sufficient numbers at this time. The over-recruitment of WAAF Equipment Assistants from March 1942 through until August 1945, coupled with the contribution from the Dominions and Allied nations, enabled the shortfall of male Equipment Assistants to be reduced by varying amounts per calendar month from just 5 per cent in June 1942 to a maximum of 70 per cent in March 1945 (see Appendix 4).

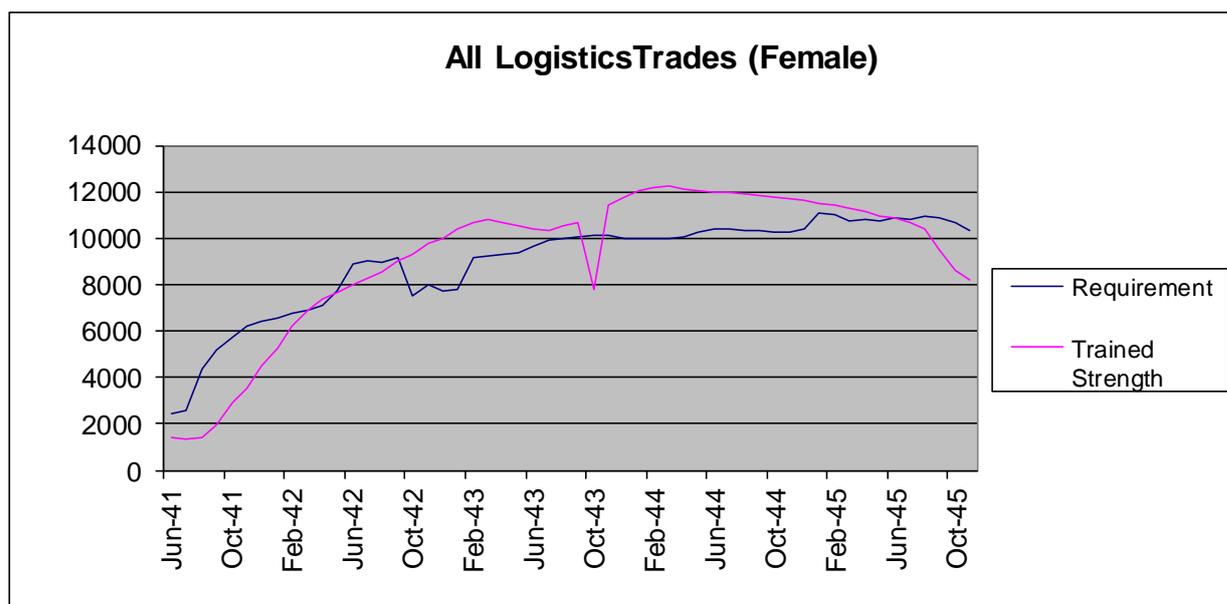
Turning to the overall position for airwomen, the comparative picture for its five logistic trades is quite different. Up until early 1942, the trained strength fell short of the requirement but, by the autumn of that year, the position had reversed with the trained strength well above the requirement through until June 1945. This overall position for females is shown in graphical form in Figure 5.

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<sup>39</sup> Air Ministry, *Manning Plans and Policy*, pp.54-55.

<sup>40</sup> *Ibid.*, p.55.

<sup>41</sup> *Ibid.*



**Figure 5 -  
Comparison of Overall Trained Strength against Requirement - All Logistics Trades  
(Female) June 1941 to October 1945<sup>42</sup>**

The comparative graphs for each of the five logistics trades (male and female) are at Appendix Five.

In early 1945, the attention of the RAF's manpower planners began to shift to the preparation for the continuing war against Japan and the assembly of what was known as Tiger Force. The requirement here was essentially a re-balancing of where manpower was employed to meet specific requirements; overall, it was estimated that it would be necessary to re-muster some 96,000 airmen to maintenance and ancillary trades, with additional training where needed – over 30,000 were drawn from surplus airmen in other trades. Of the eight Trades identified which required re-enforcement, some 1,000 extra Equipment Assistants were required.<sup>43</sup> One of the main sources of manpower to meet this shortfall came from operational tour expired aircrew and aircrew cadets who were temporarily detached from employment to a number of ground trades including Equipment Assistants.<sup>44</sup> The numbers from these sources were reasonably sizeable. In January 1945 there were 635, dropping to 498 in February before rising to a peak of 798 in March. From thereafter, the aircrew population amongst the ranks of Equipment Assistants reduced to an average

<sup>42</sup> Source: This thesis, Appendix 2.

<sup>43</sup> Air Ministry, *Manning Plans and Policy*, Chapter 8, p.195.

<sup>44</sup> TNA, AIR 72/29, AMOs 1945: Order A.552/45, Selection of Redundant Air Crew personnel and Air Crew Trainees and their Re-allocation to Ground Employment.

of 240 per month from June to September 1945 by which time, with the dropping of the atomic bombs on Japan in early August, there was no longer a requirement for a wholesale invasion of Japan and RAF manpower numbers for the Far East were significantly reduced. Tour expired aircrew (but not aircrew cadets) were also used to reinforce the ranks of the Embarkation Assistants over a similar timescale rising from 19 in January to an average of 86 per month from April to September 1945. Much smaller numbers were also used to bolster the trades of Clerk GD Movements Control and Clerk, Provisioning.<sup>45</sup> The detailed breakdown of operational expired aircrew and aircrew cadets re-employed in logistics trades from January 1945 to September 1945 is shown in Appendix Six.

## Training

### Officers

The first formal training in logistics began in August 1917 at a dedicated school established near Reading and designated No 1 Equipment Officers School of Instruction. By October 1917 the School had moved to Henley-on-Thames and was running an eight-week course. Students spent the first two weeks on stores' aspects and then six weeks to ensure that they were acquainted with 'technical terms to give them elementary knowledge of engines, aeroplanes and MT'.<sup>46</sup> With the formation of the RAF Stores Branch in 1920, there was a clear need for a dedicated, logistics-focused course for the new discipline. In the immediate aftermath of the First World War it had become evident that there was a need to improve storekeeping and accounting standards, if anything, to formalise many of the temporary procedures which had evolved during the war years.<sup>47</sup> As a result, a course to train the first instructors was held from December 1920 until February 1921 at No 4 Stores Depot (SD) Ruislip with the students (two officers, two Sergeant Majors (SM) 1s, two SM2s and two Flight Sergeants) then forming the cadre of instructors for

<sup>45</sup> TNA, AIR 22/316, Comparative Statements of Establishments and Strength R.A.F. Personnel June 1944 – January 1946 - Stats:

M2.(b)/R.S.A./19. Establishments and Strength (January to September 1945), Appendix IV, Tour Expired Aircrew and Aircrew Cadets Employed in Maintenance and Ancillary Trades.

<sup>46</sup> TNA, AIR 1/15/15/1/63, New Syllabus – EOs, School of Instruction, 4/6/18 – 8/11/18.

<sup>47</sup> TNA, AIR 29/711/17832, Equipment Training School (Airmen) formerly School of Store Accounting and Store-keeping: Operations Record Book (RAF Form 540).

future courses.<sup>48</sup> The inaugural course for Stores Officers also commenced at Ruislip in February 1921.

The number of courses grew steadily to the extent that larger accommodation was required, a situation which saw the School moved to No 1 SD Kidbrooke in October 1922. By September 1925 the School had become a self-contained unit and was known as the School of Stores Accounting and Storekeeping; at this stage, the School was responsible for the training both of officers and airmen.<sup>49</sup> The continual growth of the unit yet again led to space becoming a premium and the School relocated to RAF Cranwell on 1 December 1932, occupying a former annexe of the Sergeants' Mess on West Camp which had been converted into classrooms and offices. The move to Cranwell did not yield all of the additional space required and the officers' course was moved back to Kidbrooke as a detachment from Cranwell and renamed the Equipment Training School (Officers) in November 1938; the school became responsible for a detachment at RAF Halton which had been formed a little earlier in September 1938<sup>50</sup> and also one at RAF Henlow which had opened in January 1931 to train officers commissioned from the rank of warrant officer under Air Ministry Weekly Order 429/30.<sup>51</sup> The courses for officers appointed from civilian life (from January 1933) were twenty-six weeks in duration whereas the course for former warrant officers was reduced to thirteen weeks.<sup>52</sup> The inter-war period also saw the development of the Branch's first professional qualification with the creation of the explosives specialisation in February 1927. The names of officers so qualified were prefixed by a bold letter 'X' in the Air Force List and were defined as '.....qualified to take charge of magazines and explosives'.<sup>53</sup>

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48 Ibid. The ranks of Sergeant Major 1 and 2 were abolished in January 1933 and replaced by the single rank of Warrant Officer – W. Spencer, *Air Force Records* (Second Edition) (Kew: The National Archives, 2008), pp.147-148 refers.

49 TNA, AIR 29/711/17832, Equipment Training School (Airmen) formerly School of Store Accounting and Store-keeping: Operations Record Book (RAF Form 540).

50 TNA, AIR 29/712, Equipment Officers' School, Grange over Sands and Stannington (UK), formerly Equipment Training (Officers), Kidbrooke and Little Rissington (UK) 1938 Nov-1944 Dec.

51 TNA, AIR 29/711/17832, Equipment Training School (Airmen) formerly School of Store Accounting and Store-keeping: Operations Record Book (RAF Form 540).

52 TNA, AIR 72/13, AMWOs 1930: Order 795 – Programme of Instructional Courses for Officers, Airman Pilots and Air Gunners (39090/30) dated 4th December 1930.

53 TNA, AIR 72/9, AMWOs1927: Order 2 – Qualification of Officers – Symbols in the Air Force List (707260/260 dated 6 January 1927 and RAFC Library, *The Monthly Air Force List February 1927* (London, 1927), Column 4.

By January 1939 the Expansion Programme had generated a number of appointments at various units which were required to be filled urgently; this led to a number of trainee officers being posted prematurely before the end of their course. Consequently, and from May 1939, the course syllabus was revised and shortened from twenty-six to approximately sixteen weeks.<sup>54</sup> Despite this curtailment of training there is no evidence that it affected performance. A lack of space continued to be a recurring theme, this time with the space at Kidbrooke being required for Balloon Command. Thus, the School moved yet again during August 1939 to the first of two very short-lived locations in premises vacated by No 6 Flying Training School at RAF Little Rissington.<sup>55</sup> Six months later in February 1940, the School moved to Loughborough, this time into premises which permitted the detachment at RAF Halton to be closed.<sup>56</sup> Barely four months later the School relocated to Grange-Over-Sands where it remained until March 1944. Thereafter, it moved to Stannington (April to November 1944), Kirkham (December 1944 to July 1945) where it reverted to the title of Equipment Officers Course and became part of the RAF School of Administrative Trades on 13 December 1944. Its final wartime move was to RAF Bicester in August 1945.<sup>57</sup>

### **Airmen and Airwomen**

Whilst professional training for airmen of the logistics trades experienced nowhere near the number of location moves as officer training, it was more complex due to the number of specialist trades which were introduced between 1918 and 1945. Initially, the training of airmen was carried out alongside officers by the School of Stores Accounting and Store Keeping, firstly at No 4 SD Ruislip with the first courses for Storekeepers and Clerks (Stores) commencing in February 1921. As previously described, the School moved to Kidbrooke in October 1922 and then to RAF Cranwell in December 1932. In December 1936, and as a result of the term Equipment being introduced following the

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<sup>54</sup> TNA, AIR 29/712, Equipment Officers' School, Grange over Sands and Stannington (UK), formerly Equipment Training (Officers), Kidbrooke and Little Rissington (UK) 1938 Nov-1944 Dec: Entry for 27 Mar 1939 and 3 April 1939.

<sup>55</sup> Ibid.

<sup>56</sup> Ibid, Appendix A (Postagram TC/42225/39/Org.1) dated 29 February 1940 refers.

<sup>57</sup> TNA, AIR 29/712, Equipment Officers' School, Grange over Sands and Stannington (UK), formerly Equipment Training (Officers), Kidbrooke and Little Rissington (UK) 1938 Nov-1944 Dec; AIR 29/1122, RAF School of Administration, Gerrards Cross, Loughborough and Stannington 1937-1945 and AIR 29/1070, No 246 MU Bicester Jan – Dec 1945.

renaming of the officers' Stores Branch, the airmen training element of the School was renamed to Equipment Training School (Airmen) (ETS (Airmen)).

Although much of the training required airmen to thoroughly understand equipment accounting practices (especially the processing of a myriad of paper vouchers for receiving and issuing equipment), efforts were made to introduce more imaginative methods of learning. In the period up to the outbreak of war in 1939, there were four innovations which contributed in this respect. Firstly, and perhaps the most imaginative, was the creation of a 'model' storehouse in early 1923 where airmen could practise what they had learned in a simulated environment. The second innovation, introduced in 1930, was the voucher pack-up, a set of forms and vouchers used for the logistics' process, with type-written user instructions on the reverse of each; this proved to be particularly popular and provided a useful aide memoire for airmen to use when they left the School and joined their first RAF unit. The third initiative and one which was particularly welcomed by both staff and students, was the introduction of a bound volume of printed course notes in 1931; prior to this, notes had been dictated by instructors for students to transcribe into their notebooks - a simple change, but one which freed up time and permitted more time to be allocated to other subjects on the syllabus. The fourth innovation came about following the move of the School to RAF Cranwell in 1933 with the unit having access to typical RAF unit stores facilities, rather than the stores depot environment which it had experienced at Kidbrooke. Essentially, the course length was increased to four months in duration and this enabled students to work for two months of the course in Kidbrooke's main stores complex and each flight of one of the flying squadrons, in groups of four to five; they moved between different sections each week. This provided valuable 'work experience' along with the model storehouse.<sup>58</sup> The degree to which these initiatives were forward-thinking is evidenced by the fact that the model storehouse, the voucher pack-up and pre-printed course notes were still in use in 2016 by the RAF's Supply and Movements Training Wing (the twenty-first century equivalent of the School) at RAF Halton. Data in the operational record book for specific courses is quite patchy for the pre-war period but, in the period up to the end of August 1929, the School had trained 1,426 Storekeepers and 680 Clerks SA. During the

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<sup>58</sup> TNA, AIR 29/711, Equipment Training School (Airmen) formerly School of Store Accounting and Store-keeping: Operations Record Book (RAF Form 540).

same period, 271 Storekeepers and 183 Clerks SA failed the course, a failure rate of 19 per cent and 27 per cent respectively.

By the time the School had moved to RAF Cranwell, 1,843 Storekeepers and 760 Clerks (SA) had entered training since the first course was held in 1921.<sup>59</sup> The ETS (Airmen) remained at RAF Cranwell following the departure of the ETS (Officers) in April 1936. By 1941 it was becoming clear that accommodation was much in demand at Cranwell, particularly in light of the fact that the radio school was planned to be opened there in the very near future. Consequently, the ETS (Airmen) relocated to the coastal town of Bridlington in May/June 1941 where a new school complex was opened to train both airmen and airwomen (WAAF Equipment Assistants up to this date had been trained at RAF Melksham due to accommodation limitations at Cranwell).<sup>60</sup>

As with many wartime requirements, extensive use was made of existing buildings with many facilities requisitioned for the duration of the war. Seaside locations were especially suitable for billeting large numbers of trainees due to the large number of hotels and guest houses. This is well illustrated by the set-up at Bridlington where the School itself was dispersed across the town in various buildings with the Headquarters in the Alexandra Hotel. The airmen and airwomen were billeted in different houses round the Trinity Road area and took their meals on the sea front in what is now the Cottage Grill Restaurant. Most of the equipment training classes were taken in the Grand Pavilion, now the new Leisure World complex, although men and women were segregated.<sup>61</sup> The sizeable volumes of both men and women entering the School by this time led to the creation of two separate training wings respectively within the School in September 1941, primarily for the administration requirements of each; the course data for RAF and WAAF students entering the School between March 1941 and March 1944 is detailed at Appendix Seven and Eight respectively.

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59 TNA, AIR 29/711/17832, Equipment Training School (Airmen) formerly School of Store Accounting and Store-keeping: Operations Record Book (RAF Form 540).

60 RAF LHCA, Box 10 (Training): MOD(AHB), Annex A to D/AHB(RAF)8/35 – RAF Identity within Future Defence Training Schools dated 9 May 2002.

61 RAF LHCA Box 10 (Training), Correspondence with the Hon. Sec, Bridlington & District Branch Royal Air Forces Association dated 13th January 1989.

The downside to locating to an east coast position was that it brought the School in much closer proximity to the hazards and disruption resulting from enemy air raids on Britain. Indeed, during the period December 1941 to May 1942 (a period for which more detailed figures were kept) some 5,423 training man hours were lost due to air raid alerts along with considerable damage to some of the buildings used by the School in Bridlington, especially following the enemy air raids on the town on 18 June and 16 July 1941.<sup>62</sup> The School remained at Bridlington until August 1942 when accommodation demands necessitated a move to RAF Kirkham as an interim move before relocation to Eastbourne in December 1942. A move to the south east of Britain proved to be even more disruptive and, as it turned out, more tragic than Bridlington in terms of the effects of enemy air raids. Between December 1942 and July 1943, some 9,629 training man hours were lost due to enemy air raids with six trainee Equipment Assistants being killed in raids between 15 January and 1 April 1943.<sup>63</sup> The School's final wartime move was to Weston-Super-Mare in the south west of the country in July 1943, a considerably safer location where the risk from air raids had virtually disappeared, following the two heavy Baedeker raids on the town in 1942.

The training of clerks was initially carried out within the School of Stores Accounting and Store Keeping but, as part of the division of responsibility between the Stores and accountant organisations, the training responsibility transferred to the School of Clerks Accounting at Lympne in October 1931. This school also experienced a series of moves: RAF Cranwell in May 1939, Penarth in June 1941 and Kirkham in June 1944, by which time it had been renamed the School of Administrative Trades. The School also took on the training responsibility for Clerks (Provisioning), Clerks (GD)(Movement Control) and Embarkation Assistants.

The training in air movements was conducted separately. In the early days of air movements, training for the task was done very much 'on-the-job'; however, by early 1944, it became clear that this needed to be formalized. In September 1944, the Deputy Senior Air Staff Officer at HQ Transport Command

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62 TNA, AIR 29/711/17832, Equipment Training School (Airmen) formerly School of Store Accounting and Store-keeping: Operations Record Book (RAF Form 540).

63 Ibid.

(Air Commodore Brackley) convened a conference at which it was decided that a specialist school needed to be formed. This was subsequently agreed and in November 1944, the Transport Command Traffic Control School was established at RAF St Mawgan in Cornwall.<sup>64</sup> Such was the estimated size of the training task that it was agreed that only officers and SNCOs would initially be trained by the School and that these would provide 'on-the-job' training for airmen, to the School's standards, out at units. Based on the estimate that the RAF would be manning some 200 staging posts worldwide, it was estimated that as many as 600 officers and 1,200 SNCOs would need training in the first year alone. The course was of five weeks duration – three of these were spent at the School, one week at RAF stations and one week with the British Overseas Airways Corporation Traffic School at Croydon. The throughput in the early days was considerable with a planned intake of thirty officers and sixty Senior NCOs every three weeks up to a ceiling of 1,800 personnel. In November 1945, the School moved to RAF Bramcote by which time thirteen courses had been completed with 643 officers and 480 SNCOs having successfully completed training. The facilities at Bramcote proved to be far superior to their previous home with mock-up aircraft fuselages housed in a hangar close to the instructional block.<sup>65</sup> The school took on the responsibility for training Clerks (Movement Control) and Air Movement Assistants when these trades were introduced in 1945.

There is little in the operational record books of the various training schools to provide any detailed analysis of just how effective the various courses were in preparing personnel for productive service on RAF units. It is clear that courses were not purely 'attendance only' and failures of students in training do appear quite regularly in the course summaries of airmen in particular; this would suggest that there was intent to achieve a set level of quality notwithstanding the pressure to provide trained personnel for the Service, especially during the periods of manpower shortage. Moreover, the operational record books for both the Officers' and Airmen's' Equipment Training Schools contain a number of examples of revisions to course syllabi to

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64 RAF LHCA Box 10 (Training), MOD(AHB), D/AHB(RAF)8/35 – RAF Identity within Future Defence Training Schools dated 9 May 2002 and TNA, AIR 29/1130, No.1 Air Traffic School, St Mawgan.

65 TNA, AIR 29/1130, No. 1 Air Traffic School, St Mawgan.

reflect changes in training need through policy changes or new procedures.<sup>66</sup> Additionally, the provision of refresher training, especially for officers and SNCOs returning from overseas postings, also suggests that considerable effort was made to keep personnel as up to date on home procedures as possible.<sup>67</sup>

The absence of any adverse comment does not necessarily suggest that there were not issues with training being fit for purpose but it seems more likely that deficiencies in branch or trade competency were more likely to be a result of inexperience or personal qualities. The training course data for RAF and WAAF Equipment Assistants for the three year period from March 1941 and March 1944 shows that the examination pass rate for both males and females was largely the same, although training wastage for men (i.e. those individuals not suitable for employment in the trade and either discharged or re-mustered to another RAF/WAAF trade) was roughly twice the amount for women (see Table 15).

	Period	Total Intake	Total Training Wastage	% Training Wastage	Examination Pass Rate
RAF	Mar 1941 – Mar 1944	12260	1550	13%	89%
WAAF	Jun 1941 – Mar 1944	9942	559	6%	90%

**Table 15 -  
Training Data for Airmen and Airwomen Equipment Assistants  
March 1941 to March 1944<sup>68</sup>**

Archival sources do not appear to comment on why there was this difference although the official history does comment that in trade training WAAFs were '...more conscientious, inveterate note-takers, and prone to worry unduly over progress'.<sup>69</sup> The point about women being more conscientious is also made by some WAAF veterans interviewed by the historian Penny Summerfield for her book *Reconstructing Women's Wartime Lives*.<sup>70</sup> The total training wastage figures in Table 15 would appear to corroborate these views. Summerfield also makes the point that for many women, their roles were probably the '...summit of a woman's wartime ambition' whilst, in contrast many

<sup>66</sup> TNA, Air 29/711, ORB – Equipment Training (Airmen) & Equipment India and Air 29/712, ORB – Equipment Officers' School 1938-1944.

<sup>67</sup> TNA, AIR 72/28 - AMOS 1944: Order A.99 – Equipment Training – Officers and Senior N.C.Os Returning from Overseas Commands (A.519147/43/T.Admin – 10.2.44) dated 10 February 1944.

<sup>68</sup> Source: This thesis, Appendix 7 and 8.

<sup>69</sup> Air Ministry, *The Women's Auxiliary Air Force*, p.68.

<sup>70</sup> P.Summerfield, *Reconstructing Women's Wartime Lives – Discourse and Subjectivity in Oral Histories of the Second World War* (Manchester: Manchester University Press, 1998), p.124.

men were ‘...pining for a war job which would bring him closer to the wartime masculine ideal’.<sup>71</sup> Given the largely administrative nature of much of the logistics task, this view could go some way to explaining why men in logistics training were not so conscientious (or enthusiastic) as women.

## **Conclusion**

The DofE remained the Air Ministry’s controlling authority for the majority of RAF logistics from the end of the First World War, through to the end of the Second World War. During this time, it underwent a number of increases in personnel, although most of the changes until 1934 were relatively minor and mainly as a result of the on-going process to rationalize responsibility for logistics within the Air Ministry itself. From 1934, however, the Expansion Schemes started to rapidly increase the overall size and extent of the RAF’s inventory; the substantial in-flow of materiel all required careful control, not least of which was the requirement for accurate forecasting and the placement of contracts with industry. This all led to a substantial increase in workload and required a proportional and significant increase in DofE’s personnel. Notwithstanding carefully written justifications, manpower increase was by no means a foregone conclusion and it is clear from archival sources that all requests for change to the authorised personnel establishment were subject to close Treasury scrutiny, and often challenged, before approval was granted.

The day-to-day operational management of the RAF’s supply chain rested with Maintenance Command and this too underwent a number of changes to its organization. The Command’s main challenge, especially within 40 Group, was retaining control of its increasing number of units and this appeared to be satisfactorily addressed by the introduction of the UEW concept in June 1941. The question of control was not so pronounced for 42 Group although it did see a sizeable increase in the number of personnel which it required to man the explosives depots. A key point which stands out for Maintenance Command was its reliance on civilian employees. For 40 Group alone, the number of civilians amounted to some 40 per cent of the Group’s total manpower numbers.

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<sup>71</sup> Ibid, p.124.

A challenge presented by the growth of the RAF logistics organization was the process of acquiring the personnel or recruitment. On the whole this, appears to have initially met the needs of the RAF and its logistics organization in the early stages of the war although, as the overall numbers of personnel required began to increase significantly, logistics struggled to meet the numbers of officers and airmen required. In this respect, the WAAF made a greater numerical contribution than has been credited. A key part of the recruitment process was training, a requirement which was met by the establishment of a number of specialist training schools; these experienced considerable turbulence in terms of their geographical locations throughout the war, mainly as a result of the substantial accommodation requirements required for the wider RAF within the United Kingdom. One notable point about recruitment is that RAF logistics capitalized on the availability of suitable commercial expertise. Indeed, entrance requirements show that the Service made as much use as it could from similar occupations in civilian organizations, a factor which was particularly welcome at the various training schools. Indeed, using people with previous experience helped, since it was only necessary in many cases to 'militarize' civilians rather than train them in a totally new profession.

## Chapter Five: The Lifeblood of Air Power - Acquiring the Resources

### Introduction

As highlighted in Chapter One, military aviation, even from its earliest days, was a particularly resource-hungry discipline. In addition to the component spare parts required to support its aircraft, the RAF also needed an extensive range of ground support equipment and motor transport, all of which required spares for maintenance. The RAF's people, in addition to health care and food services, also required a wide range of basic and specialist military clothing, along with furnishings for technical and domestic accommodation. The provisioning of these domestic supplies attract little comment in the archival sources and appear, on the whole, to have caused no significant problems apart from the need for substantial storage space; this issue is covered in more detail in Chapter Six.

This chapter focuses on two key areas which proved problematical throughout the war years and required significant management time and effort to ensure adequate supply – spares support for British aircraft and for aircraft sourced from the United States. The provisioning of equipment and spares became an increasing and ever more complex task as the range and numbers of aircraft and related equipment grew, from the beginning of the Expansion Programme, right through until the end of the war. Much of this was influenced by the number of new aircraft designs ordered into production in Britain which, from September 1930 through until January 1945, amounted to fifty-one, and by the scale of output, which resulted in a total of 131,500 aircraft being produced in Britain from 1940 to 1944.<sup>1</sup> The challenge which this presented to RAF logistics was not the overall magnitude but the diversity, a point highlighted by Erik Lund who commented that 'If the British aviation industry did fail the "audit

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<sup>1</sup> E.Lund, 'The Industrial History of Strategy: Reevaluating the Wartime Record of the British Aviation Industry in Comparative Perspective, 1919-1945', *The Journal of Military History* 62 (January 1998), 75-99 (p.99).

of war”, as Correlli Barnett has asserted, it did so because its production was too low, primarily due to an excessive number of types in production’.<sup>2</sup>

Provisioning for this substantial requirement was mainly the responsibility of the Air Ministry’s Directorate of Equipment (DofE) and RAF Maintenance Command. This largely centralised provisioning task was made more complex by Prime Minister Winston Churchill’s introduction of the Ministry of Aircraft Production (MAP) in May 1940. Whilst the formation of the Ministry undoubtedly proved to be a saving grace in terms of fighter production during the Battle of Britain, it did lead to an unnecessary adversarial relationship with the Air Ministry which, in time, became more of a hindrance than a help. To set the scene, this chapter illustrates the complexity of the provisioning task, followed by an overview of the principles which underpinned the actual process. It then goes on to examine what could be considered as the ‘heartbeat’ of the whole activity, the Master Provisioning Scheme. The chapter then moves on to examine the aircraft spares shortage problem which hindered the effectiveness of provisioning during 1940 to 1943, the Aircraft-on-Ground priority system, provisioning for POL and explosives and the provisioning of equipment for American aircraft.

### **Provisioning – The Complexity**

By 1938 the Expansion Programme had begun to introduce considerable complexity to the provisioning of RAF equipment, which was largely the responsibility of the DofE within the Air Ministry. The personnel establishment and structure prior to this point was only configured to cope with a maximum of five types of modern aircraft - the Expansion Schemes by 1938 had begun to deliver fifteen new types to RAF and Royal Navy service (See Table 16).

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<sup>2</sup> Barnett’s work - Barnett, *The Audit of War*, p.xii aims to ‘...uncover the causes of Britain’s protracted decline as an industrial country since the Second World War’ and suggests that total war ‘...submits nations to a ruthless audit of resources, talents and failings: human, social, cultural, political and technological no less than military’. His thesis asserts that Britain did not pass this audit and it remained ‘...hidden by the outward façade of victory...’.

Manufacturer	Aircraft Type	Air Ministry Specification	Time In-Service as at 1938	Number of Approved Modifications	Number of Defects Reports Raised	Remarks
Avro	Anson	18/35	1 year	111	306	
Fairey	Battle	P.27/32	10 months	63	63	
Bristol	Blenheim	B. 28/35	1 year	69	127	
Gloster	Gladiator	F 7/30	1 year	39	82	
Handley Page	Harrow	29/35	1 year	75	120	
Hawker	Hurricane	F. 36/34	1 month	30	3	1 squadron only
Saro	London	R.24/31	1 year	56	27	
Miles	Magister	T.40/36	1 year	31	21	
Airspeed	Oxford	T.23/36	4 months	18	11	
Fairey	Seafox	S.11/32	1 year	25	16	Fleet Air Arm
Supermarine	Stranraer	17/35	1 year	11	13	
Fairey	Swordfish	S.15/33	2 years	137	240	Fleet Air Arm
Supermarine	Walrus	2/35	2	90	130	
Vickers	Wellesley	G.4/31	1 year	69	143	
Armstrong Whitworth	Whitley	B. 3/34	1 year	100	53	

**Table 16 -  
New Aircraft which Entered Service during 1936 to 1938<sup>3</sup>**

Of particular note is that, despite the relative 'youth' of this range of aircraft (most had only been in service between one and two years), there was a relatively high number of approved modifications and defect reports had already been raised. The modifications would have required new components to be procured and installed, whilst defect reports invariably related to a faulty component or system which, again, might need replacement.<sup>4</sup> An example of the growing complexity is provided by the DofE E7 Branch in the Air Ministry which was responsible for aircraft armament. The staff of this branch was managing some twenty-eight types of gun turret which were becoming a common feature of the new bomber aircraft being introduced to service such as the Wellington and Manchester (with two and three turrets each respectively), as well as smaller aircraft types such as the Boulton Paul Defiant (with a single turret situated behind the pilot's cockpit).<sup>5</sup> All of these were complex structures with their own hydraulic and electrical systems, in addition to the actual machine gun installations within them. Each of the major components of an aircraft required a schedule of spare parts to be drawn up and maintained, this adding

<sup>3</sup> TNA, AIR 2/3317, Directorate of Equipment Reorganization 1938, Note on Proposed Organisation of the Directorate of Equipment – June 1938, p.2.

<sup>4</sup> Defect reports were the formal method by which engineering tradesmen detailed a problem or failure of a component or system.

<sup>5</sup> TNA, AIR 2/3317, Directorate of Equipment Reorganization 1938, Note on Proposed Organisation of the Directorate of Equipment – June 1938, notes on E7 Branch, p.4.

to the workload of the DofE staff on top of the routine work of procuring equipment and spares for the various types in question. This range of aircraft was but the beginning - of the aircraft purchased under Expansion Scheme 'F', a further twenty new types were still to be delivered (See Table 17).

Manufacturer	Aircraft Type	Air Ministry Specification	First Ordered	Delivered to RAF/RN	Remarks
Fairey	Albacore	S.41/36	1936	Mar 1940	
Bristol	Beaufort	10/36	Aug 1936	Nov 1939	
Bristol	Bombay	C.26/31	Not Known	Nov 1939	
Blackburn	Botha	45/36	Dec 1936	Jul 1939	
Boulton Paul	Defiant	F. 9/35	1937	Dec 1939	
Handley Page	Hampden I	30/36	Aug 1936	Aug 1938	
Hawker	Henley	P.4/34	May 1937	Nov 1938	
Handley Page	Halifax	32/37	Sep 1937	Oct 1939	
Fairey	Fox	7/24	1925	Jun 1926	
Handley Page	Hereford	44/36		1940	Manufactured by Short & Harland, Belfast
Saro	Lerwick	R.1/36	1938	Jul 1939	
Westland	Lysander	A.39/34	Jun 1935	May 1938	
Avro	Manchester	P. 13/36	Sep 1936	Nov 1940	
Miles	Mentor	38/37	1937	Apr 1938	
Fairey	Not Known	P 4/34	Jan 1937	Not Known	
Blackburn	Roc	O. 30/35	Apr 1937	Late 1939	Fleet Air Arm
Blackburn	Skua	O. 27/34	1935	Late 1938	Fleet Air Arm
Supermarine	Spitfire	F.10/35	Jun 1936	1939	Prototype
Short	Sunderland	22/36	Mar 1936	1938	
Vickers	Wellington	29/36	Aug 1936	1938/1939	

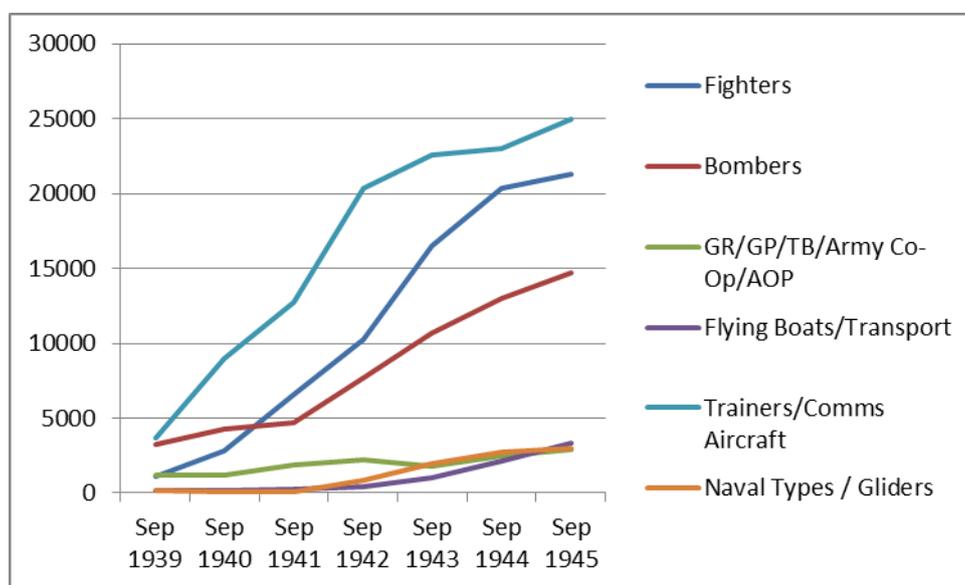
**Table 17 -  
Aircraft Due to Enter Service under Expansion Scheme 'F' (as at June 1938)<sup>6</sup>**

The extent of modifications and defect reports for the aircraft in Table 17 is not recorded but, it is clear from the DofE case to seek approval for additional staff, that a similar situation was expected to the position summarised in Table 16.<sup>7</sup> The situation was further complicated by the fact that this range of aircraft (Tables 16 and 17) came from a supplier-base of some sixteen main manufacturers, each of which would have had their own administrative procedures for ordering against specific contracts. An important point when considering the supplier-base is that each aircraft type manufacturer required the supply of components and assemblies manufactured by other companies;

6 TNA, AIR 2/3317, Directorate of Equipment Reorganization 1938, Note on Proposed Organisation of the Directorate of Equipment – June 1938, notes on E3 Branch, p.2. Data supplemented from: Thetford, *Aircraft of the Royal Air Force*, pp. 406-408 and C. Sinnott, *The RAF and Aircraft Design 1923-1939 – Air Staff Operational Requirements* (London: Cass, 2001). See also: C. S. Sinnott, 'RAF Operational Requirements 1923-1939' (unpublished doctoral thesis, Kings College London, 1998).

7 TNA, AIR 2/3317, Directorate of Equipment Reorganization 1938, Note on Proposed Organisation of the Directorate of Equipment – June 1938, notes on E3 Branch, p.3.

the acquisition of these items was secured via an extensive network of sub-contractors. For many aircraft types this often proved to be complex and involved firms from a wide geographical area. In the case of the Avro Lancaster, for example, there were 125 sub-contractors supplying Avro by the end of 1942, from the north, south, east and west of Britain and Scotland.<sup>8</sup> A further complication was that the rate of production of new types only allowed a gradual replacement of obsolescent types; this led to both old and new aircraft remaining in service concurrently for a considerable period, thus still requiring spares and equipment for both. The position was compounded by the fact that further new types of aircraft would enter service beyond Expansion Scheme 'F'. The number of aircraft in worldwide service with the RAF grew exponentially throughout the war and is illustrated (by generic grouping) in Figure 6.



**Figure 6 -  
World Total of RAF Aircraft September 1939 to September 1945<sup>9</sup>**

A particularly strong theme in the Director of Equipment's case to the Treasury to support further change in 1940 (see Chapter 4) was a number of imperatives relating to the procurement of spares. The first of these was the lead time from placing orders to receipt of the item; in many cases the DofE was finding that equipment was required in-service well before the time it took to have it manufactured, packed and delivered. Of particular note is that for brand

<sup>8</sup> TNA, AVIA 10/269, AVRO Lancaster sub-contractors.

<sup>9</sup> Source data from TNA, AIR 20/2022, Intake of Aircraft. E1 and State Room Statements - RAF Aircraft Strength Returns September 1939 to September 1945.

new aircraft designs there were no stock of spares ready to order at the manufacturers. As a result, much time was spent in hastening orders and speeding up production. On the whole, spares and equipment were delivered direct to the equipment MUs but, in the case of urgently required items, this route was by-passed and deliveries made direct to the demanding unit. Conversely, where there was an urgent need and stock was available at another RAF unit, stock could be re-distributed to another unit with a greater urgency of need (see the section 'Aircraft on Ground Priority System' later in this chapter). It is clear that the Directorate was under increasing pressure to hasten procurement of equipment. Indeed, the Director of Equipment remarked that:

...in war, the presence of the new type of equipment may be the factor which decides whether an aeroplane returns safely from its raid or not, and very great pressure is put upon the supply organization to introduce the new equipment with the least possible delay.<sup>10</sup>

Attention was drawn to the increased range of ancillary equipment such as navigational equipment, cameras, hydraulic and electrical equipment and bomb sights. The issue here was that there were relatively few items which were common to several types of aircraft – a change to one item was likely to affect other items. An example cited was the introduction of new electrical, wireless or hydraulic equipment which were likely to require the provision of a different generator or pump.<sup>11</sup> Lack of standardization was particularly noticeable in the armament range of equipment where no two types of aircraft gun turret were interchangeable and most were made up of several hundred component parts. This situation was not without efforts being made to address the problem and the Air Ministry had been actively engaging with British industry since the end of the First World War, imploring them to use standardized parts as far as possible and to design aircraft and engines so that they could be maintained and handled with a common range of tools and equipment.<sup>12</sup> A further complication to the standardization problem came through the increasing use of American produced aircraft where virtually no part was interchangeable with British produced equipment. The threads of their screws and even their rivets, which were used in great quantities in aircraft

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10 AIR 2/4236, Proposed Re-organization of the Directorate of Equipment – 1939, DoE to Treasury dated 15 February 1940, Paragraph 5.

11 Ibid, Proposed Re-organization of the Directorate of Equipment – 1939, DoE to Treasury dated 15 February 1940, Paragraph 6.

12 Ibid, Proposed Re-organization of the Directorate of Equipment – 1939, DoE to Treasury dated 15 February 1940, Paragraph 11.

production, were completely different.<sup>13</sup> The Americans also struggled with a lack of uniformity in identifying items which led to many identical items being held under different part numbers, something further exacerbated by US manufacturers regularly changing part numbers. Surprisingly, it was not until 1945 that the US Army Air Corps was able to put in place ‘...a uniform and accurate method of numbering spare parts’.<sup>14</sup> The RAF’s problem was never satisfactorily resolved and remained a significant complication in most aspects of aircraft spares’ procurement throughout the war. It is not clear from primary or secondary sources why there was little progress towards standardization, but two of the official histories suggest that what was known as the ‘doctrine of quality’ might have been a contributory factor. It is clear that the pursuit of quality in aircraft design was a goal of both the Air Ministry and MAP and this invariably led to frequent changes in design specifications and modifications; this led to the introduction of many new components, not previously used in other designs. Additionally, with a growing number of aircraft manufacturers, each seeking to win Air Ministry contracts and to get successful designs into service as quickly as possible, it could be argued that there was little incentive for collaboration between manufacturers. With an eye on winning a contract, companies were probably less inclined to worry about the wider benefits of common components and tooling.<sup>15</sup>

### **Provisioning – The Principles**

Provisioning was at the heart of RAF logistics and was vital to ensuring that the right equipment or supplies were available when required for use. This significance was quite clearly acknowledged by the Air Ministry in 1938 when defining the division of responsibilities between the Directorate of Equipment and Maintenance Command, highlighting that ‘Provisioning consists of the forecasting of requirements and their fulfilment at the times required, which is the fundamental object of any supply organisation’.<sup>16</sup> There were essentially three levels to this process. First, at the most complete assembly level, was the

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<sup>13</sup> Ibid, Paragraph 11.

<sup>14</sup> Craven and Cate, *The Army Air Forces in World War II*, pp.378-379.

<sup>15</sup> Postan, *British War Production*, pp.323-326 and M.M. Postan, D. Hay and J.D. Scott, *Design and Development of Weapons – Studies in Government and Industrial Organisation* (London: HMSO, 1963), pp.15-24 and 76-83.

<sup>16</sup> TNA, AIR 2/3317, Proposed Re-Organization of the Directorate of Equipment 1938 (S.45106), Annex to Air Ministry Letter S.37588/8.9. dated 26 August 1938, p.10.

acquisition of complete assemblies such as aircraft, engines or vehicles; second, the forecast range of spares to support the higher assembly whilst it was in RAF service (initial provisioning) and third, the on-going reordering of spares and supplies to maintain the major assembly throughout its in-service life (re-provisioning). The introduction to service of a new aircraft type serves to illustrate this process. Following the main equipment order with the manufacturer, the respective office within the Air Ministry's Directorate of Equipment would place orders for sufficient IP spares to maintain the squadrons which would operate the aircraft type; this was based on an estimate of spares required for a twenty seven month period at peacetime maintenance rates, along with four months' supply as additional stock for estimated war rates of operation.<sup>17</sup>

Much of this work was based on forecasts, whereas requirements for RP spares was a more informed process and was based on data accumulated from actual operating experience. Once the calculation process was complete, IP spares' requirements would require new contracts to be placed with manufacturers; these, in turn, would provide a standing or 'call-off' contract for RP spares once the aircraft was in operational service. Generally speaking, equipment and supplies were delivered directly from the manufacturer to the 40 or 42 Group depots as appropriate. Where an item was required urgently by a unit, and stock was not available at any of the RAF depots, the requirement could be delivered directly from the manufacturer to the unit (by-passing the depots) requiring the item under what was known as a Diversion Order.<sup>18</sup>

The RAF logistics system relied on its various units, from flying stations and various support units (both at home and overseas), through to the various types of equipment depots, holding and maintaining a set level of stock (or establishment as it was known) which was generally required for repair spares. This stock was also used to supply repair firms in Britain and for special purposes such as the Empire Training Scheme, overseas expeditions and for new squadrons.<sup>19</sup> This level was expressed in numerical terms as a lower and

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<sup>17</sup> TNA, AVIA 46/228, The Spares Problem – Narrative dated 24 July 1951.

<sup>18</sup> TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Memorandum by D.G.E, Air Ministry to the Air Supply Board: Supply of Airframe and Engine Spares for Repair. Reference S.B.M. 456/40 dated 22 August 1940.

<sup>19</sup> Ibid.

an upper limit. The lower or minimum establishment was the point at which a stock replenishment order could be placed; the order quantity was not permitted to bring the total stock holding above the maximum establishment level. The minimum establishment took into account the lead time from order placement to receipt of the items; the items remaining in stock served as a 'buffer' stock to meet user demands until the replacements arrived. The maximum establishment regulated the total amount of stock holdings in the inventory, thereby limiting excessive cost growth. This cyclical concept has endured as a basic principle of stock control systems, for both military and civilian organizations, well into the twenty-first century.<sup>20</sup>

For the RAF at this time, the figures for the maximum and minimum establishments were expressed as a specific number of months-worth of consumption – this represented the average amount of equipment issues for recurring (or normal) use during that period. For British-based RAF units, the maximum figure was usually three months and the minimum two months; for depots, a similar principle was applied but the calculation was somewhat more complex, taking into account reserve stocks for emergencies and was based on a core stock at the depots amounting to an estimated six months' worth of equipment and fourteen months' worth on order with suppliers.<sup>21</sup> At depot and unit level, equipment due to arrive (known as dues in) or about to be issued (known as dues out) also had to be taken into account. Against these provisioning principles, stock holders endeavoured to maintain adequate stocks of equipment to meet the demands from user sections/squadrons (in the case of RAF units) or the demands from RAF Unit Equipment Sections (in the case of the various depots). The regulatory governance for this entire process was the equipment accounting system issued as Air Publication 830, the first version of which had been introduced in 1921.<sup>22</sup>

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20 Most of the leading management science academic texts include this basic principle as part of supply chain management theory. See, for example: M. Christopher, *Logistics & Supply Chain Management (Fourth Edition)* (Harlow: Pearson Prentice Hall, 201), pp.106-107; Chopra and Meindl, *Supply Chain Management*, pp.305-309 and Lysons & Farrington, *Purchasing and Supply Chain Management*, p.323-329.;

21 TNA, AVIA 46/228, The Spares Problem – Narrative dated 24 July 1951 and AVIA 10/320, Provisioning Aircraft and Engine Spares (Scheme A) Investigations, Analyses and Reviews 1942-1945.

22 TNA, AIR 10/844, Air Publication 830 - Instructions for Store Accounting and Store Keeping (Amendment Lists: 1-17) dated August 1921.

## The Master Provisioning Scheme

The exponential growth in the size of the RAF's inventory and the corresponding increase in the number of Universal Equipment Depots (UED) led to a pressing need to put in place a provisioning process which could cope with this complexity. By June 1940, the Directorate of Equipment was responsible for a total inventory size of some 500,000 different items.<sup>23</sup> Whilst the dispersal of stock across the UEDs sites provided a pragmatic and affordable approach to protecting valuable assets, the distribution of the same type of item across five depots in 1939 (later increasing to seven in 1941), with provisioning calculations being carried out centrally at the Air Ministry in London (and largely from Harrogate when much of the Directorate of Equipment relocated there in September 1939), the whole process became untenable.<sup>24</sup> The crux of the problem was that for the provisioning process to work, up-to-date information on the overall inventory (by specific item) was essential. Of particular concern was that fresh stock was not purchased for one depot, when there was already stock elsewhere. With large volumes of equipment being received at the depots from industry and large volumes of equipment being issued from the depots to units, it was virtually impossible for one central location to keep track of exactly what the stock balance was for any one item and when reorders of stock needed to be placed. This was further complicated by changes in the inventory picture, as unserviceable (but repairable) equipment became available again after successful repair. Various approaches to solving this stock control problem were considered by Maintenance Command throughout 1938, with much of the thinking beginning to polarise around a concept which became known as Master Provision. This work culminated in the formulation of a scheme entitled *Master Provisioning for Universal Equipment Depots* in October 1938. The Scheme, along with a covering note from the Air Ministry's Director of Equipment, was submitted to AMSO in May 1939. The scheme was subsequently approved for implementation in October 1939.<sup>25</sup>

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23 TNA, AIR 20/1832, Ministry of Aircraft production – Suggested Absorption of DDGE, Memorandum by DDGE - Relationship of Directorate of Equipment with Ministry of Aircraft Production dated 28 June 1940, p.2.

24 Air Ministry, *Maintenance*, pp.152 and 159.

25 *Ibid*, Chapter 8, p.160.

To provide a methodical approach to the provisioning, two specific schemes were introduced. The first of these, Scheme "A", was introduced in December 1940 and was the responsibility of the offices established under the Master Provisioning Scheme and covered airframe and engine spares required mainly for maintenance and repair after aircraft had entered operational service.<sup>26</sup> At the heart of the scheme was the requirement for every item of equipment to be reviewed twice a year and for those high turnover items to be reviewed once per month; this systematic approach ensured that there was adequate forward cover on contract.<sup>27</sup> Calculations for equipment provisioned under this scheme were quite specific by aircraft type and mark, with consideration being taken of flying squadron strength and the frequency and type of missions flown by those squadrons. The second scheme, Provisioning Scheme "B", dealt with airborne equipment which was not peculiar to specific aircraft types and in general use throughout the RAF. Additionally, Scheme "B" covered non-airborne equipment such as general electrical stores, various items of ground equipment, various barrack and aerodrome stores plus hospital and medical equipment. The work on Provisioning Scheme "B" was less complex and was the responsibility of provisioning staff in DGE's organization in the Air Ministry (under DofE (B)).<sup>28</sup>

Essentially, the Master Provisioning concept divided up the RAF's inventory into generic groups of equipment types such as airframe spares, engine spares and motor transport spares, and allocated provisioning responsibility for these specific ranges to a nominated Master Provision Office (MPO). Initially, seven of these offices were established on the sites of existing Equipment MUs at: 7 MU Quedgeley, 14 MU Carlisle, 35 MU Heywood, 16 MU Stafford, 25 MU Hartlebury and 61 MU Handforth; an additional MPO was also established at Stafford specifically to look after spares sourced from the United States of America. With the continued expansion of the RAF, the increased number of aircraft types and individual equipment, along with the progressive increase in demand level and the introduction of new types of equipment depots, a further six MPOs were established in November 1942 at 3 MU Milton,

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<sup>26</sup> Additionally, this scheme also included aircraft general spares, balloons (and related filling equipment) gun turret spares, kites and power plant spares.

<sup>27</sup> Air Ministry, *Maintenance*, Chapter 8, p.160.

<sup>28</sup> TNA, AVIA 15/1364, Memorandum on the provisioning, Storage and Distribution of Spares and Aircraft Equipment (W.16523) dated 19 November 1942.

68 MU Bolton, 216 MU Sutton Coldfield, 55 Wing Derby, Wakefield and Leighton Buzzard.<sup>29</sup> The increase in the number of units in the Middle East led to the formation of an MPO in July 1941 (known as the Middle East Provision Office (MEPO) to avoid confusion with Military Post Office) at 107 MU in Egypt. As an overseas unit, this office was manned entirely by eighty-nine male RAF staff.<sup>30</sup> An MPO was also established at RAF Fauld, responsible entirely for explosives and POL products.

The detailed evolution of the MPOs is difficult to assess due to incomplete Air Ministry primary sources, but it is clear that much reallocation of responsibility for equipment types occurred throughout the war years to balance workload and to cater for new requirements. What is clear is that, primarily due to the extensive manual clerical work involved, the MPOs required a significant workforce. An example of this can be found amongst the Air Ministry papers relating to the re-allocation of equipment types to MPOs in November 1942. The total number of personnel required at that time amounted to 2,657 comprising: ninety-seven officers (RAF and WAAF); 1,620 civilians and 940 Service personnel (RAF and WAAF); the Air Ministry data excluded the MPO at Stafford (no reason specified) and a simple extrapolation to include this, based on typical MPO establishments, would bring the total MPO manpower number to just over the 3,000 mark in November 1942. Of particular note is that civilians accounted for approximately 60 per cent of the MPO workforce with, typically, some 77 per cent WAAFs (airwomen) at Service manned offices. The employment of WAAF officers, in keeping with their limited employment at the time, was approximately 25 per cent.<sup>31</sup>

Each of the MPOs had, by and large, the same task, which was to calculate when stock replenishment was required. In cases where components were repairable the MPO would issue instructions for the feed-in to repair organizations and would then allocate the repaired item to a specific depot on its return. Where replenishment for non-repairable items was required, and having calculated the quantity required, the MPO would forward details to the

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29 TNA, AIR 2/8212, No. 40 Group Organisation – Master Provision Offices (S.86228), HQ Maintenance letter to Air Ministry: MC/S.5199/0.1(a) dated 4 December 1942.

30 TNA, AIR 29/798, MPO ME Cairo, Middle East Air Order No.268 (S.52596/Org) dated 22 July 1941.

31 Ibid, Enclosure 1B, Re-allocation of Vocabulary Sections to MPOs – Staff Requirements. Calculations for WAAF Airwomen based on averages for 16 MU, 61 MU, 216 MU and 55 Wing (only units for which a breakdown by male and female is shown).

Air Ministry's Directorate of Equipment who would then arrange for orders to be placed through the Ministry's contracts department. In addition to this, the MPOs would transfer equipment between the depots where required, often to ensure that stock was dispersed in line with Maintenance Command's security policy as far as was practically possible.<sup>32</sup> The theory was one thing, but the practicality was another matter altogether. To carry out its task, each MPO needed to know how much stock was held in each equipment depot, what stock was due to be issued or received from suppliers and what equipment was in the process of repair. The timely availability of information was therefore crucial to the whole Master Provision Scheme. The only way this data could be provided at the outbreak of war was by using a paper posting slip, part of a process which required large numbers of clerks to compile and despatch data from the equipment maintenance depots and then for MPO staff to receive and consolidate this data into an overall total; the dispersal of the same stock across a number of depots (with each submitting their own information) required the data for these to be combined into a single figure before stock control calculations could be carried out. To avoid depots notifying the MPOs when they were nearing or actually out of stock, stock transactions were reported as they occurred.

The original planning study for the Master Provision Scheme in 1938 had included a recommendation for electro-mechanical equipment to produce data cards (as an alternative to posting slips) at the equipment depots and for sorting and consolidation at the MPOs. Such equipment was already in use at the Central Ordnance Depots at Chilwell, Didcot and Weedon, as well as by the civilian company Messrs Joseph Lucas Ltd. The ordnance depots, inter alia, were using what was known as the 'New NCR' system, a machine produced by the National Cash Register Company which was used for posting stock cards and producing an overall stock balance. The depot at Didcot was using the 'Hollerith' system produced by the British Tabulating Machine Co Ltd which used paper punched-cards. Lucas was using a similar punched-card system produced by Powers-Samas Accounting Machines Ltd.<sup>33</sup> The estimate produced

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<sup>32</sup> Air Ministry, *Maintenance*, pp.39-40 & pp.159-160 and TNA, AIR 2/3102, Master Provisioning Scheme at Equipment Maintenance Units (880976/39) dated 9 February 1939, Master Provisioning at Equipment Maintenance Units, Section I (1).

<sup>33</sup> TNA, AIR 2/3102, Master Provisioning Scheme at Equipment Maintenance Units (880976/39) dated 9 February 1939, Master Provisioning at Equipment Maintenance Units, Appendix A to Paper MC/539 dated 18 October 1938.

by Maintenance Command in October 1938, for the eight MPOs then envisaged, included provision for punch-card equipment (based on Power-Samas equipment) and a card index system (based on Shannon equipment) amounting to £54,400. Even the initial implementation of the Master Provision Scheme generated an estimate of £36,670.<sup>34</sup> This level of expenditure for such a new and untried scheme was not received enthusiastically by the Treasury and it was not until 1943 that Hollerith electro-mechanical card machines were installed at the main depots; the first machines were installed at 25 MU Hartlebury in November 1943, but it was not until February 1945 that the last machines required to equip all the depots were received. Much of the delay in implementing mechanisation can be attributed to the lack of dedicated expertise within Maintenance Command, the requirement for detailed and often lengthy feasibility studies by manufacturers and the time taken to secure capital expenditure approval from the Treasury.<sup>35</sup> In essence, the machines were used to punch a series of holes on an inserted card for every movement of stock. The specific details of receipts or issues were punched in code and included, for example, the item's unique military reference number, the quantity involved in the transaction and the identity of the consignee. The cards were then used to prepare what was termed the daily stock journal for the depot concerned and also the posting sheet for onward transmission to the respective MPO. The introduction of these machines reduced clerical labour, increased accuracy and provided a more manageable means of obtaining statistical data for equipment provisioning.<sup>36</sup> Notwithstanding these benefits, the impact of this mechanisation on the overall personnel numbers is difficult to assess due to limited data in archival sources, especially for civilian staff employed in the MPOs. The figures for military Provisioning Clerks (the trade which formed the greatest proportion of military manpower at each MPO) do not reflect any noticeable reduction as a result of the introduction of electro-mechanical machinery. Indeed, the total requirement for military Provisioning Clerks (male and female combined) rose from 728 in June 1942 to a fluctuating total of between 2,500 and 2,800 up until July 1945. There was a peak requirement of just fewer than 3,200 in August and September 1945, and this probably reflects the uncertainty of the duration

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<sup>34</sup> Ibid, Appendix C to Paper MC/539 dated 18 October 1938.

<sup>35</sup> TNA, AIR 2/3102, Master Provisioning Scheme at Equipment Maintenance Units (880976/39) dated 9 February 1939, Master Provisioning at Equipment Maintenance Units, AOC maintenance Command to Air Ministry (E.17) dated 2 May 1939.

<sup>36</sup> Air Ministry, *Maintenance*, p.162.

of the war in the Far East. A reduction in Provisioning Clerk requirements is only noticeable from November 1945, but this is most likely due to the reducing equipment requirement following the end of the war in the Far East.<sup>37</sup> It is possible that manpower savings might have been made in the numbers of civilians employed in the MPOs but this cannot be assessed due to the lack of available data. The most likely explanation is that the provisioning process still required significant numbers of clerical staff to operate the equipment, but the introduction of electro-mechanical aids reduced the time spent on manually assimilating data.

The wider question of the overall effectiveness of the Master Provisioning Scheme is more difficult to assess. The practical challenges of the forthcoming provisioning task were recognized early and the analysis carried out in 1938 ensured that a workable scheme was put in place on the outbreak of war in September 1939. There is no final report on the effectiveness of the scheme at the war's end as Master Provisioning remained part of the RAF's post-war logistics system up until computerised stock control technology began to be introduced in the 1960s. What is clear is that there is no indication in the archival sources that Master provisioning did not work or possessed failings which led to equipment shortages; such weaknesses manifested themselves as a result of much higher policy decisions and are discussed later in this chapter. The overall scale of the provisioning task by April 1945, in terms of the broad groupings covered, is shown in Table 18.

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<sup>37</sup> Data Source: This thesis, Appendix 2.

Type of Spares Provisioned	MPOs	Number of Items Provisioned		Total
		Active	Current Supply	
Airframe Spares	3 MU Milton 7 MU Quedgeley 25 MU Hartlebury	56,614	185,291	241,905
Engines & Engine Accessories	16 MU Stafford	34,700	16,700	51,400
Radio, Electrical & Armament Spares	14 MU Carlisle MPO Buckingham Area	87,300	9,700	97,000
Misc. Airframe Spares & AGS	61 MU Handforth 68 MU Bolton 35 MU Heywood	21,601	26,394	47,995
Tools & Materials	MPO Wakefield	4,955	4,358	9,313
MT Spares	216 MU Sutton Coldfield	31,905	135,095	167,000
Barrack & Clothing	55 Wg Derby	14,127	5,401	19,528
American Spares & Equipment	MPO(USA) 16 MU Stafford	60,356	118,766	179,122
Totals		311,558	501,705	813,263

**Table 18 -  
Master Provisioning Offices and Items Provisioned April 1945<sup>38</sup>**

### The Spares Shortage Problem 1940 – 1943

The Master Provisioning Scheme established a sound and standard policy for procuring equipment, but relied heavily on a manufacturing capacity which could produce the required numbers of spares, in parallel with the production of complete aircraft. Given that the spares were also components of airframes and engines, a balance needed to be struck. Given that the main thrust of the Expansion Schemes was the production and delivery of specific numbers of complete aircraft by specific dates, it was inevitable that a conflict between supply and demand would occur. This risk was highlighted by the Director General of Equipment in 1940 who commented that:

...there is a tendency to press for and to count only the production of complete aircraft or engines which are so much more in the limelight. It would, however, be a fatal move to allow the balance between spares production and the production of complete aircraft to be upset in favour of the latter. If this were to happen the effect of the real strength of the Service, that is aircraft in fighting condition, would be immediately felt

<sup>38</sup> Data from Air Ministry, *Maintenance*, p.160, supplemented by additional information from TNA, AIR 2/3102, Master Provisioning Scheme at Equipment Maintenance Units (880976/39) dated 9 February 1939.

and we should see a rapid deterioration in the effective strength of the Service.<sup>39</sup>

With aircraft spares production being inextricably linked with complete aircraft production, the adequacy of the former was largely governed by the way in which the latter was regulated. By the beginning of the Expansion Programme in 1934, supervision of aircraft production was conducted by the Directorate of Aeronautical Production (DAP) within AMSO's department. By 1938, as the output of the Expansion Programme became more significant, aircraft production management was rationalised and became part of a newly created organization under the Air Member for Development and Production (AMDP), with two new directorates being formed – the Directorate General of Research and Development (DGRD) and the Directorate General of Production (DGP); the latter became the focus for aircraft production with eight directorates responsible for aeronautical production, engine production, subcontracting, aircraft equipment production, materials production, Air Ministry factories statistics, planning, and war production planning.<sup>40</sup> Additionally, a sub-committee of the Air Council was formed to oversee the implementation of Scheme L of the Expansion Programme. With an initial responsibility for apportioning contracts, the Air Council Sub-committee on Supply had, by May 1938 '...virtually assumed complete responsibility for aircraft production'.<sup>41</sup> The fact that the Director General of Equipment had a seat on the sub-committee can perhaps be viewed as an influencing factor in its policy decision, reached at its 127<sup>th</sup> meeting in December 1939, when it was agreed that fifteen per cent of production capacity should be reserved for manufacturing spares. The Director General of Equipment noted that:

It was stated that an effort in excess of this could only be achieved at the expense of aircraft production, the assumption being that production was calculated to allow a margin of this order for spares. It became, in consequence, a practice to advise Contractors that their programmes were accepted on the assumption that 15% of the productive capacity of the works would be available for the production of airframe spares.<sup>42</sup>

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39 TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Memorandum by D.G.E, Air Ministry to the Air Supply Board: Supply of Airframe and Engine Spares for Repair. Reference S.B.M. 456/40 dated 22 August 1940, Paragraph 2.

40 Ritchie, *Industry and Air Power*, pp.50-53.

41 Ibid, pp.50-51 and Holland, *The Battle of Britain*, p.169.

42 TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Memorandum by D.G.E, Air Ministry to the Air Supply Board: Supply of Airframe and Engine Spares for Repair. Reference S.B.M. 456/40 dated 22 August 1940, Paragraph 3.

Notwithstanding this pragmatic approach to balancing complete aircraft and spares production, a growing shortage of aircraft spares developed in the first half of 1940 which became the subject of often quite acrimonious dialogue and on-going complaint between MAP and the Air Ministry, through until late 1943.<sup>43</sup> In his work on *British War Production*, M.M. Postan highlighted the difference in interests between the Air Ministry which was 'concerned as it was with the maintenance of aircraft in service', whereas MAP's focus was on new production. Postan states that some remedial measures were taken in September 1941 but these were '...mostly of an administrative kind...'.<sup>44</sup> His account provides no further detail on this issue apart from the observation that '...the supply of spares continued to give cause for anxiety throughout 1942' and that 'The anxiety spread outside the Air Ministry and Service circles'.<sup>45</sup> The Air Ministry official history of the development of maintenance also comments on the issue but neither this, nor Postan's work, explore the complexity of the issue or why there were such divergent views.<sup>46</sup> Archival sources provide a more illuminating picture of the problem, with correspondence in late 1940 and throughout 1941, between the Chief of Air Staff and the Minister of Aircraft Production, along with frequent interjection from Prime Minister Winston Churchill, showing that the issue was of significant concern, with quite notable differences in opinion regarding the extent and magnitude of the problem and how to solve it.

Churchill believed that the British rate of aircraft production was slow – a view he had held since before the war. By the first half of 1940 he had come to the conclusion that the answer was to form a separate and independent Ministry of Aircraft Production (MAP).<sup>47</sup> This was a concept similar to the Ministry of Munitions which had been formed during the First World War in response to the shortage of artillery shells. Consequently, MAP was formed on 14 May 1940 with Lord Beaverbrook as the minister in charge.<sup>48</sup> Churchill's decision to form MAP at this time, and its influence on producing urgently required fighter aircraft, proved to be a critical success factor in the Battle of Britain. It must be

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43 Postan, *British War Production*, p.320.

44 Ibid.

45 Ibid.

46 Ibid and Air Ministry, *Maintenance*, pp.45-46.

47 A.J.P. Taylor, *Beaverbrook* (London: Hamish Hamilton, 1972), p.412.

48 Ibid, pp.414-415.

said, however, that manufacturing industry disliked the 'separation of the procurement functions of the Air Ministry into the MAP'.<sup>49</sup> There is little doubt that Beaverbrook's efforts were significant, a point articulated by Air Chief Marshall Sir Hugh Dowding, the Commander-in-Chief RAF Fighter Command, who commented in his official report on the Battle of Britain that '...the effect of Lord Beaverbrook's appointment can only be described as magical and thereafter the supply situation improved to such a degree that the heavy aircraft wastage which was later incurred during the Battle of Britain ceased to be the primary danger'.<sup>50</sup> Dowding reiterated this view in the Times on 1 June 1945 where he commented that '...we had not the supply of machines necessary to withstand the drain of continuous battle. Lord Beaverbrook gave us those machines...'.<sup>51</sup> The role of Beaverbrook is commented on by the historian Juliet Gardiner who states how he '...took – and was given by Churchill – the credit for the remarkable increase in aircraft production'.<sup>52</sup> Similarly, Peter Howard relates how Beaverbrook's successor in MAP, Colonel Moore-Brabazon, suggested that 'Lord Beaverbrook is among those to whom the Prime Minister referred when he said that never was so much owed by so many to so few'.<sup>53</sup>

Contemporary scholarship supports this perspective. Richard Overy, for example, comments that aircraft production was the key to success in maintaining aggregate numbers, despite high losses at the height of the battle.<sup>54</sup> Stephen Bungay highlights how, in single-engined fighter production '... the British consistently out-produced Germany by well over two-to-one throughout the months of the Battle'.<sup>55</sup> James Holland also draws attention to the important role which the extensive Civilian Repair Organization played and how Beaverbrook dovetailed its role with aircraft production to maximize aircraft availability. Holland comments how 'The Air Ministry was bypassed entirely. The effect was electric' and highlighting:

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49 D.E.H. Edgerton, 'Technical Innovation, Industrial Capacity and Efficiency: Public Ownership and the British Military Aircraft Industry, 1935-48', *Business History* 26(3) (November 1984), 247-279.

50 Ibid, p.415.

51 Ibid, p.415.

52 J. Gardiner, *Wartime Britain 1939 – 1945* (London: Headline Book Publishing, 2004), p.306.

53 P. Howard, *Beaverbrook – A Study of Max the Unknown* (London: Hutchinson & Co, 1964), p.124.

54 R. Overy, *The Battle of Britain – Myth and Reality* (London: Penguin Books, 2010), p.33.

55 S. Bungay, *The Most Dangerous Enemy*, p.97.

...in the last two weeks of June more than 250 [aircraft] were repaired and sent back to squadrons. In just a few weeks, the production of new aircraft had risen by 62 per cent, new engines by 33 per cent, repaired aircraft by a staggering 186 per cent, and repaired engines by 159 per cent. It was an astonishing turn-around.<sup>56</sup>

The success which MAP had, under the leadership of Beaverbrook, in urgently providing aircraft for the Battle of Britain is not disputed. Gavin Bailey in his work on aircraft supply and the Anglo-American alliance comments that Beaverbrook's appointment '...was apparently crowned with clear success as the production of aircraft, and specifically fighters, more than doubled in the course of the year [1940]'.<sup>57</sup> The well-deserved accolades do, however, draw attention away from the wider picture which was developing at the time – a reducing level of spares' support for the RAF's other aircraft. The needs of Fighter Command in early 1940, not unexpectedly, dominated the output of aircraft production. Indeed, Beaverbrook had agreed with the Air Ministry that production would be focused on five aircraft types: Spitfire and Hurricane fighters and the Blenheim, Hampden and Whitley bombers; of these, precedence was given to the fighter aircraft.<sup>58</sup> The detailed picture for these aircraft types is shown in Table 19.

Aircraft Type	3 September 1939	1 May 1940	3 September 1940	Variation in Total Aircraft Numbers September 1939 to September 1940
Blenheim	1020	1672	1416	+39%
Hampden	195	383	437	+ 124%
Whitley	172	343	419	+ 144%
Hurricane	379	1209	1758	+ 364%
Spitfire	247	607	628	+ 154%

**Table 19 -  
Total Strength of Priority Aircraft Types - September 1939 to September 1940<sup>59</sup>**

To place this emphasis in context, the RAF had a total of 1,122 fighters in September 1939; this represented 11.7 per cent of the RAF's total aircraft strength of 9,554 aircraft. By September 1940, the total number of fighters had

<sup>56</sup> Holland, *The Battle of Britain*, p.323.

<sup>57</sup> Bailey, *The Arsenal of Democracy*, p.71.

<sup>58</sup> Richards, *Royal Air Force 1939-1945, Volume 1*, p.154 and D. Farrer, *The Sky's the Limit – The Story of Beaverbrook at M.A.P.* (London: Hutchinson, 1943), p.14.

<sup>59</sup> Data extracted from TNA, AIR 20/2022, Strength of Aircraft in RAF, Returns for September 1939, May 1940 and September 1940. Variation figures are own calculations.

more than doubled to 2,306, representing 16 per cent of the RAF's total aircraft strength of 17,556 aircraft. The initial numbers of bombers was much greater. The RAF had a total of 3,255 bombers in service in September 1939, representing some 34 per cent of the total aircraft strength of 9,554 aircraft. By September 1940, the number of bombers had increased by a much smaller proportion than fighters, amounting to 4,229 aircraft, a figure which represented 24 per cent of the RAF's total aircraft strength of 17,556 aircraft.<sup>60</sup> The difference in production achievement between fighters and bombers is due to the greater need for fighters during the Battle of Britain.

However, David Farrer in his book on Beaverbrook's time as the Minister of Aircraft Production, draws attention to the important point that this focus on fighters did '...long term harm to the aircraft production lines, and that but for Beaverbrook's action we should to-day [i.e. in 1943] have a larger Air Force'.<sup>61</sup> Farrer goes on to defend this criticism of Beaverbrook by pointing out what he refers to as the threat of German air supremacy at the time and also that the fighters protected the factories which could so easily have been obliterated by enemy bombing with a resulting total loss of production. He adds that the focus on the five aircraft types lasted only as long as the 'acute emergency prevailed' and that work on the postponed production projects [i.e. other aircraft types] resumed thereafter.<sup>62</sup> A reasonable defence and one which suggests that it was a question of urgency of need, and that all returned to normality once the enemy threat, as experienced during the Battle of Britain, had receded. Farrer's perception, however, needs to be considered in light of the fact that his book, according to AJP Taylor, was written under Beaverbrook's direction.<sup>63</sup>

There are a number of pointers towards Beaverbrook's preoccupation with whole aircraft production which do suggest what could be considered a short sighted perception of the broader logistical situation. Perhaps the strongest example is illustrated by a comment made by Beaverbrook to his successor in MAP, Colonel J.T.C. Moore-Brabazon, that 'better a stringency in spares and a bountiful supply of aircraft than a surplus of spares and a shortage

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60 Ibid.

61 Farrer, *The Sky's the Limit*, pp.14-15.

62 Ibid, p.15.

63 Taylor, *Beaverbrook*, Notes on Sources, p.676.

of aircraft'.<sup>64</sup> Taylor comments how Beaverbrook '...sent his agents round the airfields, where they surveyed the spare parts and raided the cupboards at will – finding "pots of gold", Beaverbrook called it'.<sup>65</sup>

Beaverbrook's limited understanding of the broader role of the Air Ministry's Directorate of Equipment is best typified by the fact that on 10 Jun 1940, in a telephone conversation with DDGE (Air Vice-Marshal Garrod), he proposed that the Directorate of Equipment should be transferred from the Air Ministry to MAP. In his immediate note to AMSO, Garrod expressed his alarm at this proposal and was clearly suspicious of Beaverbrook's motives, fearing that '...it indicates a desire to control the reserve stocks and the allocation of Air Force equipment'. Garrod pointed out to AMSO that 'If we are not careful we shall have the M.A.P producing to the Prime Minister the most marvellous production statements and at the same time the whole of the Air Force will be unable to fly because there are no spares'.<sup>66</sup> Beaverbrook wasted no time in pursuing this ambition and formally submitted the proposal to the Secretary of State for Air on 11 June 1940. The Air Ministry had already formulated a closely reasoned argument against Beaverbrook's aspirations and it therefore took little persuasion for the Secretary of State to inform Beaverbrook just one day later that he could not possibly agree.<sup>67</sup>

Despite the efforts of the Air Ministry to educate MAP on the broader responsibilities of its Equipment Organization, Beaverbrook still seemed to view the RAF's depots as a stockpile, rather than a component of a supply chain where quantities of equipment had been ordered following careful forecasting. This perception is typified in a letter to AMSO discussing spares just before Christmas 1940, where Beaverbrook makes the flippant comment 'If you would like us to search the Equipment depots ourselves let us know and we will put in detectives'.<sup>68</sup> Of particular note at this time is Churchill's personal support of Beaverbrook's position and his slight suspicion of the Air Ministry; the former was at times a clear bias, whilst the latter was verging on disdain. Indeed, in a private note to Beaverbrook in mid-December 1940, Churchill suggests that

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<sup>64</sup> Ibid, p.418. Moore-Brabazon succeeded Beaverbrook as Minister of Aircraft Production in May 1941.

<sup>65</sup> Ibid.

<sup>66</sup> TNA, AIR 20/1832, Ministry of Aircraft production – Suggested Absorption of DDGE, Garrod to AMSO dated 10 June 1940.

<sup>67</sup> Ibid, Beaverbrook to Sinclair dated 11 June 1940 and Sinclair to Beaverbrook dated 12 June 1940.

<sup>68</sup> TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Beaverbrook to Courtney, 23 December 1940.

'They [the Air Ministry] regard you as a merciless critic and even enemy. They resent having had the M.A.P function carved out of their show, and I have no doubt they pour out their detraction by every channel open'. Moreover, Churchill actually believed that an adversarial relationship between the two ministries was a productive and healthy way to conduct business and stated to Beaverbrook that he was '...definitely of the opinion that it is more in the public interest that there should be a sharp criticism and counter-criticism between the two Departments, than that they should be handing each other out ceremonious bouquets. One must therefore accept the stimulating but disagreeable conditions of war'.<sup>69</sup> Churchill was also quite open in public regarding his bias towards MAP. In a speech in Parliament on 20 August 1940, Churchill commented on the current status of the Battle of Britain and drew attention to the point that 'a great system of salvage, directed by the Ministry of Aircraft production, ensured the rapid repair of damaged machines and the best use of spare parts'.<sup>70</sup> It was the Air Ministry, not Beaverbrook who worked to ensure the best use of spare parts – they were not given any such credit in Churchill's oration that day.

The spares shortage had become particularly evident in the closing months of 1940, following enquiries CAS had made into the number of aircraft which were grounded due to a lack of spares. Of particular concern was the status of Flying Training Command where, on 6 December 1940, 410 aircraft were grounded through lack of spares – 12.2 per cent of the Command's total aircraft strength. There was also concern at the picture for the other RAF commands although the total number grounded was 227 aircraft across Fighter, Bomber, Coastal and Army Co-operation Commands.<sup>71</sup> These were the key facts which CAS presented to the Secretary of State for Air, Sir Archibald Sinclair, in December 1940, suggesting that the concerns regarding Training Command were taken up with Beaverbrook at MAP. Beaverbrook's close friendship with Churchill is clearly apparent from what transpired following CAS's note. Indeed, Beaverbrook had been quick to present the Prime Minister with his own data which presented a more favourable picture than CAS had alluded to. In a personal minute to CAS, just four days after the note to the

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69 Churchill Papers, CHAR 20/13/9, pp23-24. Churchill to Beaverbrook 15 December 1940.

70 Mr Churchill's Speech in Parliament on August 20, reported in *Bulletin of International News* (17(18) (7 September 1940), 1153-1156 (p.1155).

71 TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Portal to Secretary of State, 18 December 1940.

Secretary of State, the Prime Minister sought CAS's views on Beaverbrook's figures (attached with Churchill's minute), ending his note with the view that if MAP's figures were the more reliable then '...it does not seem to me that your complaint was valid: on the contrary, the achievement of M.A.P. during the last six months appears astounding'.<sup>72</sup> The figures in Beaverbrook's response to the complaint from CAS were more detailed than Portal's original note and were subject to further analysis by DGE. The complex picture which emerged is summarised in Table 20 and shows the contrasting views of MAP and the Air Ministry for the positions at the beginning of January 1940 and at the end of November 1940.

	MAP Figures		Air Ministry Figures	
	Quantity	% of Quantity	Quantity	% of Quantity
<b>1 January 1940</b>				
Total Aircraft Strength	12,066	-	12,066	-
Aircraft Grounded in RAF Commands awaiting Spares	-	<b>47%</b>	809	<b>9.3%</b>
Aircraft Grounded in Aircraft Storage Units (ASU) awaiting spares	2748	-	2,659	-
Aircraft under and awaiting repair at repair firms	-	-	456	-
<b>30 November 1940</b>				
Total Aircraft Strength	20,264	-	18,345	-
Aircraft Grounded in RAF Commands awaiting Spares	-	<b>6%</b>	652	<b>6%</b>
Aircraft Grounded in Aircraft Storage Units (ASU) awaiting spares	306	-	3,285	-
Aircraft under and awaiting repair at repair firms	-	-	1,345	-

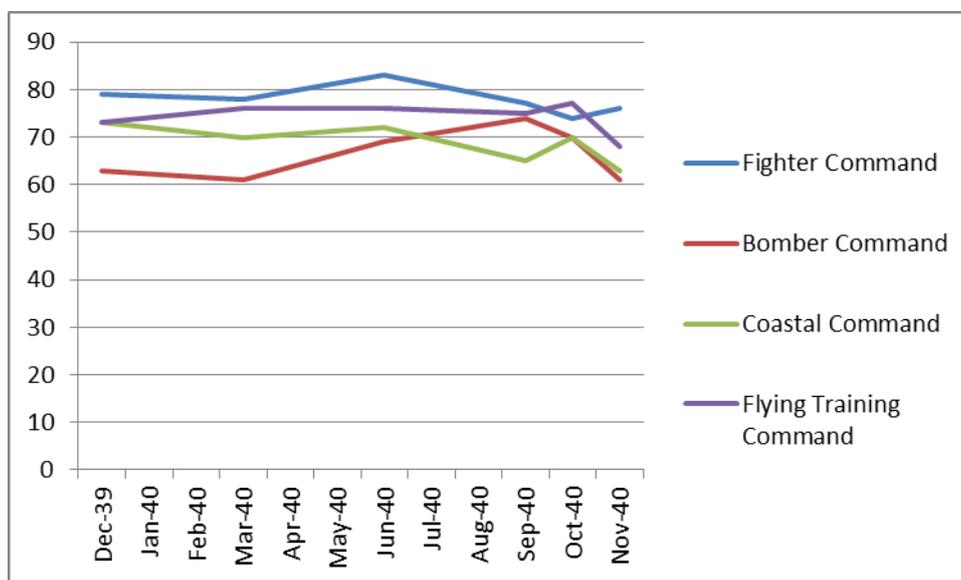
**Table 20 - MAP and Air Ministry Perception of Aircraft Grounded through Lack of Spares January and November 1940**<sup>73</sup>

Essentially, Beaverbrook was asserting that, even though there was a substantial increase in total aircraft strength, the number of aircraft grounded in the RAF home commands through a lack of spares dropped from 47 per cent on 1 January 1940 to just 6 per cent on 30 November 1940. In stark contrast, the Air Ministry claimed that Beaverbrook's 47 per cent January figure was

<sup>72</sup> TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Enclosure 8A:Prime Minister's Personal Minute Serial No M 445 to CAS dated 22 December 1940.

<sup>73</sup> Source: TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Enclosure 8A, DGE to PS to CAS, 28 December 1940.

misleading and included aircraft grounded for a much wider range of reasons including repair and inspections, as well as through a lack of spares. The more accurate figure, they believed, was a significantly lower starting position in January 1940 of 9.3 per cent; an improvement, but nowhere near the extent which Beaverbrook was claiming. This manipulation of statistics is alluded to by Gavin Bailey who highlighted the point that Ernest Bevin, the then Minister of Labour, responded to one of Churchill's comments on Beaverbrook's production success with the observation that '...magic is nine-tenths illusion'.<sup>74</sup> The statistical picture was one thing, but additional comment by DGE provides a more illuminating view of why and where the spares shortage was of particular concern. Whilst overall aircraft serviceability in the home commands gradually improved from January 1940 through to approximately June 1940, the position had started to decline from there on, with a notable dip for Flying Training, Coastal and Bomber Commands from October 1940. The trend for the four main home commands for the period December 1939, through until November 1940 is shown in Figure 7.



**Figure 7 - Aircraft Serviceability in the Home Commands December 1939 to November 1940<sup>75</sup>**

<sup>74</sup> Bailey, *The Arsenal of Democracy*, p.71.

<sup>75</sup> Source: TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Enclosure 8A, DGE to PS to CAS, Attachment A – State of Serviceability 1939-1940 – Operational Types in Squadrons at Home and Main Types in Flying Training Command, dated 28 December 1940.

The spares' contribution towards trying to maintain the serviceability position, according to DGE, was through prolonged and widespread use of the Diversion Order procedure, where spares were being delivered direct to the requiring unit. Whilst this was meeting the needs of the home Commands, DGE was concerned it could not meet the long term needs of the overseas commands and those of the Empire Air Training Scheme. It was essential that supplies of spares were delivered to the Universal Equipment Depots to build up buffer stocks from where issues could be made to overseas units. The number of Diversion Orders was running at approximately 150 per day by November 1940. A particular concern, highlighted by Commander-in-Chief Bomber Command, was that the enemy's targeting of manufacturer's premises could so easily disrupt the Diversion Order channels of supply. It was essential, therefore, that buffer stocks were built up in the 40 Group storage units. This was a concept which Beaverbrook seemed to struggle with in his preoccupation with whole aircraft production.<sup>76</sup> In the ensuing correspondence between MAP and the Air Ministry, Beaverbrook was insistent that his figures were correct and that the supply of spares was the healthiest it had been for ten years. He also commented that matters in the latter part of 1940 had not been helped by the '...loss of large quantities of spares in France' and that the RAF '...have been making claims on spares for the Middle East and for Canada [i.e. for the Empire Air Training Scheme]'. Beaverbrook's response could be somewhat irascible and often displayed a limited appreciation of the bigger picture. Indeed, he suggested to CAS in his initial response to the complaint from the Air Ministry that 'If you will hand over to this Ministry [i.e. MAP] the complete control and the entire responsibility for spares and repairs, we will continue to fulfil your desires'.<sup>77</sup> What is also clear from the correspondence is that Beaverbrook was making his own enquires directly with RAF contacts he had in the operational commands. The fact that Beaverbrook was making statistical claims which did not accord with the Air Ministry perception raises the question as to why there was not a unified view. There is insufficient detail in the correspondence to ascertain if these individuals were the same officers supplying the Air Ministry with their data. There is nothing to suggest that there was disloyalty amongst RAF officers involved in this debate, but plenty to suggest that Beaverbrook

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76 TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Enclosure 8A.

77 TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Enclosure 6A, Beaverbrook to Portal, 22 December 1940.

(through what clearly appears to be his limited understanding of RAF logistics and engineering operations) was not able to make a like-for-like comparison. This was not helped by the fact that the Minister did much of his business by direct, personal intervention (much of it spontaneous in nature) and not by the use of a central MAP statistics' office. Beaverbrook admitted to Portal in January 1941 that 'I have no organisation to prepare figures and statements for me. I dictate my letters. And I do not even have time to revise them after they are written'.<sup>78</sup> Beaverbrook continued to make use of his staff at the *Daily Express* newspaper, some of whom were 'taken off their journalistic work at a moment's notice to produce "data" ... or to write appeals for higher production'.<sup>79</sup> The key point which Beaverbrook seemed reluctant to recognize was that, by the end of 1940 and the end of the Battle of Britain, the urgent need to focus on complete fighter aircraft production had changed and a more flexible approach was required.

This shift in position was clearly articulated by Portal in early January 1941:

...I hope that everything possible will be done to improve stocks. If the only way to achieve this is to reduce the output of complete aircraft, we would accept the necessary reduction. It would weaken us a great deal if large numbers of aircraft were not fit to fly in the coming air battles owing to lack of spares.<sup>80</sup>

The acrimonious correspondence continued between Portal and Beaverbrook to the point where a letter written by Portal on 12 January 1941 prompted a further, very short note from its author to Beaverbrook which stated that 'Last night I sent you a letter. I hear you do not like it. Will you please therefore send it back to me and I will burn it and regard it as never having been written'.<sup>81</sup> Beaverbrook remained committed to his view and made it quite clear that he would be referring the whole issue to the Cabinet or the Defence Committee. It was only a personal meeting between Portal and Beaverbrook which defused the situation and persuaded the Minister that he would 'take all the necessary steps to see that the Air Force are provided with all they require

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78 TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Beaverbrook to Portal dated 11 January 1941.

79 Taylor, *Beaverbrook*, p.419.

80 TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Portal to Beaverbrook dated 9 January 1941.

81 *Ibid*, Portal to Beaverbrook dated 13 January 1941.

in the way of spares'.<sup>82</sup> A further letter from MAP to the Personal Secretary of the Vice Chief of the Air Staff, reiterated Beaverbrook's newly found cooperative attitude, quoting Beaverbrook's own words in which he was resolved to '...push like hell to supply the Air Ministry with all the spares they want'.<sup>83</sup> This outcome strongly suggests that the Air Ministry had been right all along.

By the end of January 1941 the fresh focus and commitment to spares had encouraged a more cooperative approach to develop, although the number of aircraft in the Home Commands which were unserviceable, awaiting spares, had increased significantly. By the middle of October 1941, there were 1,061 such aircraft reported on the weekly returns being submitted by AMSO to the Secretary of State for Air and CAS. The detailed breakdown by type is shown in Table 21.

Type	Total Grounded	Percentage of Type
Bombers	221	8.7
Fighters	222	7.8
Ground Attack / Reconnaissance	23	17
Flying Boats	11	17
Trainers	535	9.7
US Bombers	16	10.9
US Fighters	14	11.1
US Ground Attack / Reconnaissance	9	2.7
US Flying Boats	3	5.1
US Trainers	7	33.3

**Table 21 -**  
**Total Number of Aircraft Grounded in the RAF Home Commands Through Lack of Spares**  
**17 October 1941**<sup>84</sup>

This led to further investigation for which both the Air Ministry and MAP agreed for targeted studies into the Home Command situation to be conducted by Captain V.H Baker, a director of the aircraft company Martin Baker Co. The first of these was into the supply of advanced trainers, closely followed by an examination of aircraft and spares at the Operational Training Units (OTU). These studies and further work by the staffs of MAP and the Air Ministry went on to highlight a shifting focus of concern during the first half of 1941, alighting first on Bomber Command, then Training Command, before moving to Coastal

<sup>82</sup> Ibid, Freeman to Griffith dated 14 January 1941.

<sup>83</sup> Ibid, Griffith to Salter dated 15 January 1941.

<sup>84</sup> Data extracted from TNA, AIR 8/458, Shortage of Spares – AMSO Returns (Aircraft Awaiting Spares), Return from AMSO to Secretary of State dated 3 November 1941.

Command; particular concern was expressed with regard to the latter due to the on-going Battle of the Atlantic. A new issue did begin to emerge concerning the supply of spares for American sourced aircraft, a responsibility for which Beaverbrook and MAP disclaimed any responsibility as his Ministry did not control aircraft factories in the United States.<sup>85</sup> This view was underpinned by Beaverbrook's staffs' view that it was the '...duty of the Air Ministry representative in America to ensure that all action is taken by contractors to produce the spares required subject to the understanding that the B.A.C [British Air Commission] will give every assistance they can in this respect'. This disagreement was soon resolved by the Air Ministry who pointed out that such an approach was highly likely to conflict with MAP's production requirements.

A significant shift in relationships between the two ministries came in May 1941 when Moore-Brabazon replaced Beaverbrook as the Minister of Aircraft Production.<sup>86</sup> It is clear from archival sources that the Secretary of State for Air, Sir Archibald Sinclair, recognized the importance of fostering better working relationships at this time, albeit by September 1941 there was still significant concern regarding spares availability. In a note to the new Minister on 12 September, Sinclair pointed out that the situation was not improving and that the total proportion of aircraft awaiting spares in the Home Commands had reached 10.1 per cent as at 23 August. He concluded by emphasising the point that this was '...the peak of what appears unhappily at the present time to be a rising trend'.<sup>87</sup> The end of September 1941 however, saw a more buoyant mood within DGE's organization with the Director commenting to AMSO that '...the new heart in evidence in M.A.P is now beginning to show results'. It was believed that the 'peak of unserviceability' had been reached with a downturn in overall serviceability in the home commands becoming noticeable as the month of September progressed. A key point made by DGE was that the unserviceability issue needed to be viewed in perspective, particularly taking into account wear and tear due to increased flying effort, a fact which he believed '...to some extent masked the improvement in the spares supply

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85 TNA, AIR 8/459, Unserviceability due to Shortage of Spares – Correspondence with M.A.P., Beaverbrook to Sinclair dated 22 April 1941.

86 Scott and Hughes, *Administration of War Production*, p.507.

87 TNA, AIR 8/459, Unserviceability due to Shortage of Spares – Correspondence with M.A.P., Sinclair to Moore-Brabazon dated 12 September 1941. It is not clear from this source if the shortage was a production issue or poor MPO evaluation.

position'.<sup>88</sup> This increase in effort was quite dramatic. The increase in flying hours per aircraft as a result of operations or training in six months comparing December 1940 with June 1941 was 88 per cent for operational aircraft and 67 per cent for non-operational aircraft. The increase was even more spectacular in the bomber aircraft operational training units (OTU), an area known to be particularly demanding on spares as a result of damage to aircraft occurring through trainee aircrew getting to grips with handling multi engined, heavy aircraft.<sup>89</sup> In the same period the increase was in the order of 175 per cent.<sup>90</sup>

The year 1942 saw a continued improvement apart from the position for Bomber Command which was beginning to draw closer attention by the Air Ministry and MAP. Of particular concern was the rate of damage to Wellington bombers. By the end of 1941 the number of Wellingtons unserviceable for spares was running at just over 9 per cent (ninety aircraft) but concern was being expressed at the ability of Vickers, the aircraft's main manufacturer, to increase their output of spares, especially in light of the increasing numbers of the aircraft abroad.<sup>91</sup> Problems with Wellington spares had been simmering from as early as July 1941 when the issue first surfaced at an Equipment Service Conference held at Harrogate. At that time a shortage of spares for the Wellington was impacting on the aircraft's major inspection programme where the planned activity was eight days but lengthened to two or three weeks as a result. In early 1942 the OTUs remained the most significant area of unserviceability, primarily as a result of the increasing need for trained bomber crews for operational squadrons and was an area of concern up to ministerial level.<sup>92</sup> The Wellington proved to be one of the most successful of the RAF's medium bombers and by 1942 formed more than half of Bomber Command's strategic force.<sup>93</sup> The aircraft also formed a sizeable proportion of the OTUs. Given this significance, along with the increasing number of aircraft losses in Bomber Command and the bomber OTUs, it was inevitable that concern should be focussed on the number of Wellingtons which were grounded as a result of

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88 TNA, AIR 19/305, Aircraft Spare Parts – Production Difficulties, DGE to AMSO dated 23 September 1941.

89 The first nine OTUs were inaugurated in April 1940, with a further eight formed by May 1941. Denis Richards, *RAF Bomber Command in the Second World War – The Hardest Victory* (London, 1994), p.73 refers.

90 TNA, AIR 19/305, Aircraft Spare Parts – Production Difficulties, DGE to AMSO dated 23 September 1941.

91 Ibid, AMSO to Secretary of State dated 10 January 1942.

92 Ibid.

93 R. Overy, *The Bombing War – Europe 1939-1945* (London: Allen Lane, 2013), p.241.

unserviceability through lack of spares. The proportion of Wellingtons lost by year in Bomber Command and the OTUs is shown in Table 22.

	Operational Squadrons <sup>94</sup>		Operational Training Units <sup>95</sup>	
	Total Losses	Wellington Losses	Total Losses	Wellington Losses
1939	146	29 (20%)	Not applicable	Not applicable
1940	1071	153 (14%)	190	43 (23%)
1941	1512	516 (34%)	390	150 (38%)
1942	1880	692 (37%)	655	400 (61%)
1943	3072	349 (11%)	545	445 (82%)
1944	3517	5 (0.14%)	382	330 (86%)
1945	1080	Nil	102	83 (81%)
Totals	12278	1744 (14%)	2264	1451 (64%)

**Table 22**  
**Bomber Command Aircraft Losses 1939-1945**  
**Showing proportion of Wellington Aircraft Lost**<sup>96</sup>

By July 1942, with the focus of effort on coordination for the bomber offensive, concern broadened as to general aircraft unserviceability in Bomber Command; in the period April to June 1942 this rate had fluctuated considerably and had been as high as 45 per cent in April but had dropped to just 10 per cent in May.<sup>97</sup> The reasons for this were not just spares' availability but included aircraft taken out of service for minor inspections, airframe and engine repairs, new aircraft being fitted with operational equipment or undergoing crew trials; on the whole, these were an inevitable fact of life but a lack of spares was something which, through careful planning, could be minimised and the effect on aircraft unserviceability reduced.

The spares' shortage position persisted throughout the remainder of 1942 with regular correspondence between the Air Ministry and MAP and ministerial level. In August 1942, in a letter to a new Minister of Aircraft Production (Colonel J.J. Llewellyn) the Secretary of State for Air summarised the general concern, drawing attention to the need for additional spares through the movement of squadrons overseas or in an increased flow of aircraft to the overseas' commands or to Britain's allies; the Minister highlighted that

<sup>94</sup> Includes operational, non-operational and on the ground losses.

<sup>95</sup> Includes operational, non-operational and on the ground losses. OTUs were not formed until 1940 – W.R. Chorley., *Royal Air Force Bomber Command Losses of the Second World War, Volume 7, Operational Training Units 1940 - 1947* (Hinckley: Midland Publishing, 2002), p.11 refers.

<sup>96</sup> Figures from: W.R. Chorley., *Royal Air Force Bomber Command Losses of the Second World War, Volumes 1 to 6, 1939 to 1945*, Appendix 1 and Appendix 4 for each volume (Earl Shilton: Midland Counties Publications, 1992 Volume 1, 1993 Volume2, 1994 Volume 3, 1996 Volume 4, 1997 Volume 5 and 1998 Volume 6).

<sup>97</sup> TNA, AIR 19/305, Aircraft Spare Parts – Production Difficulties, Note by AMSO (C.S.O(3)(iv)) Co-ordination for the Bomber Offensive – Aircraft Serviceability dated 10 July 1942.

'Whenever we have been compelled to take steps of that kind, we have invariably been embarrassed by the absence of spares to send with the aircraft'.<sup>98</sup> Apart from the number of aircraft grounded in Britain through a lack of spares (running at approximately 1,000 at the end of June 1942), the spares' shortage situation was greatly limiting the RAF's ability to provide for the flexible employment of squadrons at home or overseas.<sup>99</sup> By December 1942 both the Air Ministry and MAP had agreed that spares' production required a more strategic rather than a tactical approach and it was agreed that a 'High Power Committee' would be formed, chaired by the MAP Parliamentary Under-Secretary Ben Smith with senior representatives from the Air Ministry and MAP. At the heart of this committee's work were two priorities: first, to tackle the manufacturers of specific aircraft types or component systems and, second, to apply the principle of a cut of up to 10 per cent in complete aircraft production to concentrate on spares manufacture should this measure prove necessary.<sup>100</sup> As part of this work, manufacturers were required to produce a 'minimum monthly list of spares' which were to be produced as a first priority on their production runs. Apart from an on-going issue with the production of sufficient spares for Mercury and Pegasus aircraft engines throughout 1943, the wider issues regarding spares availability generated considerably less correspondence by senior staffs than the previous year, largely as a result of the endeavours of the High Power Committee. By the end of December 1943 the situation had improved to the extent that the Secretary of State for Air wrote to the Minister of Aircraft Production (by then the Labour politician Sir Stafford Cripps) congratulating the Ministry on its progress in reducing the number of aircraft unserviceable in the home commands awaiting spares. The Secretary of State highlighted the fact that 'Since the summer of 1941 when the average was over 9 per cent the figure has been steadily falling and by November of this year [1943] had dropped to 3.6 per cent'. The Minister emphasised the point that 'The result of your efforts has been a great accession of strength to the Royal Air Force'.<sup>101</sup>

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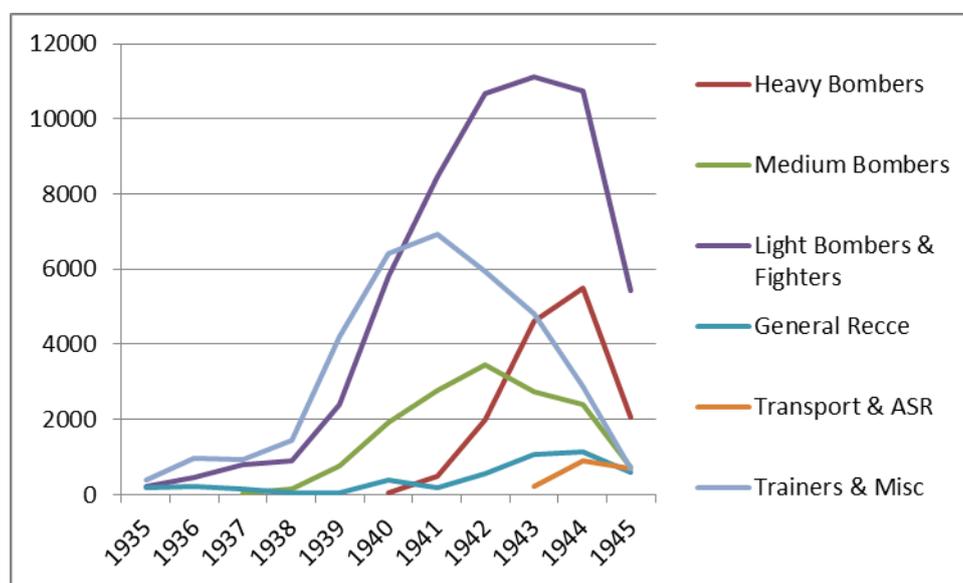
<sup>98</sup> Ibid, Secretary of State for Air to Minister of Aircraft Production dated 6 August 1942.

<sup>99</sup> Ibid.

<sup>100</sup> Ibid, Bradley (Air Ministry) to Smith (MAP) dated 22 December 1942. The aircraft types singled out for attention were the Halifax, Lancaster, Anson, Spitfire, Whitley, Beaufort, Beaufighter, Lysander, Oxford, Wellington and Defiant, with undercarriage components also being identified as requiring further work. In total, this list involved some nineteen different manufacturing companies.

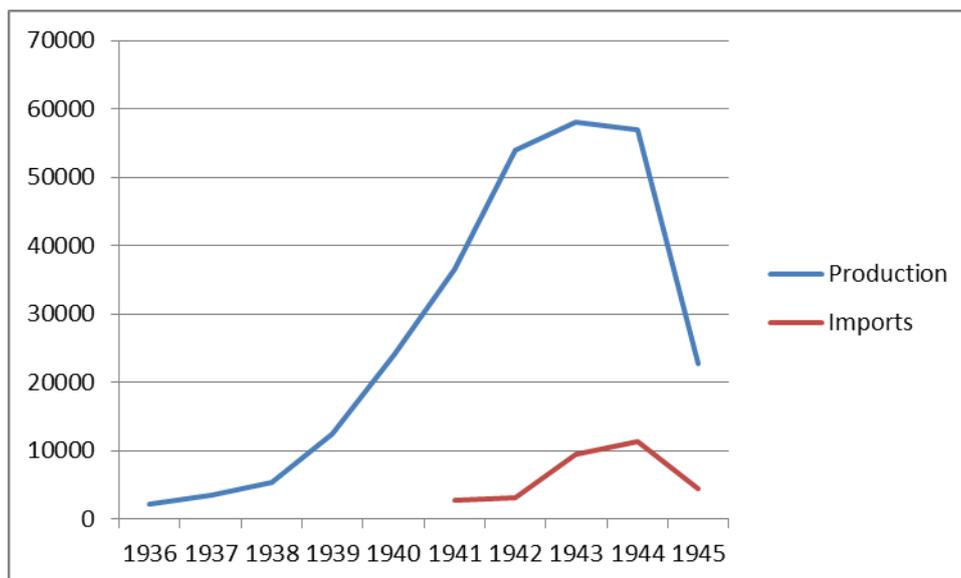
<sup>101</sup> Ibid, Secretary of State for Air to Minister of Aircraft Production dated 3 December 1943. The quoted figures are believed to be from the Air Ministry.

Whilst the adequacy of spares' production remained an issue which required careful and detailed management for the remainder of the war, the four year period from 1940 through until the end of 1943, required an almost constant dialogue between senior RAF staffs and the Air Ministry, and the latter with the Ministry of Aircraft Production. In the earlier part of the period even the Prime Minister's attentions came to bear. Whilst the roots of the spares availability problem can be clearly attributed to the critical months of the Battle of Britain during 1940, where demands for whole fighter aircraft production undoubtedly diverted attention from spares' production, this does not account for why the problem persisted until the end of 1943. There is a simple point here which can easily be missed in the complexities of the detailed arguments, in that a whole aircraft is the fighting tool of a pilot and crew, not an amalgamation of spares. The rapid pace of the war in the air, along with the requirement for large numbers of aircraft types and numbers, placed an enormous strain on the manufacturing capacity of the aircraft industry – the primary output was a finished aircraft; the extent of aircraft production is shown quite clearly in Figure 8 and for aero engines in Figure 9.



**Figure 8 -  
Aircraft Production by Main Groups 1935 to 1945<sup>102</sup>**

<sup>102</sup> Source: W.K. Hancock, *Statistical Digest of the War* (London: HMSO, 1951), Table 130, p.152. Figures for 1945 are up to and including the 3rd Quarter.



**Figure 9 -  
Aircraft Engine Production and Imports 1936 to 1945<sup>103</sup>**

It was inevitable that manufacturers would consider individual items as components in an assembly process rather than as destined for storage depots for eventual use in repair or replacement once the aircraft was in operational service. There were of course people who did understand this; these were to be found in the ranks of the Air Ministry's Directorate of Equipment who tirelessly lobbied their superiors for support. Whilst Churchill's creation of MAP undoubtedly yielded results during the Battle of Britain, the adversarial relationship pursued by Beaverbrook (and encouraged by Churchill) appeared to have endured beyond his tenure as minister in charge. Much time and effort was wasted at senior level in the often fruitless arguments regarding the statistical extent of the spares' shortage problem. It was not until 1943 that both the Air Ministry and MAP began to realise that a commonly agreed spares' production policy needed to be agreed between them and with the aircraft industry. It took, however, the formation of the High Power Committee to provide the momentum required in this direction and for improvements to be realised. Indeed, from mid-1943, a noticeable improvement can be seen in the number of aircraft awaiting spares within the RAF Home Commands as shown in Table 23.

<sup>103</sup> Source: Hancock, *Statistical Digest of the War*, Table 134, p.155. Figures for 1945 are up to and including the 3rd Quarter.

Year	Month	Total for all Commands (%)	Bomber Command (%)	Fighter Command (%)
1941	June	8.7	4.8	7.5
	December	8.1	6.6	7.9
1942	June	6.8	4.5	6.1
	December	7.1	5.4	6.9
1943	June	5.2	3.8	5.2
	December	3.1	2.4	3.6
1944	June	2.7	1.4	3.5
	December	2.5	1.4	3.6
1945	June	2.5	1.4	2.7

**Table 23 -  
Aircraft Awaiting Spares as Percentages of all Aircraft with the Home Commands<sup>104</sup>**

The issue did not escape Parliamentary attention and observations were made in the Tenth Report from the Select Committee on National Expenditure published in August 1943. The Committee highlighted what they saw as three contributory factors. First, what they perceived to be the attitude of industry. Whilst it was clear that the demand for spares had been exacerbated by operational needs and the development of the repair and recovery service, particularly overseas, industry management believed that they had received less credit for the production of spares than complete aircraft. Second, was the question of whether or not there was merit in segregating the manufacture of spares in separate factories – this had been dismissed as un-economical as it would have required additional machine tools, the duplication of jigs and tooling as well as managerial effort. The third factor, and one which the Committee considered the more serious, was the method by which spares were ordered. In the Committee's investigations, nearly every manufacturer had complained that orders for spares were not placed at the same time as for complete aircraft, though it could be argued that perhaps they could have anticipated this. Consequently, they claimed, it was impossible to plan production effectively. Investigations, however, showed that there was often a delay on the part of the contractors to submit lists of spares to the Air Ministry and MAP of minor parts which might be required as spares; the average time delay was cited as four

<sup>104</sup> Source: Postan, *British War Production*, p.321.

months but, in one case, was as long as nine months.<sup>105</sup> Perhaps the final word on this sorry saga, and a sentiment which sums up the cause of the problem in few words, belongs to DGE who commented as early as September 1941 that there had been a 'total failure to plan and progress spares contracts'.<sup>106</sup>

### **The Aircraft-on-Ground Priority System**

Amongst the many commitments of the RAF's logistics organization, the support of aircraft was the main priority and there were many components that could potentially 'ground' individual aircraft if they could not be replaced when unserviceable. With such an enormous volume of equipment flowing through the RAF supply chain, the identification of such spares' consignments was critical in order that they could be clearly identified and given due attention in the issue and movement processes. It is not clear exactly when it was introduced, but at some time during the inter-war years, the concept of Aircraft-on-Ground (AOG) was introduced and became an important procedure during the war itself. Officially defined as a '...special system for rapid supply of items essential to render serviceable aircraft, which are in the hands of RAF Squadrons but are grounded for lack of parts'. In such cases, units were authorised to demand for such items using the signal message system on their regional or affiliated MU. If stock was available, it was despatched by the fastest possible means. Where stock was not available, it became known as an 'inability' and the requirement was signalled to the appropriate MPO who would check to see if stock was available at another MU and then instruct that depot to make an issue to the demanding unit. Where no stock was held, the MPO issued an instruction for diversion of the required item from the supply contractor direct to the demanding unit. This 'Diversion Order' was copied to MAP who then managed the requirement, reported progress to the demanding unit or operational command and also to take any necessary steps to obtain supply from salvage or repair.<sup>107</sup> Whilst the supply of spares by Diversion Order met urgent requirements, it was not enabling the build-up of stock in the storage

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105 TNA, AVIA 10/327, Memorandum on Airframe and Engine Spares. Production Organization, Ordering and Aircraft on Ground. Select Committee 1943 (SB.18993), Tent Report from the Select Committee on National Expenditure, session 1942-1943 – Aircraft Production, published 4 August 1943, Section VI – Spares Production, pp. 9-10.

106 TNA, AIR 19/305, Aircraft Spare Parts – Production Difficulties, DGE to AMSO dated 23 September 1941.

107 TNA, AVIA 10/327, Memorandum on Airframe and Engine Spares. Production Organization, Ordering and Aircraft on Ground. Select Committee 1943 (SB.18993).

depots, a fact which was leading to significant concern within the Directorate of Equipment in the Air Ministry in March 1941. During November and December 1940 there was a total of 9,532 Diversion Orders raised, amounting to an average of 156.24 per day (for eight aircraft types including the Spitfire and Hurricane). In a memorandum to the Air Supply Board, DGE commented that 'this practice is highly dangerous in as much as enemy action at a contractors works will immediately make itself felt in the operational efficiency of the Squadrons, and it is to obviate this dangerous position that stocks are necessary in the Depots'.<sup>108</sup> Overall, the Aircraft on Ground and Diversion Order procedures did not solve the spares shortage problems, but enabled the clear identification of requirements (along with an increased level of urgency) which were directly leading to aircraft being grounded.

## **POL and Explosives**

Pre-war arrangements for the provision of POL were considerably more advanced than many other areas of logistics, largely as a result of the British Government's forward thinking decision to allow the country's petroleum industry to formulate its own oil plan for war. This work had commenced in the summer of 1938 following discussions between various ministries, the Services and leading groups in the oil industry. With Government approval, this led to the formation of what was known as the Petroleum Board, an entirely voluntary body which was '...intended to remain as a shadow and planning organisation until such time as a national emergency might bring it into active service'. The original members of the Board were: Anglo-American Oil Co. Ltd; National Benzole Co. Ltd; Shell-Mex & B.P. Ltd and Trinidad Leaseholds Ltd.<sup>109</sup> Detailed analysis of the best way to manage petroleum products in time of war began in the autumn of 1938 when a number of committees were set up by the Petroleum Board; the results of this work were encapsulated in a final report entitled *Petroleum Distribution: Emergency Arrangements* in January 1939. At the heart of this report was the basic proposal that when such arrangements were implemented, petroleum distribution would be carried out under a pooling scheme. It was also recommended that there should be a drastic reduction in

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<sup>108</sup> TNA, AVIA 10/181, Air Supply Board March 1941, 76th to 83rd Supply Board Meeting. Agenda, SBMs, Conclusions etc. Memorandum by DGE, Air Ministry – Supply of Airframe and Engine Spares for Repair and Maintenance (S.B.M. 133/41) dated 1st March 1941.

<sup>109</sup> Petroleum Board, *Petroleum at War*, p.3.

the number of grades of petroleum products. Following this work, more detailed planning took place during the period January to August 1939 with the United Kingdom being divided into thirteen regions as part of the pool concept and these corresponded approximately with the Civil Defence Regions, including Northern Ireland.<sup>110</sup>

On the declaration of war, the pool concept became operational, the working of which was formalised in three agreements between September 1938 and May 1940. The first two agreements involved the original members of the Petroleum Board but the third agreement included thirty-two independent companies (known as the additional members) , all of which were importers of petroleum products. Additionally, a further fifty-seven non-importing oil distributing companies were affiliated, but not as members of the Pool. Given the substantial numbers of companies involved in petroleum product involved in importation and distribution, this concept was far sighted and took the opportunity at an early stage of the war to put in place a coordinated and focused approach to controlling this vital commodity which proved to be critical to the overall war effort. Indeed, as recorded in the official wartime history of the Petroleum Board, this brought under the control of the Pool ‘...substantially the whole of the petroleum industry so far as it related to the importation, storage and distribution of oil products’.<sup>111</sup> At the heart of the Board’s operation were three executive departments: Physical & Supplies; General Sales, and Finance & Accounts. Of these, the Physical & Supplies department was key to the management of RAF POL, with sub-sections dedicated to bulk imports, inland distribution, quality control, purchasing bulk storage and the UK pipeline which was constructed in 1941 (See Chapter Seven).<sup>112</sup> Additionally, and due to the vast quantities of fuel required by the RAF, the Petroleum Board established an Aviation Co-ordinator who was also appointed by the Air Ministry as their honorary Fuel Adviser on storage and distribution matters.<sup>113</sup> The day-to-day control of POL was carried out by HQ 42 Group in conjunction with the Petroleum Board and RAF user units.<sup>114</sup>

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110 *Ibid*, p.4.

111 *Ibid*, p.5.

112 *Ibid*, pp. 13-14.

113 *Ibid*, p.13.

114 Air Ministry, *Maintenance*, p.53.

There was one issue which required resolution during the lead-up to the outbreak of war and was key to the longer term security of fuel stocks. During the inter-war years, supplies of POL were obtained under standing contracts, directly from the petroleum supplying companies and delivered to units. The RAF at this time did not have any reserve storage and it was not until 1937 that the Air Ministry commenced a programme of reserve tankage at the main ocean tanker reception terminals. In due course, further reserve storage was built, along with a number of distributing depots (See Chapter 6).

The provisioning of explosives differed from the 40 Group range of equipment in that the sole MPO responsible for these (21 MU Fauld) was primarily responsible for the maintenance of a single stock record, the distribution of stocks and traffic control of explosives movements; the provisioning task itself was carried out by E18 Branch within the Directorate of Equipment at the Air Ministry. There is little in archival sources to indicate any major issues with the explosives range in the first four years of the war although, by 1944, the Air Ministry official history refers to a heavy operational period during which production struggled to keep pace with turnover. Indeed, in 1944 the RAF's turnover of explosives amounted to 2,899,000 tons, whilst the production output from ordnance factories that year was just 1,196,400 tons.<sup>115</sup>

### **Provisioning of Equipment for American Aircraft**

The adoption of American aircraft by the RAF can be traced to March 1938 when the Secretary of State for Air, Lord Swinton, had succeeded in a request to the Committee of Imperial Defence for a mission to be sent to the United States and Canada to investigate the possible purchase of American aircraft types. Swinton and his deputy were to be dismissed from their posts in May 1938, primarily as a result of growing dissatisfaction at the rate of progress of the British Expansion programme. Purchase of aircraft from North American sources was viewed as a possible option to improve the rate of rearmament although, as commented on by the historian Gavin Bailey, 'American purchases to supplement this programme [Expansion Scheme 'L'] were regarded as 'a

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<sup>115</sup> TNA, AIR 2/3317, Air Ministry memorandum dated June 1938 regarding the proposed organisation of the Directorate of Equipment organisation of Maintenance Command and Air Ministry, *Maintenance*, pp.123-126 and Appendix 13.

contingent reserve".<sup>116</sup> Although the mission to North America in April-May 1938, headed up by Group Captain Weir, commented that American military aviation was 'backward compared with British standards', an order was placed for two hundred Lockheed Super Electra airliners modified to operate in the General Reconnaissance role (became the B-14 Lockheed Hudson in RAF service), with an option for a further fifty aircraft by the end of 1939. It was also recommended that two hundred North American Harvard I trainers be purchased.<sup>117</sup>

Following the decision by the French government to purchase a number of American aircraft to supplement their struggling aircraft industry in the summer of 1939, Britain was encouraged by President Roosevelt to consider additional purchases which led to a further British mission headed by Lord Riverdale. In due course, this resulted in the establishment of a Purchasing Commission in the United States to establish the organisation required for managing a programme of wartime supply from North America. Follow-on orders were also placed by Britain for a further two hundred Lockheed Hudsons, six hundred North American Harvards and new contracts for 120 Brewster Buffalo fighters and fifty Consolidated PBY Catalina amphibians.<sup>118</sup> Although Britain was actually more concerned with the supply of American produced machine tools to meet the growing needs of her Expansion programme at the time, growing pressure from the French for the Allies to try and achieve air superiority over Germany, led to an Anglo French purchase programme, of which Britain was committed to buying 280 Curtiss P-40, 760 Curtiss P-46, 300 Lockheed P-38, 500 Martin GM 187, 200 Douglas A-20 and 400 Lockheed 37.<sup>119</sup> With the fall of France in June 1940, Britain took over the French element of the purchase programme at an additional cost of \$600 million.<sup>120</sup> In time, the Air Ministry found that only a very small percentage of airframe spares had been ordered by the French and no provision at all had been made for engine and propeller spares. Endeavours were made to place additional orders but

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<sup>116</sup> Bailey, *The Arsenal of Democracy*, pp.36-37.

<sup>117</sup> *Ibid.*, p.40.

<sup>118</sup> *Ibid.*, pp.52-53.

<sup>119</sup> *Ibid.*, pp.54-55. The new aircraft ordered became known as the Tomahawk, Kittyhawk, Lightning, Baltimore, Boston III and Ventura in RAF service respectively.

<sup>120</sup> *Ibid.*, p.90. The additional French contracts were accepted by the British Purchasing Commission in an agreement with the French State dated 16 June 1940 – H. Duncan Hall, *History of the Second World War – North American Supply* (London: HMSO, 1955), Appendices, p.501 refers.

contracts were either not placed or did not become operative for some time.<sup>121</sup> Orders were one thing, but deliveries were another matter altogether. By the end of December 1940, delivery delays were affecting all orders expected to be delivered by the end of that year. Bailey highlights how ‘...out of 428 aircraft ordered, 153 were expected to be delivered to the BAC [British Air Commission] in the United States between October and December 1940, yet only twenty-one had been received’.<sup>122</sup> It soon transpired that the management of these contracts would occupy much time and effort and, by early 1941, the Air Ministry had established a Directorate of Equipment liaison officer (Group Captain Trinder) within the BAC in Washington. His work involved close liaison with American aircraft manufacturing companies, seeking to gain improvement in deliveries on the one hand, and to foster good working relations on the other. It is in a letter from the BAC to DGE at Harrogate in early February 1941 that the issue of spares’ availability for American sourced aircraft, first surfaces as a trans-Atlantic area of concern.<sup>123</sup> The source of the problem appears to be in the timely production of schedules of spare parts, a problem which was also to be observed by the British Select Committee on National Expenditure in August 1943 when looking back at the RAF’s spares’ shortage problem. These schedules were important in that they identified spare parts which were likely to be required and for contract action to be taken to purchase sufficient quantities before they were actually required. The problem was exacerbated by insufficient trained staff to produce the schedules and because the range of spares and equipment ordered by the US Army Air Corps varied considerably from the British for the same types of aircraft and engines – this led to much confusion within the American firms.<sup>124</sup> In his letter, Trinder comments that ‘we are faced again, therefore, with taking what we can get in time and trying to ensure that it does provide a reasonable basis for the stocking and re-ordering of spares’.<sup>125</sup>

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121 TNA, AIR 2/8073, American Equipment – Basis of Provisioning for Spares (H.S. 67757), Enclosure 143A - A Note by DGE: Resume of Difficulties Encountered in Ordering and Obtaining Adequate Supplies of Spares for American Type Aircraft.

122 Bailey, *The Arsenal of Democracy*, p.102.

123 Group Captain Trinder had first flagged up this issue to Sir Henry Self the Head of the BAC in late December 1940. TNA, AIR 2/8072, American Equipment – Basis of Provisioning for Spares (H.S. 67757) refers.

124 TNA, AIR 2/8073, American Equipment – Basis of Provisioning for Spares (H.S. 67757), 30th Weekly Letter from air Marshal Harris to CAS, Week Ending 1800 Hours Saturday 17 January 1942 – procurement of Spares and equipment.

125 TNA, AIR 2/8072, Re: Maintenance Equipment and Spares for early American Types (BAC/582, FNT/210) dated 3 February 1941, Trinder to DGE (E37).

By January 1941 it had become clear to all involved in American aircraft procurement that large contracts had now been placed for complete aircraft, engines and propellers but the spares' coverage was totally inadequate due to the under-ordering in some cases and failure to order at all in others. In the case of engine spares this under-order represented some \$40 million, whilst propeller spares the shortfall was in the region of \$5 million.<sup>126</sup> The water was further muddied by MAP in March 1941 when its officials tried quite hard to assert that MAP had no responsibility for such problems and that DGE should be responsible for the supply of spares, ground equipment and tool kits for American aircraft.<sup>127</sup> This position was reiterated to the Secretary of State for Air by Beaverbrook in late April 1941, a letter in which he stated quite boldly that 'I should remind you that we do not control aircraft factories in the United States as we do in Great Britain. In this country we can switch a factory from production to spares at any moment; in the United States we cannot'.<sup>128</sup> A less than helpful approach (albeit probably quite correct), but later correspondence between the Air Ministry and MAP does suggest that these differences were eventually resolved and MAP began to play a more proactive role in the management of spares for American sourced aircraft.<sup>129</sup> Up until this point, the procurement of aircraft, engines and spares depended quite heavily on the goodwill of the US Army Air Corps but this relationship changed considerably with the passing of the Lend-Lease Act on 11 March 1941.<sup>130</sup> Detailed lists of spares were drawn up to take advantage of this arrangement but it was then found that US authorities took three months to decide by what means and in what form requisitions were to be submitted. The issue reached a head in August 1941 when DGE wrote to the head of the BAC, Sir Henry Self, outlining the background to the deteriorating position regarding the provision of spares for American sourced aircraft. Following a lengthy introduction, DGE made the point that:

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126 TNA, AIR 2/8073, American Equipment – Basis of Provisioning for Spares (H.S. 67757), Enclosure 143A - A Note by DGE: Resume of Difficulties Encountered in Ordering and Obtaining Adequate Supplies of Spares for American Type Aircraft.

127 TNA, AIR 19/265, Spares for American Aircraft. Responsibility for Production, Hennessey to Courtney dated 19 March 1941.

128 Ibid, Beaverbrook to Sinclair dated 22 April 1941.

129 TNA, AIR 2/8073, American Equipment – Basis of Provisioning for Spares (H.S. 67757), Havers to AMSO dated 2 April 1941 and TNA, AIR 19/265, Spares for American Aircraft. Responsibility for Production, Sinclair to Moore-Brabazon dated 12 May 1941.

130 See: W.F. Kimball, *The Most Unsordid Act – Lend-Lease, 1939-1941* (Baltimore (USA): The John Hopkins Press, 1969), Appendix, pp. 243-246 and A.P. Dobson, *US Wartime Aid to Britain 1940-1946* (Beckenham: Croom Helm, 1986), pp.62-88.

...the operational efficiency of the R.A.F. is being impaired at the most critical stage in its history, by the lack of insistence on the part of M.A.P. that spares must be produced concurrently with the airframes and engines. We are now rapidly approaching precisely the same position in regard the lack of spares for American aircraft.<sup>131</sup>

By way of example, DGE cited the position of the Curtiss Tomahawk where, despite the fact that 1,180 had been produced and delivered, approximately only 25 per cent of the spares (monetary value) had been produced to support the aircraft. Consequently, Tomahawks '...are lying unserviceable by the dozen in Middle East and due to one thing only LACK OF SPARES [sic]'.<sup>132</sup> In October 1941, the DGE representative in the United States (now an air commodore post entitled Director of Equipment (U.S.A.)), wrote to DGE Harrogate, emphasising that '...the inadequate supply of spares has been continually stressed here during the past few months' and placing '...a statement showing the inadequacy of spares supply before the Joint Aircraft Committee, which, in this country, is the highest level to which matters of this nature can be addressed'.<sup>133</sup>

Britain was just beginning to feel the benefits of the more formal relationship which Lease Lend provided when the United States entered the war on 7 December 1941, following the Japanese attack on Pearl Harbour. This turned America's focus back to support for its own military aircraft and led to the freezing of exports and the commandeering by the US authorities of equipment and spares being delivered off British contracts and Lease Lend requisitions. Much of this was driven by America's realisation that the spares provision for their own aircraft was totally inadequate to cover their world-wide deployment which was soon to take place.<sup>134</sup>

When the United States realised to what extent they had under-provisioned on spares, a special Joint Committee (British and American) was established in January 1942 to investigate and recommend the percentage of

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131 TNA, AIR 19/265, Spares for American Aircraft. Responsibility for Production, DGE to Sir Henry Self dated 25 August 1941.

132 Ibid.

133 Ibid, Drowley to DGE (E-37) dated 3 October 1941.

134 TNA, AIR 2/8073, American Equipment – Basis of Provisioning for Spares (H.S. 67757), Enclosure 143A - A Note by DGE: Resume of Difficulties Encountered in Ordering and Obtaining Adequate Supplies of Spares for American Type Aircraft.

spares which should be ordered for the various classes of equipment. To enable new arrangements to be put in place, it was agreed that the revised percentages would be implemented in January 1943 but, until then, an interim arrangement would be enforced. Essentially, deliveries for the remainder of the calendar year 1942 were to be made using the existing percentages and that no aircraft were to be delivered during the remainder of the year unless they were accompanied by their full quota of spares. Also, all arrears were to be delivered and these were to be made up on the basis of ten equal monthly lots starting in March 1942.<sup>135</sup>

From 1941 onwards, with the strategic bombing offensive becoming a key part of British strategy, obtaining sufficient numbers of heavy bombers became an important priority for Anglo-American aircraft supply diplomacy. Following a conference in Washington in December 1941/January 1942, the first of what were known as the Arnold-Towers-Portal (ATP) agreements came into force which aimed to provide some 275 Boeing B-17 Flying Fortress and 314 Consolidated B-24 Liberator aircraft during 1942.<sup>136</sup> Further ATP agreements were reached in June 1942 and December 1942. In the lead-up to the second ATP agreement, General Arnold visited Britain as part of the negotiations. Arnold was already having misgivings about the British allocations, especially what was perceived as the 'misuse of American heavy bombers'. Bailey comments that Arnold, having flown into Britain via the transatlantic ferry route had landed at Prestwick and observed the number of B-24 Liberators which were being modified for Coastal Command there – not the heavy bomber role for which they were originally intended. Arnold noted '...from my point of view, too many of the planes were just standing there when they were badly needed elsewhere'.<sup>137</sup> Bailey comments that, primarily as a result of Arnold's observations at Prestwick, the General tasked his aide and personal Pilot, Colonel Eugene Beebe, to carry out a survey of British maintenance procedures to investigate what the Americans believed to be unnecessary delays in the delivery of American aircraft to Britain and their operational deployment. It is not clear who agreed to Beebe's survey, or what assistance he was given by the Air

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<sup>135</sup> Ibid.

<sup>136</sup> Bailey, *The Arsenal of Democracy*, pp.137 and 185. The signatories of the agreement reflected in the ATP acronym were: General Henry Arnold (Head of the USAAF), Admiral Jack Towers (USN Bureau of Aeronautics) and Air Chief Marshal Sir Charles Portal (British Chief of Air Staff).

<sup>137</sup> Bailey, *The Arsenal of Democracy*, p.187.

Ministry or RAF. What is clear is that Beebe's report was not well received and had reached the eyes of Churchill before the Air Ministry. The Secretary of State for Air briefed the Prime Minister with little, if any, resulting staff work. Portal, then CAS, was not happy with the content and wrote to Air Marshal Sir John Slessor in Washington in June 1942, anxious to disabuse General Marshall of Beebe's perceptions. Portal, *inter alia*, commented on two issues concerning spares in the report. First, Beebe asserted that American spares, with some exceptions, were available, either in transit to or actually in Britain in more than adequate quantities. Second, he commented that the supply system used by the RAF for distributing spares is such that prohibitive quantities of spares must be poured into the system before 'any trickle out to the consumer'.<sup>138</sup> In the Air Ministry's subsequent analysis of the report (believed to be by DGE's staff), the opening paragraph commented that '...the report seems to have been based on a very hurried series of visits by Colonel Beebe, who has no practical experience of equipment matters'.<sup>139</sup> On the question of Beebe's view regarding the availability of American spares in Britain, the Air Ministry commented that this was more complex than Beebe had asserted and that spares supplied had been based on a much lower estimation percentage figure of production capacity than was now in operation for determining scales (previously 5 per cent, revised to 30 per cent). There were cases where some spares were not available at all and the example was cited of repair work on Allison engines at the repair depot at Burtonwood being held up altogether for the lack of parts. With regards to Beebe's view regarding the efficiency of the RAF's supply system and the depots, the Air Ministry commented that this had been based on careful design before the war, taking into account 'best practice' from industry. Moreover, they also made the point that a senior manager within the Lockheed Aircraft Corporation (a company who had some three years' experience by then of the RAF system) had commented '...the departments responsible for spares to date should be complimented on handling a tough job remarkably well'.<sup>140</sup> The credibility of Beebe's findings as far as spares and the RAF's supply system is perhaps reflected in the comment made by the Secretary of State for Air in his note to Churchill regarding the report in which he

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138 TNA, AIR 8/681, Inspection of American Aircraft, Spares and Factory Personnel in England – Comments on Report by Colonel Beebe. Portal to Slessor 10 June 1942.

139 *Ibid*, Report of Inspection of American Airplanes, Spares and American Factory Personnel Now in England. Comment on Report by Colonel Beebe dated 1st June 1942, p.4.

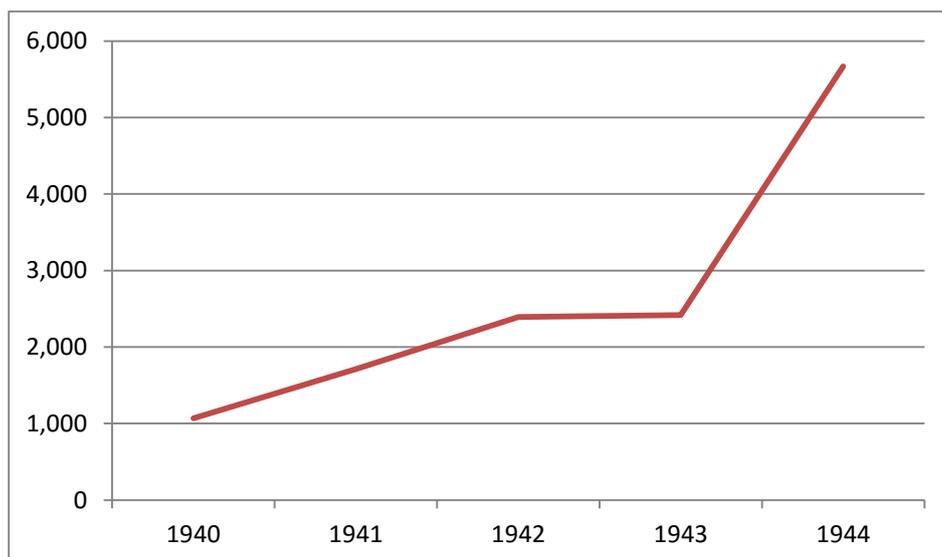
140 *Ibid*, p.5.

observed that '...he [Beebe] did not discuss the question of supply of spares with the responsible officers of the Air Ministry, nor did he visit, so far as I have been able to trace, any of our equipment depots'.<sup>141</sup> The Beebe report was perhaps just a 'storm in a teacup' but, as with the many perceptions regarding the British aircraft spares' shortage problem, it demonstrates the lack of understanding regarding the significance of spares and their management which persisted up until the end of 1943.

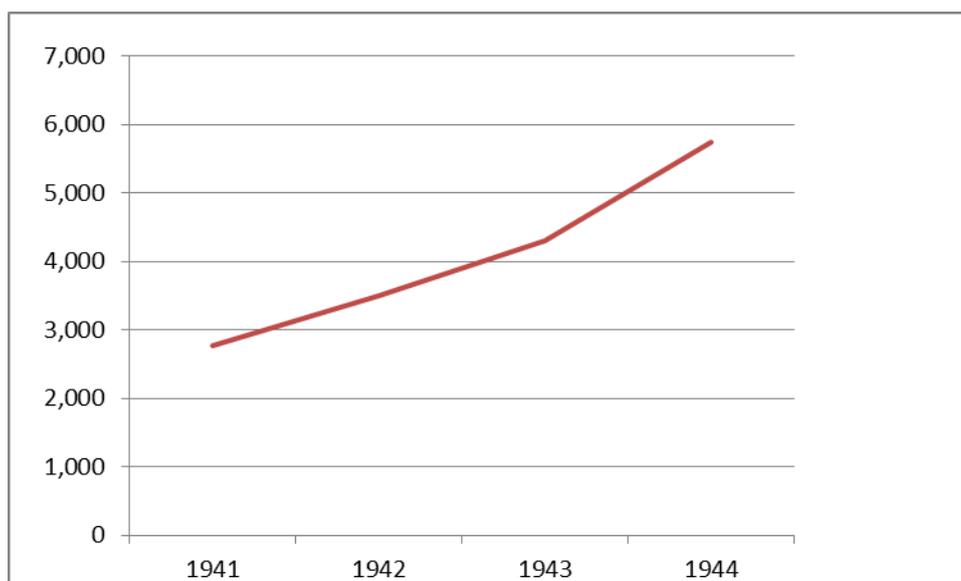
One final point regarding American aircraft in RAF service is the impact this had on the overall number of types in service and the number of main aircraft contracts with which the Air Ministry and MAP had to conduct business. In September 1939, the RAF was operating a total of 10,023 aircraft, comprising sixty-nine types, produced by twenty different manufacturers. Of this total, there were only two types of American aircraft in service - the Lockheed Hudson and the North American Harvard; the total number of these accounted for just 2.9 per cent of the RAF's overall fleet, with their manufacturers forming 10 per cent of the total number of manufacturing companies from which the RAF was procuring. By May 1945, the number of American aircraft types in RAF service had increased to twenty-three, with some 15,156 in operational use; this represented 28 per cent of the RAF's total fleet size. Of particular significance was that the number of American manufacturers of this element had increased to twelve, forming 41 per cent of the total number of manufacturing companies. The number of aircraft arriving in the United Kingdom from North America from 1940 to 1945 is shown in Figure 10 and arriving to overseas directly from America is shown in Figure 11.

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<sup>141</sup> Ibid, Secretary of State for Air to Churchill dated 6 June 1942.



**Figure 10 -  
Aircraft Arrivals in the United Kingdom from North America 1940 to 1945**<sup>142</sup>



**Figure 11 -  
Aircraft Arrivals Overseas Direct from the United States**<sup>143</sup>

Thus, by the end of the war in Europe, the RAF was operating a total aircraft fleet size of 54,084 aircraft (from British and American sources), comprising sixty-six different aircraft types, produced by twenty-nine different manufacturers.<sup>144</sup>

<sup>142</sup> Source: Hancock, *Statistical Digest of the War*, Table 135, p.156.

<sup>143</sup> Source: Hancock, *Statistical Digest of the War*, Table 136, p.157. Figures include all to British overseas commands and other governments, including Canada.

<sup>144</sup> Data calculated from figures in: Thetford, *Aircraft of the Royal Air Force*, Appendix J.

## Conclusion

The pre-war Expansion Scheme introduced many new aircraft types of modern construction, with considerably more complex components and systems, significantly increasing the range and number of parts, all of which added to the list of potential spares required to support them in operational service. The introduction to service of a number of American aircraft types added to the extent of this growth. Cumulatively, this led to an extensive supplier base with little commonality between the components which they used in the manufacture of their aircraft and sub-assemblies such as undercarriages, propellers and gun turrets. Once the items required as spares had been identified, this led to a significant growth in the number of items in the RAF's inventory. The Air Ministry foresaw the challenge this presented and established the Master Provision Scheme at the outset of the war; this was all the more important given the difficulties of managing dispersed stocks which occurred through the introduction of the UEDs. The Master Provision Offices introduced to operate this scheme proved to be an effective stock control organization, albeit they required large numbers of people to manage the volumes of paperwork generated by the daily stock reporting requirement. The widespread adoption of electro-mechanical equipment to process this information came too late in the war to make a significant difference in terms of reducing manual processes and the accompanying reduction of clerks which might have been expected through the adoption of such technology.

Of all the challenges which procurement presented throughout the war, the spares shortage problem from 1940 to 1943 was perhaps the most significant. The extent of this, and the divergence of views regarding the responsibility for the problem, and the numerical extent of the shortfall, involved many senior staff, not least of which were the Secretary of State for Air, the Minister of Aircraft Production and the Prime Minister himself. Whilst the creation of MAP in 1940 was undoubtedly key to achieving urgently required fighter aircraft during the Battle of Britain, the adversarial relationship which ensued between MAP and the Air Ministry wasted much time and energy, at the expense of agreeing the need for a spares' production policy between the two

ministries and the aircraft industry. This led, in many quarters, to a hand to mouth existence with the timely availability of spares for front line squadrons. The AOG Priority System proved to be an effective means of getting short supply items direct from manufacturers to RAF units, but the extent of its usage gave rise to concern regarding the vulnerability of the process, given the Luftwaffe's targeting British aircraft companies during the Blitz in late 1940 and early 1941. Of particular concern here was that sufficient stock was not being accumulated at the UEDs. POL and explosives required a more specialist approach to provisioning and of particular note in this respect is the far-sighted work of the petroleum industry during the latter part of the Expansion Programme which led to the highly successful concept of the Petroleum Board and its coordinated approach to the management of this critical resource.

The introduction to service of American aircraft types brought further management problems, adding to the number of aircraft types in RAF service and the need for extensive liaison activities on both sides of the Atlantic throughout the war. It is evident that the Americans too were slow to recognize the significance of establishing an adequate spares' production policy; the unforeseen entry of America into the war in December 1941 led to greater demand for military aircraft spares. Even with the improved supply situation resulting from the Lend-Lease agreement, there was an enduring requirement for DGE's representative in the BAC delegation in Washington to maintain a constant dialogue between the USAAF, the American aircraft industry and the Air Ministry in Britain.

A more general observation can be drawn on this aspect of logistics regarding the uncertainty of war and the impact which this can have on existing planning assumptions. This is particularly well illustrated following the fall of France in June 1940 when the Air Ministry unexpectedly had to take ownership of French aircraft orders. Similarly, America's entry into the war in December 1941 increased the demand on its aircraft industry at a time when Britain was also trying to secure output from this source of supply. In a much wider sense, and despite the fine-tuning of forecasting techniques as the war progressed, procurement remained a challenge, largely due to the unpredictability of operational needs in general.

## Chapter Six: The Right Place at the Right Time - Accumulation and Protection of Stocks

### Introduction

In the broader and longer history of military logistics, the need to accumulate, maintain and protect adequate supplies for military campaigns is a recurring theme.<sup>1</sup> Indeed, as early as the 4<sup>th</sup> Century AD, Vegetius, a writer of the later Roman Empire, highlighted such requirements as a prerequisite to the commencement of war.<sup>2</sup> The Roman army was perhaps one of the earliest to recognize that the mobile supply trains which typically accompanied armies on the march were a major constraint on mobility. It was this that led the Romans, along with a number of other ancient armies, to use depots or supply dumps on many of their campaigns, coupled with the use of land convoys and ships to move supplies between depots and armies in the field; this concept was often used where long-distances were involved.<sup>3</sup>

Such a concept, though, did not typify the support of warfare during the Middle Ages and the few writers who have examined the historical development of military logistics refer to the general prevalence of 'pillage and plunder'.<sup>4</sup> This changed, mainly as a result of the growing size of armies and it was from perhaps the mid-seventeenth century onwards that the use of depots (or magazines as they were initially known) became more commonplace. John Lynn observes on this period that 'magazines disgorged their food and fodder to armed forces tied to them by supply lines...' and that 'umbilical cords of supply bound armies'.<sup>5</sup> The advent of the railways during the industrial revolution enabled supplies to be transported in greater weight and volume over much greater distances and speeds. Lynn highlights the important point that the First World War 'intensified dependence on depots and mechanical means of

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1 See: D.W. Engels, *Alexander the Great and the Logistics of the Macedonian Army*, (London: University of California Press, 1980); J.H. Pryor (ed), *Logistics of Warfare in the Age of the Crusades*, (Aldershot: MPG Books, 2006); Roth, *The Logistics of the Roman Army at War*; Thompson, *Lifefood of War*; G.C. Shaw, *Supply in Modern War* (London: Faber & Faber, 1938), and Van Creveld, *Supplying War*.

2 Flavius Vegetius Renatus, *The Military Institutions of the Romans (DE RE MILITARI)*, translated from the Latin by Lieutenant J.Clarke in T.R. Phillips (ed), *Roots of Strategy* (Harrisburg PA (USA): Stackpole Books, 1985), p.128.

3 Roth, *The Logistics of the Roman Army*, p.187.

4 See: Van Creveld, *Supplying War*, pp.5-16; Lynn, *Feeding Mars*, pp.10-11 and Thompson, *Lifefood of War*, pp.26-27

5 Lynn, *Feeding Mars*, p.10.

transportation' and that by the Second World War 'the truck revolutionized logistics by providing a new highly mobile link between the railhead and the army in the field'.<sup>6</sup> It was this evolution which lay behind the widespread use of depots by all three of Britain's armed services by the 1930s. By the outbreak of the Second World War, the RAF had established an extensive range of equipment depots, largely centred on the Universal Equipment Depots (UED) and Ammunition Depots (AD) in 40 and 42 Groups Maintenance Command respectively. These depots enabled large quantities of equipment, munitions and fuel to be accumulated in key geographical areas, thereby providing a buffer stock between the manufacturing output of industry and the day-to-day requirements of RAF units.<sup>7</sup>

This chapter examines the development of the warehousing component of RAF logistics, with particular emphasis on how the growth of the Service, its fleet of aircraft, and the total number of its personnel, led to an increasing number of specialist storage units being established throughout the war years, both in the United Kingdom and overseas. It then moves on to examine how these stocks were protected and identifies some of the issues experienced through enemy attack, both at home and overseas.

## **Accumulation of Stocks**

### **Storage Developments in 40 Group Maintenance Command**

By the end of 1940, the work to achieve the new universal supply system had been completed, with the seventh, and final, UED at Stafford (No 16MU) opened on 1 December 1939.<sup>8</sup> With the organizational change implemented, attention turned to increasing the effectiveness and efficiency of the new depots. In early January 1940, the Air Officer Commanding of 40 Group, in conjunction with his depot commanders, agreed that the UEDs would work towards achieving a performance standard in three key areas of operations. First, it was acknowledged that equipment needed to be received and brought to account quickly; it was agreed that this should be done within seventy-two

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<sup>6</sup> Ibid, p.11.

<sup>7</sup> This structure has been referred to as a two-tier system. See: Stockfish, *Linking Logistics and Operations*, p.2.

<sup>8</sup> TNA, AIR 29/976, No 16 MU ORB: No 40 Group Administration Instruction No 12: Opening of No 16 Maintenance Unit, Stafford (40G/S.5341).

hours. Second, to ensure a speedy issue time to demanding units, it was agreed that for issues, other than for which a specific time instruction had been given, would be made within forty-eight hours. Third, it was agreed that a forty-eight hour despatch service would be maintained to all RAF stations. To achieve these targets, a standardized way of working for all UEDs was soon implemented, with changes to personnel establishments and administration adjusted accordingly.<sup>9</sup> This commitment to a defined level of service was important in two respects. First, bringing equipment to account quickly enabled an accurate picture of logistics' capability to be maintained; this was particularly important in terms of assessing, from a planning perspective, whether or not operational aspirations could be met and sustained. Second, the speedy despatch of equipment from the depots ensured that front line units could be replenished quickly in the event of unexpected high levels of consumption. This was, of course, entirely dependent on industry manufacturing sufficient stock in the first place.

A commitment to providing a defined level of service was perhaps one of the more straightforward of the issues facing Maintenance Command at this time. The availability of physical storage space was soon to prove more problematical. At the outbreak of war, planning staff in the Air Ministry had little idea of how long the war would last, nor how many stations the RAF would build, both at home and overseas. The growth, even in the first year of war, soon showed that the RAF's stockholding policy, based on the UEDs serving the six geographical areas in Britain, would not be adequate in the longer term and a range of new storage units began to evolve. A combination of an equipment provisioning programme, in support of the Expansion Scheme, and an evolving view of the RAF's war materiel needs led to a substantial in-flow of equipment delivered off war contracts, all of which had to be receipted and placed in an appropriate storage location. Given this, and the fact that not all of the UEDs and their sub-depots were completed, the rate of equipment receipt outpaced the Group's capacity to actually store it. An early indication of the magnitude of this problem came at a conference held at HQ Maintenance Command on 19 January 1940 when the Air Ministry representative advised that the Group should be looking towards holding nine months' worth of stock;

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<sup>9</sup> Air Ministry, *Maintenance*, p.37.

in terms of storage space, it was estimated that this amounted to some 9½ million square feet. When the available storage space was mapped to this planning requirement, two problems emerged. First, the total floor-space available across all the UEDs and other storage when their respective building programmes was complete, only amounted to eight million square feet; it was agreed that the only way this shortfall of 1½ million square feet against the planning requirement could be met was by the creation of an additional UED. The second problem was that, of the eight million square feet capacity of the existing depot infrastructure, not all of it was yet available; construction of several of the storage sheds at Heywood and Quedgeley was not finished and none of the sheds at Stafford were yet in use.<sup>10</sup> To compound this problem, the storage of MT vehicles began to present a similar challenge. A similar review was urgently required for 12,800 assorted vehicles in addition to the normal reserves. However, it was estimated that, when work had been completed on the MT sites at Stafford and Heywood, space would still only be available for 5,350 vehicles, under half the storage capacity required. With the rate of receipt of vehicles estimated to be in the region of 1,000 per month from 1 February 1940, the problem would not diminish.<sup>11</sup> By March 1940, the shortage of storage space in 40 Group had started to present a significant problem with congestion occurring at the UEDs and the various sub-depots. At the Wembley and Hammersmith depots, for example, substantial stocks of anti-gas clothing were leading to overcrowding, whilst at the UEDs some 200,000 square feet of space had been misappropriated for furniture storage.<sup>12</sup> Various temporary arrangements were made such as storage in the open air where possible and the Society of Motor Traders was also approached to seek their assistance in storing RAF vehicles at trade garages.<sup>13</sup>

Despite the progressive introduction of the new types of depots, the projected growth of the RAF led to an increasing concern from planning staffs in 40 Group as to whether the storage capacity was keeping pace; early estimates envisaged that the expansion was likely to be in the region of 228 new

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<sup>10</sup> Ibid, p.38.

<sup>11</sup> Ibid.

<sup>12</sup> Ibid, pp.38-39.

<sup>13</sup> Ibid, p.39.

squadrons by June 1942 – a 100 per cent increase in front line strength.<sup>14</sup> Along with the increase in squadron numbers came the increased range of spares that were required to be held for new aircraft types, particularly those of American origin. To meet this, and taking into account building work that was already underway, it was estimated that a 50 per cent increase in storage space would be required in 40 Group by June 1942.<sup>15</sup> One of the first measures to be taken was to remove the much lower priority ranges of barrack and clothing equipment from the UEDs and to relocate them in dedicated Barrack and Clothing Depots (BCD), six of which had been formed by the end of 1940.<sup>16</sup> The creation of the BCDs relieved part of the storage space problem, but the more pressing issue, however, was the increasing demand load being placed directly on the UEDs. By the end of 1940, there were approximately 478 RAF units, each demanding separately on an item-by-item basis.<sup>17</sup> This piecemeal way of dealing with equipment demands placed an enormous strain on the logistics' system, with each demand requiring its own paperwork, picking from stock, packing and then despatch to the demanding unit; it was estimated that ten separate demands for just one item, took almost ten times longer to process than one demand for ten times the quantity.<sup>18</sup> The solution to this problem was to create intermediate depots, or holding parks, forward and much closer to the operational units. Known as Equipment Parks (EP), these units relieved stockholding pressures and reduced some of the workload at the UEDs by holding forward three months maximum and two months minimum levels of aircraft stores. These new units maintained their holdings (on a similar basis to the UEDs) by submitting demands on their parent UEDs and directly met the equipment demands from the RAF units within their respective areas. Initially, two parks were formed on a trial basis; by the end of the war, a total of fifteen EPs had been established. The benefit of the parks was not just in terms of creating additional space and reducing workload at the UEDs. They also enabled a greater proportion of equipment to be dispersed, a concern which

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<sup>14</sup> Ibid, p.154.

<sup>15</sup> Ibid.

<sup>16</sup> TNA, AIR 2/8185, Reorganisation of Maintenance Command, Memoranda E.40/42 – RAF Equipment – Storage and Distribution Organisation in the United Kingdom (S.81906) dated 24 June 1942 and Air Ministry, Maintenance, pp.136-137.

<sup>17</sup> Air Ministry, *Maintenance*, p.137.

<sup>18</sup> Ibid, p.138.

had gained increasing prominence following the Luftwaffe's attacks on British cities and industrial infrastructure during late 1940 and early 1941.<sup>19</sup>

Although the introduction of the BCDs and EPs did much to relieve the pressure on the main UEDs, the relentless flow of equipment into RAF storage continued apace, well into 1942. Time precluded the building of a further UED which was estimated to take at least two years and a further measure was therefore introduced in the first half of 1942 with the creation of a new type of depot, initially known as Equipment Dispersal Depots (EDD), but renamed Ground Equipment Depot (GED) in June 1942.<sup>20</sup> Four of these new depots were initially constructed, each of 250,000 square feet capacity. It was originally intended that these depots would primarily be a form of bulk holding unit feeding the UEDs, but they soon evolved into a specialist stockholding unit in their own right, holding a wide range of non-airborne equipment such as machine tools, spares for MT and marine craft, general hardware, paints and metals.<sup>21</sup> A total of seven GEDs were eventually established and served the same geographical areas for its range of equipment as the UEDs. By June 1942, the progressive removal of the non-airborne ranges of equipment from the UEDs into the newly formed ground equipment depots, led to them being re-named Aircraft Equipment Depots, a designation they retained for the duration of the war.<sup>22</sup> In addition to the main equipment storage depots, further specialist depots were also built to receive and store MT vehicles and marine craft. From September 1939 through until May 1945, the number of equipment storage units (excluding those for MT and marine craft) more than quadrupled. This development is detailed by year in Table 24.

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19 TNA, AIR 2/8455, Equipment Dispersal Depots – Proposals by Maintenance Command 1941, HQ Maintenance Command letter MC/S.9383 – RAF Equipment Storage and Distributive Organisation at Home dated 11 April 1942.

20 TNA, AIR 2/8455, Equipment Dispersal Depots – Proposals by Maintenance Command 1941, HQ Maintenance Command letter RAF Equipment Storage and Distributive Organisation at Home dated 19 June 1942.

21 Air Ministry, *Maintenance*, p.144, TNA, AIR 2/8455, Equipment Dispersal Depots – Proposals by Maintenance Command 1941, HQ Maintenance Command letter S.68709/0.1.b – RAF Equipment Storage and Distributive Organisation at Home dated 19 June 1942 and Air Ministry Memorandum No. 1007 – Treasury Inter-Service Committee: Proposed Construction of Equipment Dispersal Depots (S.68709/F.5) dated 20 May 1941.

22 TNA, AIR 2/8455, Equipment Dispersal Depots – Proposals by Maintenance Command 1941, Organisation Memorandum. No /42.

Unit Type	Sep 1939	Dec 1940	Dec 1941	Dec 1942	Dec 1943	Dec 1944	May 1945
Universal Equipment Depots	5	6	7	-	-	-	-
Aircraft Equipment Depots	-	-	-	7	7	7	7
Barrack & Clothing Depots	3	6	5	6	6	6	6
Equipment Parks	-	-	7	15	15	15	15
Ground Equipment Depots	-	-	-	6	7	7	7
Totals	8	12	19	34	34	34	34

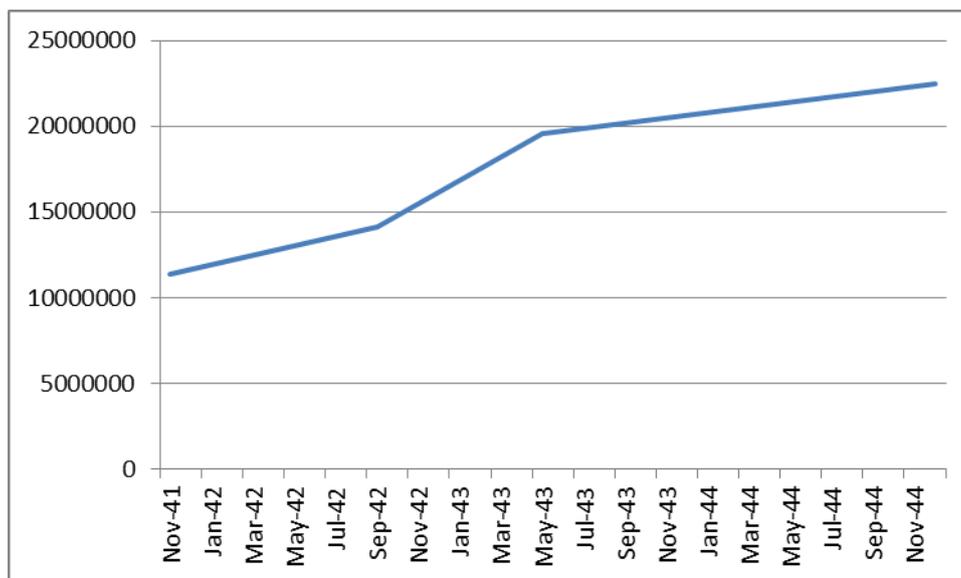
**Table 24 -  
Growth of 40 Group Equipment Storage Units in the United Kingdom 1939 to May 1945<sup>23</sup>**

The whole question of sufficient storage space remained an ongoing problem throughout the war and the official Air Ministry history recounts a complex and diverse range of solutions to this problem, from new-build sites and hirings, through to the use of redundant Balloon Centres and RAF units at the end of 1944 when the concluding months of the war were rapidly approaching.<sup>24</sup> An exact figure for the growth is difficult to determine, primarily due to the lack of comprehensive and comparable statistics for all the 40 Group units. However, of the figures available, the general picture shows that the Group managed to approximately double its storage space in square feet between 1941 and the end of 1944, by which time the main storage units had amassed over twenty two and a half million square feet of storage space.<sup>25</sup> This increase, by year and square footage, is detailed in Figure 12.

<sup>23</sup> Source: Data extracted from Air Ministry, *Maintenance*, p.152, Diagram 18.

<sup>24</sup> TNA AIR 2/8316, Storage Requirements of No 40 Group 1944-1945, Air Ministry letters S.1371/ADO1 – Dismounting of Balloon Barrages: Additional Space for Maintenance Command and S101315 – provision of Airfields for Maintenance Command Storage Requirements dated 20 September 1944.

<sup>25</sup> Air Ministry, *Maintenance*, Appendix 14, Equipment Storage November 1941 – December 1944.



**Figure 12 -  
Growth of 40 Group Main Storage Capacity (Square Feet) November 1941 to December 1944<sup>26</sup>**

Despite the logic of this depot/unit breakdown, the reasoning behind it was not always supported. One such dissenter in the early stages of the war was Sir Arthur Harris when he was Air Officer Commanding 5 Group. A far-sighted commander, he was keen to ensure that his ground support organization was as effective as possible, thereby letting his aircrews get on with the flying. As far as logistics was concerned, he had asked for a dedicated depot to be set up within his group to handle purely Handley Page Hampden aircraft spares; Number 5 Group was the sole operational user of the aircraft at the time. Understandably, he saw the need as quite simple with a dedicated, aircraft-specific depot receiving spares direct from manufacturers. However, when he heard that a new MU was being set up near Manchester for this purpose he was not impressed 'It is fundamentally wrong, even stupid, to make a triangle out of a line of supply when a direct line is all that is necessary'. He went on to add that 'Minutes, let alone hours, days or weeks, will count when the war really starts'. His view made sense, albeit from the perspective of just one Group commander and his specific aircraft needs; it also showed that some senior commanders took logistics seriously.<sup>27</sup> His request was never implemented and the equipment depot structure which evolved was viewed as adequate to meet his needs. Moreover, if exceptions had been made for one

<sup>26</sup> Source: TNA, AIR 2/8316, Storage Requirements of No 40 Group 1944-1945 and Air Ministry, *Maintenance*, Appendix 14, Equipment Storage November 1941 – December 1944.

<sup>27</sup> Cited in: Probert, H., 'Supply: Two Wartime Examples' in Proceedings of the RAF Historical Society Seminar – Supply: an Air Power Enabler, 30 October 2004 (Northmoor: Advance Book Printing, 2005), pp.35-36.

aircraft type, there was then the risk that other commanders would make similar demands, a position which would progressively undermine the UEW concept.

### **Storage Developments in 42 Group Maintenance Command - Explosives**

As the war progressed, the need for explosives of all types grew rapidly and this led to a significant growth in the holdings of the 42 Group depots. The greatest expansion occurred as a result of the preparations for the invasion of North West Europe. For example, in February 1943, the total holdings of high explosives and incendiaries amounted to some 192,486 tons but, just one year later, this figure had grown to 275,000 tons.<sup>28</sup> Even more dramatic, the turnover from the beginning of the war through to December 1940 was 350,000 tons but by 1943 this had tripled to 1,059,696 tons; by 1944, the figure had reached 3,068,127 tons.<sup>29</sup> This had placed an enormous strain on the Ministry of Aircraft Production factories; between 1939 and the peak output in 1944, annual production had risen from 103,400 to 1,196,400 tons.<sup>30</sup> Accompanying this growth was a corresponding increase in the number of depots required, although nowhere near as extensive and diverse as that seen in 40 Group. The main explosives storage facilities were the Ammunition Depots (AD); four of these were in operation in 1938/39, and a fifth at Llanberis (31 MU) was added in May 1941. Forward of these ADs were seven Air Ammunition Parks (AAP), constructed at carefully selected locations before the war within the geographical areas of the operational bomber stations.<sup>31</sup> Despite its apparent simplicity, the supply chain up until 1941 had nine stages of handling within the Group.<sup>32</sup> Given the projected significant increase in the requirement for bombs between 1943 and 1945, it became clear that a more flexible and rapid distribution system would be needed.

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28 Air Ministry, *Maintenance*, p.121.

29 Ibid.

30 Data extracted from: Air Ministry, *Maintenance*, Appendix 13(b), Deliveries of Bombs and Chemical weapons from the Ministry of Aircraft Production Factories from 1939 to 1945,p.441. This source attributes munitions production to MAP which is almost certainly incorrect and should be attributed to the Ministry of Supply - J. Scott and R. Hughes, *Administration of War Production*, pp.219-220 refers

31 Air Ministry, *Maintenance*, pp.121-125.

32 Ibid. The source does not specify what these stages were.

Consequently, the Air Ministry introduced what was known as the Forward Ammunition Depot Scheme in late 1941/early 1942. As part of this, all the existing AAPs became Forward Ammunition Depots (FAD), each with a storage capacity for 10,000 to 20,000 tons of high explosive (HE) and looking after fifteen to twenty five heavy bomber squadrons, operating from ten to fifteen airfields situated within a radius of twenty-five miles of each FAD.<sup>33</sup> A number of the new depots had sub or 'satellite' sites, many of which had been constructed in early 1940. In the early years of the war these acted as a form of reserve holding and held duplicate stocks to the parent unit; as the danger of enemy air attack lessened, these satellites were absorbed into the general storage plans of the parent unit and provided much-needed extra capacity as the Bomber Offensive commitments grew. Many utilised open storage on standings in woodlands or along the verges of minor roads, areas which then had to be closed to the public. The AAP designation was retained, however, for a much smaller size of units which were situated in outlying areas looking after the comparatively smaller and infrequent needs of Fighter and Coastal Command stations. To cater for any potential breakdown in the forward supply programme, Reserve Ammunition Depots (RAD) were also created, each with a capacity for 20,000 to 40,000 tons of HE.<sup>34</sup> The revised scheme worked well although the numerous designations became somewhat confusing and before long the new RADs became ADs and the FADs and AAPs both became AAPs. Despite the name changes, the functions of the various units remained the same. The growth of 42 Group units in Britain, from December 1939, through until July 1945 is shown in Table 25.

Unit Type	Dec 1939	Dec 1940	May 1941	Nov 1942	Dec 1943	Dec 1944	Jul 1945
Ammunition Depots (AD)	4	4	5	5	9	9	10
Air Ammunition Parks (AAP)	7	8	9	12	11	13	14
Reserve Ammunition Depots (RAD)	-	-	-	3	-	-	-
Forward Ammunition Depots (FAD)	-	-	-	-	2	-	-
Totals	11	12	14	20	22	22	24

**Table 25 -  
Growth of 42 Group Ammunition Storage Units in the United Kingdom  
December 1939 to July 1945<sup>35</sup>**

<sup>33</sup> Ibid, p.125. These units almost certainly held stock of incendiaries as well although this is not shown in the source.

<sup>34</sup> Air Ministry, *Maintenance*, p.125.

<sup>35</sup> Data extracted from: Sturtivant et al, *Royal Air Force Flying Training and Support Units*, pp.204-215.

## Storage Developments in 42 Group Maintenance Command - POL

The overall reserves of POL increased substantially throughout the war years. Perhaps the most significant was that of aviation fuel with the 1936 holdings of 8,000 tons increasing to a total of 2,090,700 tons distributed across thirty-six main reserve storage depots and forty-two distribution depots.<sup>36</sup> Despite the fact that so little was known about the likely nature of the war and to what extent Britain might be subjected to air attack, much time and effort went into fuel storage tank design and construction, especially the requirement for protection from enemy attack. As early as 1937, a special Technical Sub-Committee of the Oil Board was formed to oversee all aspects of tank design. Headed by the Secretary of Mines, the Board consisted of representatives from the Oil Board, Petroleum Companies, Service Departments and the Home Office. The Board had a fair amount of executive authority as no construction could proceed without its approval. In parallel with this, the Air Ministry's Works Directorate was actively working on formulating design principles to afford the best possible protection from air attack, as well as carrying out full scale trials on the effects of explosion and the subsequent penetration of tankage.<sup>37</sup> As far as tank design was concerned, four types were developed: Types C1 and C2 for above ground storage and Types D1 and D2 for underground storage.

Apart from the bulk storage of fuel, arrangements were also made in 1937 for the manufacture and filling of suitable tin containers, known as 'packed' storage. This requirement would prove to be an important tactical 'enabler' during many of the campaigns during the Second World War and enabled fuel to be provided, until tankage or pipeline supply could be introduced in operational theatres. Joint schemes were set up in conjunction with the Army, who also had a substantial need for packed fuel stocks for their mechanised forces. Tin-making and filling factories were set up at Stanlow and Ardrossan, each adjacent to a ready supply of fuel from a Shell Refining and Marketing Co Ltd refinery. In 1940 it was decided to create separate dumps of packed stocks in suitable locations as an emergency operational reserve.

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<sup>36</sup> Air Ministry, *Works*, p.272.

<sup>37</sup> *Ibid*, p.276.

Overall, there were forty-six of these storage dumps with a total capacity of 120,000 tons of fuel.<sup>38</sup>

### Storage Overseas

In September 1939, the number of sizeable RAF logistics' MUs overseas was relatively small. The most significant was Number 101 MU at El Ma'sara in Egypt. Elsewhere, supply services were collocated with smaller repair depots or as smaller, detached facilities. As the war progressed, unfolding campaigns gradually added more logistics' MUs to the RAF's order of battle, though these came under the command and control of the appropriate overseas Command and Group structure, rather than as part of Maintenance Command. The exact number of these is difficult to ascertain as many changed use or were disbanded and re-formed as a different unit type in another location altogether. As an approximate indication, some thirty-three additional MUs were formed between 1940 and 1945 in the area of the Middle East, the Mediterranean and Africa; twenty-one in the area of India and Burma; four in Italy and two in Singapore.<sup>39</sup>

One sizeable, temporary storage area formed for Operation OVERLORD in 1944 is notable and warrants more detailed comment. The need for some form of base maintenance organization had been considered for some time prior to OVERLORD, although it was not until 8 January 1944 that the HQ of 85 (Base) Group was formed.<sup>40</sup> Following the invasion and as the bridgehead enlarged and became more secure, the Allies were able to develop what was known as the Rear Maintenance Area (RMA), which provided a more permanent location for logistical support. The British RMA was substantial and its layout resembled a spider's web, with numerous depots and bases radiating from the town of Bayeux, south-west of Arranches. In many ways, the whole of the surrounding countryside resembled an enormous retail park. Within this boundary the RAF had four main depot areas, three of which were in the vicinity of Creully with a fourth, established later in the campaign, just outside Caen.<sup>41</sup>

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<sup>38</sup> Ibid, pp.282-283.

<sup>39</sup> Sturtivant et al, *Royal Air Force Flying Training and Support Units*, pp.204-220.

<sup>40</sup> Air Ministry (AHB), RAF Narrative (First Draft), *The Liberation of North West Europe, Volume II, The Administrative Preparations* (London: Air Ministry, Undated), pp.231-232 and Air Ministry, *Maintenance*, p.325.

<sup>41</sup> J. Man, *The Penguin Atlas of D-Day and the Normandy Campaign* (London: Penguin Books, 1994), p.87.

By 24 July 1944, a substantial and relatively secure bridgehead had been established on the Continent allowing the Allies to breakout in late July, with the British advancing through Belgium, Holland and then into Germany. Throughout the breakout, the ASPs kept pace with the flying squadrons as they moved forward. Just before the breakout, the Rear HQ of 2<sup>nd</sup> TAF moved to Normandy along with an advance party of No 85(Base) Group to assist with running the RMA. Up until this point, the RMA remained the advanced base on the Continent and it was supplied through the Mulberry harbour at Arromanches and the three beach-heads in the British sector. The breakout brought a new challenge in the form of meeting the needs of the advancing airfields and RAF units as they moved forward and over an increasingly lengthened Line of Communication (LoC). Initially, the advancing forces were resupplied by road and rail from the RMA but, as the LoC was extended, it soon became necessary to open supplementary ports through which to discharge men, machinery, equipment and supplies. Continued enemy opposition, however, in the Channel ports area made this difficult and it soon became clear that the capture of the port at Antwerp was an urgent operational necessity, although it was not successfully captured until 4 September 1944.<sup>42</sup> The problem was that Antwerp is some eighty miles inland and connected to the North Sea by the River Scheldt – land on either side of the river remained occupied by the enemy with the German 16<sup>th</sup> Army (bypassed by Montgomery on his advance) effectively controlling access to the port from the sea. It was not until the end of November 1944, following further operations to clear the enemy, that the port of Antwerp became usable by the Allies.<sup>43</sup> Notwithstanding this, the area around Antwerp was soon developed into an advanced logistical base which enabled a sizable component of the Normandy RMA (including much of the 85 (Base) Group stock) to move forward. This was particularly important for the air component as, up until this point, re-supply (especially for heavy and bulky supplies such as POL, explosives and large airframe spares) to the ASPs that were supporting the advancing RAF units in northern France, Belgium and Holland, were still being disembarked in Normandy and moved-on by road. The new logistical base at Antwerp enabled holdings of equipment and supplies to be accumulated in quantity much closer to the advancing RAF squadrons. With the

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42 R. Neillands, *The Battle for the Rhine 1944* (London: Weidenfeld & Nicolson, 2005), pp.70-71

43 Ibid, pp.157-173.

eventual opening of the port, the need for road movement from Normandy rapidly diminished.

The first few months of 1945 were a period of build-up of reserve stocks to support the forthcoming spring campaign. A target date of 1 March had been set by RAF planners as the point by which the deployed RAF was required to be at its maximum strength in aircraft and crews, as well as adequate supplies and reserves. The target was achieved by the beginning of the offensive and the move forward did not cause any undue problems for RAF logistics, with existing bases being able to support operations up to the crossing of the Rhine. The problem from there on was how the advancing forces could be supported through an area where the railway infrastructure was completely wrecked and there was limited bridging over the River Rhine itself. There was still little hope of opening any further ports and Antwerp remained the main port until perhaps Bremen could be captured. Indeed, the 21<sup>st</sup> Army Group decided that they would be looking towards Hamburg as their next Advanced Base. For its operations, the RAF concentrated stocks of equipment and supplies in the area of Goch, a position on the main LoC and as close to the River Rhine as was possible; by the time of the crossing of the river, the RAF had concentrated sufficient supplies to maintain any advance that Numbers 83 and 84 Group might be required to undertake.<sup>44</sup>

## **Protection of Stocks**

### **Depot Stocks in the United Kingdom**

Whilst limited use had been made of underground storage during the First World War, the growth, capability and range of the Luftwaffe's bomber aircraft in the period leading up to the Second World War significantly increased the risk of air attack on the RAF's logistics infrastructure in the United Kingdom.<sup>45</sup> Early on in the war, the Air Ministry was particularly concerned that a significant proportion of 40 Group's in-use storage space was situated in industrial target areas; of the 8 ½ million square feet in use, approximately 1½

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<sup>44</sup> Air Ministry, *Maintenance*, pp.348-351.

<sup>45</sup> N.J. McCamley, *Secret Underground Cities* (Barnsley: Leo Cooper, 1999), p.8.

million was located in the areas of London, Newport, Sheffield and Manchester.<sup>46</sup> The perceived risk to the depots from enemy air attack had become an area of concern as early as the autumn of 1938. The operations record book of 14 MU Carlisle, for example, recorded that 'on this date, as a result of the Czecho-Slovakia [sic] /German crisis, No. 14 Maintenance Unit was opened. Had the crisis resulted in war, it was anticipated that there would have been a bombardment of the existing R.A.F. Maintenance Units at a very early stage'.<sup>47</sup>

The Air Ministry's approach to mitigating the risk of stock losses following enemy air attack for the new 40 Group equipment depots, constructed as part of the Expansion Programme, was one of distance and dispersal. Distance was achieved by siting the new depots west of a line between Edinburgh & Southampton, thereby placing them as far as possible from the Luftwaffe's operational bomber airfields on the Continent; this distance, however, was shortened significantly following the German invasion of France in 1940 and the Luftwaffe's occupation of new airfields situated considerably closer to the United Kingdom.<sup>48</sup> Dispersal was achieved by distributing the depot storage sheds across well dispersed sub-sites. The sheds themselves were built to three construction standards, ranging from full protection (from small incendiary bombs and splinters), a limited level of protection and a non-protected standard.<sup>49</sup> Further dispersal measures were implemented in the autumn of 1940 to divide stocks of important items between sheds and sites to reduce further the risk of complete loss of stock in the event of an air attack.<sup>50</sup> The fuel and ammunition stocks of 42 Group were the subject of more extensive use of underground and semi-buried storage, although this was predominantly intended to minimize the risk to the surrounding civilian population. Camouflage also had a role to play and the MUs were subject to the RAF's General Camouflage Policy which was developed by the Air Ministry in 1938 and remained in use throughout the war until it was discontinued in 1944.<sup>51</sup>

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46 Air Ministry, *Maintenance*, pp.348-351.

47 TNA, AIR 29/973, Royal Air Force Operations Record Book and Appendices (Form 540), Headquarters No.14 MU entry dated 26 September 1938.

48 *Ibid*, p.50.

49 Air Ministry, *Works*, p.288.

50 Air Ministry, *Maintenance*, pp.158-159.

51 Air Ministry (AHB), RAF Monograph (First Draft), *Decoy and Deception* (London: Air Ministry, Undated), p.99.

Identifying how the RAF went about its stock protection measures is relatively straightforward. The question of assessing the effectiveness of the measures is more complex. The first real test of the measures in the United Kingdom came with the Blitz during late 1940 and early 1941. As part of a wider enemy air raid on Coventry during the night of 14/15 November 1940, some 3 per cent of 40 Group's storage space was lost when 'C' MU at Coventry (predominantly barrack stores) was hit.<sup>52</sup> Whilst there was not an immediate Air Ministry reaction, the attack did precipitate many of the engineering firms in the Midlands to seek dispersed factory accommodation, including Rover whose Helen Street works had been severely damaged during the raid. Some six months later, the Ministry of Aircraft Production encouraged Rover to consider relocating their component production to an underground facility at Drakelow near Kidderminster. Rover was not entirely enthusiastic about this proposal, primarily due to the disruption to production which would inevitably occur through relocation of plant and machinery. Lengthy negotiations between MAP and Rover and the reduction in the intensity of the German bombing campaign by the end of 1942, meant this initiative made little progress and only half the Rover component production capability was relocated to Drakelow.<sup>53</sup> Drakelow was used by the RAF and some 82,500 square feet was utilised by 40 Group for aircraft components in 1942.<sup>54</sup> It was only the fuel installations of 42 Group which were directly attacked by the Luftwaffe. The depot at Plymouth was attacked three times during 1941 and once in 1944. Falmouth and Barrow were each attacked in 1941. Of all the attacks, raids on Poole and Falmouth were the most significant in that they were the only installations where any damage was actually done to storage tanks.<sup>55</sup> There is no archival evidence for direct enemy attacks on the Group's ammunition stocks, although Number 31 MU Llanberis in North Wales suffered a major tunnel roof collapse in January 1942 and Number 21 MU at Fauld in Staffordshire suffered a catastrophic underground explosion in November 1944; neither of these incidents was the result of enemy action.<sup>56</sup>

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52 McCamley, *Secret Underground Cities*, p.223 and Air Ministry, *Maintenance*, p.139.

53 McCamley, *Secret Underground Cities*, p.223.

54 Ibid, p.224.

55 Air Ministry, *Works*, pp.281-282.

56 N.J. McCamley, *Disasters Underground* (Barnsley: Pen and Sword, 2004), pp.61-76 & 90-132 and Air Ministry, *Maintenance*, p.127.

The Air Ministry narratives, especially *Works* (AP 3236) and *Maintenance* (AP 3397) are quite thin on detail regarding damage to logistics' infrastructure, with perhaps the exception of 42 Group locations, an omission which suggests this was not an issue for Maintenance Command. Even during the War, such was the level of confidence in the protective measures, that the Air Ministry Directorate General of Works saw no reason to establish any department or office to monitor damage from air attack - 'efforts were naturally concentrated on repair and rehabilitation'.<sup>57</sup> The other Air Ministry official narratives for the same period though, contradict this rather simplistic assertion regarding the effectiveness of the protective measures. The narrative on the Battle of Britain for example, records that six occurrences of slight damage to RAF equipment depots were sustained during the period 1 June 1940 to 30 September 1940, although the account does not specify where or when these attacks occurred, nor if they were part of a wider raid.<sup>58</sup> A more detailed analysis of the respective Operational Record Books, however, reveals a more complex picture. The level of detail in these primary sources varies enormously – some record each and every occurrence of an air raid alert, whilst others record only those that had an actual impact on the unit in question; the net result is detailed in Table 26. What is clear from these results is that a relatively low number of attacks or direct threats actually occurred.

MU	Location	Recorded Air Raid Alerts	Actual Attacks/Direct Threat
1	Kidbrooke (S.E. London)	13	10 attacks in 1940 3 attacks in 1941 (Blitz related) 4 attacks in 1944 including 2 direct hits from V1 flying bombs.
3	Milton (Oxfordshire)	89	1 attack in 1940
4	Ruislip ((Middlesex)	151	1 attack in 1940
7	Quedgeley (Gloucestershire)	132	
14	Carlisle (Cumbria)	1	
16	Stafford (Staffordshire)	6	1 enemy aircraft incursion
25	Hartlebury(Worcestershire)	10	
35	Heywood (Lancashire)	26	2 attacks in 1940

**Table 26 -  
Enemy Air Raid Alerts and Attacks Causing Damage or a Threat to the RAF's Universal  
Equipment Depots 1940 to 1944<sup>59</sup>**

<sup>57</sup> Ibid, p.208.

<sup>58</sup> Air Ministry, Air Historical Branch (AHB), *The Battle of Britain*, A Narrative Prepared in the Air Historical Branch (undated), Appendix 31.

<sup>59</sup> Source data extracted from: TNA files – AIR 29/998, 35 MU Heywood Operational Record Book (ORB); AIR 29/964 & AIR 29/965, 7 MU Quedgeley ORBs; AIR 29/987, 25 MU Hartlebury ORB; AIR 29/973 & AIR 29/974, 14 MU Carlisle ORBs; AIR 29/976, 16 MU Stafford ORB; AIR 29/957, 1 MU Kidbrooke ORB; AIR 29/959, 3 MU Milton ORB and AIR 29/960, 4 MU Ruislip ORB.

The greatest numbers were recorded on No 1 MU Kidbrooke in South East London – more as a result of its proximity to the heart of the City of London, rather than as a specific target. Notwithstanding, what is clear is that the RAF's supply chain was not subject to any concerted or sustained effort by the Luftwaffe to destroy or disrupt it, excluding, of course, the targeting of British industrial sites during the German night offensive from November 1940 through to May 1941.<sup>60</sup> The Luftwaffe, however, was well aware of the location of the RAF's key logistics' sites through active intelligence gathering.<sup>61</sup> Given the significance of the depots in terms of their role in sustaining RAF air power, the question which arises is why they were not selected as specific targets for intensive or sustained attack? The answer lies not in the doctrine of German air intelligence as 'supply depots of all types' and 'air supply depots and dumps of all types' were both specific target sub-categories classed as 'Mission 1: Counter-air Action – Targets on the Ground'.<sup>62</sup> The most likely explanation is three-fold. Firstly, one of need, a point made by the historian Taylor Downing who asserts that 'because, in the first part of the war, German military activity had been offensive, the principal need had been for tactical military information, not for the strategic interpretation of their enemy's war economy'.<sup>63</sup> Secondly, and a common theme throughout the literature on this period, is reference to poor intelligence which Basil Liddell Hart described as a 'constant German handicap'.<sup>64</sup> Whilst the information gathered as part of the German planning for an invasion of Britain (Study Blue) and the subsequent accumulation of photographic reconnaissance data provided a relatively comprehensive assessment of target detail, this, as pointed out by Liddell Hart, was 'inadequately supplemented by the Luftwaffe's own Intelligence department – which was headed only by a major'.<sup>65</sup> Although the analysis of Study Blue was supplemented by civilian experts from fields such as industry, economics,

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60 B. Collier, *History of the Second World War – The Defence of the United Kingdom* (London: HMSO, 1957), pp.261-281 & Ray, *The Night Blitz*, pp.225-232 refer. Contemporary logistics theory considers the manufacturing element as the start of most supply chains.

61 Such intelligence had been gained through the comprehensive listing of RAF units (including their locations) in the Air Force lists up to 1938 and air reconnaissance photographs which had also been taken as early as 1938 by Lufthansa aircraft with concealed cameras. See: T. Downing, *Spies in the Sky – The Secret Battle for Aerial Intelligence during World War II* (London: Little, Brown, 2011), p.337; Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), *Scotland from the Air 1939-49 Volume 1 – Catalogue of the Luftwaffe Photographs in the National Monuments Record of Scotland* (Edinburgh: RCAHMS, 1999), p.4, B.H. Liddell Hart, *History of the Second World War* (London: Pan, 1970), p.121 and H. Boog, *German Air Intelligence in the Second World War* in M. I. Handel (ed), *Intelligence and Military Operations* (London: Cass, 1990), p.370.

62 Deichmann, *The System of Target Selection*, pp.11-12.

63 Downing, *Spies in the Sky*, pp.337-338.

64 Liddell Hart, *History of the Second World War*, p.121.

65 Ibid, p.121. Other commentators on this limitation include: Boog, *German Intelligence in the Second World War*, p.366 and Lund, *The Battle of Britain*, p.31.

foreign trade, technology and politics to provide specialist input, it is unlikely that the significance of RAF logistics was considered.<sup>66</sup> In part, this could be explained by the fact that little significance was attached to logistics by the Luftwaffe's operational planning staffs as a result of what could be termed as Germany's blitzkrieg mentality. This cultural effect had developed within the Luftwaffe since its early days. Indeed the Air Division, Control Commission for Germany (British Element) study on German Air Force Supply makes the point that 'the leading pioneers of the German Air Force concerned themselves with aircraft production, the training of pilots and the dissemination of propaganda. They had little time for consideration of supply problems...'.<sup>67</sup> This mentality is well illustrated by the Secretary of State for Air (Generalfeldmarschall Erhard Milch) in January 1938 during an exchange of views on repairs with the Director of the RLM Technical Department (Generaloberst Ernst Udet) in which he expressed the view that '...all campaigns will be short and German aircraft production will be so tremendous that during such periods of operation no major repairs will be necessary. Damaged planes will be repaired and salvaged at home after the campaigns are won'.<sup>68</sup> Either way, there does not appear to have been recognition that there were links between aircraft manufacturing companies, the RAF depots and RAF flying units – a supply chain perspective. It was not just complete aircraft that industry was manufacturing and supplying to the RAF, but a host of spare parts and materials, as well as tools, test equipment and various ancillary items to enable activities such as battle damage repair and maintenance to be conducted. Enemy targeting of industrial plants was an understandable priority but, given that aircraft spares were being accumulated in great numbers at the UEDs and that these units were the main distributors to RAF flying units, serious targeting of these units at an early stage of the Battle of Britain would have had a significant impact on unit operations. The intelligence data gathered failed to recognize that large amounts of mission critical equipment and spares were effectively being funnelled-in to just eight UEDs. The third issue, and perhaps the most influential, was the ultimate decision-making. In this respect, Herman Göring and his Chief of the Air Staff, Hans Jeschonnek had much to answer for and contributed to a regime of unsystematic target selection. Both of these individuals, according to the

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66 Lund, *The Battle of Britain*, Addendum, p.32 and Deichmann, *The System of Target Selection*, pp.50-51.

67 *Air Division, A Study of the Supply Organisation of the German Air Force*, p.71. See also Stockfish, *Linking Logistics and Operations*, p.8.

68 *Ibid.*

German historian Horst Boog, 'bore the responsibility for the frequent changes of targets and the lack of sustained attacks on certain targets ... and also to a large measure for the resultant lack of success of the Luftwaffe's effort'.<sup>69</sup>

## Depot Stocks Overseas

Whilst the threat from enemy ground and air attack to the RAF's logistics depot structure in the United Kingdom diminished after the Battle of Britain in late 1940, the logistics depots overseas were to remain at risk. Three examples illustrate the predicament which some units found themselves in as a result of changing tactical conditions.

The first example is the campaign in France during 1939/1940. The overall logistics support concept for the RAF squadrons which deployed to France was based on the maintenance concept in the RAF's 1928 *War Manual*. The use of ASPs was a key part of this but, in accordance with pre-war planning, a Base Depot was also established in France which was to hold up to six months' stock of spares for RAF squadrons on the Continent. Thus, Number 21 Aircraft Depot was established at Nantes as part of No 2 Base Area with its own Port Detachment (as intended in the *War Manual*) to receive shipments of equipment from Britain. The location of the depot had been carefully selected as the location for the Base Area as the city was a major port situated on the River Loire, near the Bay of Biscay.<sup>70</sup> In addition to a repair capability for tasks requiring up to 400 man-hours of work, the depot was responsible for the issue of repaired engines and airframes and holding equipment for the RAF in France.<sup>71</sup> Its deployment to France and initial setting-up did not go smoothly, mainly due to shortages of equipment and personnel. As a result of the difficulties, the Depot was set up in what was called an *attenuated form* which meant that its Equipment Holding Unit (EHU) acted as a transit pool rather than a stock holding unit; this had the damaging impact in that it led to the ASPs having to carry considerably more stock than originally planned, much of it much heavier and bulkier than the norm. As a result, when the ASPs arrived in France, they had to be maintained direct from the United Kingdom and their

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<sup>69</sup> Boog, *German Air Intelligence*, p.366.

<sup>70</sup> Air Ministry (AHB), RAF Narrative (First Draft), *The Campaign in France and the Low Countries* (London: Air Ministry, Undated),p.114.

<sup>71</sup> Air Ministry (AHB), RAF Narrative (First Draft), *The Campaign in France and the Low Countries* (London: Air Ministry, Undated),p.118.

holdings had to be increased from the planned one month's to two month's supply. Until this problem was resolved, the mobility of the ASPs almost completely disappeared. By the end of January 1940, progress was made in bringing stock holdings up to the required levels. By the end of April, the EHU was able to receive from the United Kingdom (UK) up to six-weeks' worth of stock for all ranges of equipment in the RAF's vocabulary of stores and to issue clothing, barrack stores and MT spares. However, it took until 14 May 1940, four days after the German attack started, for the EHU to be in a position to issue items from all vocabulary sections.<sup>72</sup> The changing tactical situation, which saw British forces withdraw and eventually be evacuated from the Continent, placed 21 Aircraft Depot at significant risk and some 800 tons of its equipment were evacuated to the UK as a result of the pace of the German offensive. By 12 June a further, more drastic evacuation of stocks commenced and this succeeded in recovering all of the EHU's stocks of spare engines, 95 per cent of non-technical and 100 per cent of the technical equipment back to the UK before the final evacuation began. Despite the considerable efforts to evacuate equipment, a great deal was still lost during the withdrawal. Much of the Air Component's equipment was lost by enemy interception and there was no time or capacity to ship much of the AASF's equipment that reached the western ports at the end of the campaign. The loss of aircraft (from all causes) was also high and amounted to nearly one thousand between 10 May and 20 June 1940. At the end of the campaign and following the evacuation to the UK, the AOC Maintenance Command estimated that the RAF had lost in France (excluding aircraft and equipment in squadrons and smaller units in the forward area) the equivalent of four complete ASPs, or stock to the value of about £1,000,000.<sup>73</sup> This experience clearly illustrated just how vulnerable deployed MUs could be.

The second example is the campaign in North Africa during which changing fortunes saw both Allied and Axis forces advancing and retreating during 1941 and 1942. Again, as conceived in the 1928 *RAF War Manual*, the ASPs had a critical role in supporting deployed flying squadrons in the Western Desert; as with the situation in France, they all relied on a base depot/aircraft

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72 Air Ministry (AHB), RAF Narrative (First Draft), *The Campaign in France and the Low Countries* (London: Air Ministry, Undated), pp.117-122.

73 Air Ministry (AHB), RAF Narrative (First Draft), *The Campaign in France and the Low Countries* (London: Air Ministry, Undated), p.474.

park to provide stocks of equipment when resupply was required. A more detailed examination of their work is covered in Chapter Eight. At the outbreak of war, Number 101 MU at Aboukir (north east of Alexandria) and Number 102 MU at Abu Sueir (further east towards the Canal area) were the main depots in this area. An additional Equipment Depot was also formed at Kasfareet (relatively close to Abu Sueir) and commenced operating as No 107 MU in December 1940. Concern soon began to grow regarding the vulnerability of the Depot at Aboukir to air attack and sabotage so it was proposed that a move to the Canal area would prove safer. Consequently, the spares holdings and Equipment personnel were moved back to 102 MU at Abu Sueir. By November 1941, there were at least twelve MUs and miscellaneous units operating in the Nile Delta area providing engineering and logistics' services.<sup>74</sup> The arrival of Rommel and his Africa Corps in North Africa in February 1941 signalled a marked change in the way the war was progressing in North Africa. By the middle of the year, Axis forces had intensified their attacks on Allied bases. During July and the early part of August 1941, No 102 MU at Abu Sueir was attacked systematically. The loss of spares was not as great as it might have been and after the first 'serious' air raid, the depot managed to evacuate most of its valuable plant and stocks – a feat accomplished within the remarkable timescale of just three days. The loss of Abu Sueir was a timely reminder to the logistics' organization that the pre-war layout of a conventional depot consisting of tightly packed buildings, usually in an isolated position out in the desert, was highly vulnerable and too inflexible to meet the needs of a war whose boundaries were constantly moving. Risk of enemy action re-surfaced again in June 1942, with the Allied withdrawal to El Alamein, following the fall of Tobruk. The proximity of the MUs to the rapidly advancing Axis forces became a growing concern, a position which RAF logistics had also experienced in France during 1940. Consequently, it was necessary to disperse 111 MU's equipment further afield and 50 per cent of the stock holdings were transferred to Ramleh and Khartoum. This was a substantial task and took some three weeks, with personnel averaging between an eighteen and twenty hour working day. At Khartoum the wagons were unloaded, the equipment re-packed into boxes and crates and then dispersed in the cotton fields at Meriden Sudan.<sup>75</sup> Following

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<sup>74</sup> Air Ministry, *Maintenance*, pp.218-219.

<sup>75</sup> RAF LHCA, Personal reminiscences of service as an RAFVR Equipment Assistant (R.A. Stamp), detailed in a letter dated 12 February 1989.

Montgomery's decisive victory at the Second Battle of El Alamein in October/November 1942 and the resultant retreat of the Axis forces, the crisis subsided. Gradually, many of the units and equipment holdings in the Sudan retraced their steps north to Egypt and Palestine.

The third example occurred further East in Singapore. The RAF had maintained a presence on the island since the 1920s and by 1934 the air base at Seletar was home to two torpedo-bomber squadrons and two flying boat squadrons. The pre-war Expansion Scheme triggered a significant build-up of the RAF presence and as part of Scheme 'M', requiring an increase in overseas squadrons to forty-nine, there was a corresponding need for an increase in the support infrastructure.<sup>76</sup> Consequently, a sizable engineering presence in the form of an aircraft depot began to build up at Seletar along with a general engineering section at Kuala Lumpur. In June 1941, the depot at Seletar was re-named 151 MU and the facility at Kuala Lumpur as 153 MU. Logistics was a key part of this development and both MUs included UEDs, each operating to the principles established for the UK's 40 Group UEDs in 1939. The build-up of stocks soon led to acute congestion at Seletar and to alleviate this, a further UED was opened as 152 MU at Bukit Panjang (western part of Singapore Island) in August 1941. For explosives storage, two AAPs were established towards the end of 1941 at Seletar with a dump at Batak Quarry.<sup>77</sup> With the entry of Japan into the war following the attack on Pearl Harbor on 7 December 1941, the threat of invasion became a very real possibility. Indeed, the very day after Pearl Harbor the Japanese launched their first attack on Seletar. Shortly after this, and following the Japanese invasion of Malaya, the salvage of equipment from airfields in that area began, the majority of it finding its way back to the Armament Park at Seletar. The Japanese advance through Malaya also saw the need to evacuate 153 MU at Kuala Lumpur and this was completed by 9 January 1942. It was clear that the Japanese would continue their advance south but, as no effective defences had been put in place to resist an invasion of Singapore from the north, it became inevitable that an eventual evacuation from the island would be required.<sup>78</sup> Preliminary arrangements had

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<sup>76</sup> Air Ministry, *Maintenance*, p.359.

<sup>77</sup> RAF LHCA, History of Supply & Movements in the RAF – Research Material (Personal Accounts), Volume 6, Papers of Group Captain J.H. Nancarrow (under reference D/D Spt Pol (RAF)/112/1/2 dated 17 February 1992) and TNA, AIR 23/4637, Chief Equipment Officer, Air HQ Far East, Personal War Diary 1941-1942.

<sup>78</sup> Air Ministry, *Maintenance*, pp.360-367.

been made as early as 5 January 1942 to move men and equipment further south to Sumatra but a shortage of shipping meant that by 18 January they were still waiting to leave the island. On 21 January orders were issued for two thirds of 151 and 152 MUs to evacuate to Batavia on Java, with the remainder of the two units being formed into a Repair and Salvage Unit and an ASP (believed to be No 41) was formed on 25 January 1942 to look after the needs of the fighter force remaining in Singapore. The range of stores for the ASP had been dispersed from 151 MU stock and had been segregated in a hangar at Seletar. Nowhere was safe and even the spares storage hangar was riddled with shrapnel from a bombing raid just after the ASP's order to form date.<sup>79</sup>

By 31 January 1942, further orders were received from Air HQ to move the equipment, uncased and unlisted, by MT vehicles to a Cane Factory on the Bukit Timah Road and RAF Station Bukit Panjang. The hangar at Seletar was finally cleared of the ASP spares on 6 February 1942, an operation made all the more difficult due to the station being under shellfire from the advancing Japanese forces. A few days later the position had become desperate following the invasion of Singapore by the Japanese during the night of 8/9 February.<sup>80</sup> Fortunately, the spares at the Cane factory had been cased and delivered to the Embarkation Officer by the afternoon of 10 February. The spares at Bukit Panjang didn't fare so well and, with the advance of enemy forces, had to be destroyed on site by the units' commanding officer. Along with his team and the remaining spares from the Cane Factory, the remaining ASP personnel just managed to leave Singapore on 10 February, arriving at Batavia on Java during the afternoon of 14 February; many of the remaining MU personnel were not so fortunate and were taken into captivity and interned in a POW Camp at Surabaya.<sup>81</sup>

## Conclusion

The pre-war Expansion Programme led directly to a significant growth in the volume of equipment required by the RAF; this saw large amounts flowing

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<sup>79</sup> Ibid.

<sup>80</sup> F.Owen, *The Fall of Singapore* (London: Michael Joseph, 1960), p.172.

<sup>81</sup> RAF LHCA, History of Supply & Movements in the RAF – Research Material (Personal Accounts), Volume 6, Papers of Group Captain J.H. Nancarrow (under reference D/D Spt Pol (RAF)/112/1/2 dated 17 February 1992) and TNA, AIR 23/4637, Chief Equipment Officer, Air HQ Far East, Personal War Diary 1941-1942.

into the storage depot infrastructure, the extent of which soon proved inadequate for the requirement, particularly for 40 Group. Consequently, a range of new depot types and locations were constructed, along with the use of a range of temporary facilities. This all required careful management and the number of purpose built storage units in the United Kingdom alone rose quite dramatically during the war, from just eight in September 1939 to thirty four in May 1945. The situation overseas was a very similar picture. The storage facilities for the more specialist resources managed by 42 Group also required careful management and saw the Group making innovative use of much outdoor storage (especially in wooded areas) to keep pace with operational requirements, especially during the European bomber offensive during 1943 and 1944. The requirements for POL storage was equally challenging, but the very close working relationship between the Air Ministry, Maintenance Command and the Petroleum Board did much to improve planning and day-to-day control of POL. Overall, the story of the warehousing/storage element of RAF logistics illustrates just how much real estate was required to cope with the extensive equipment resources required by air power.

As far as the protection of stocks is concerned, the situation in the UK proved to be more resilient than pre-war planners had anticipated and the principle of dispersed stock holding did much to minimize the loss of stock in the event of enemy attack. There is a paradox here in that the Luftwaffe had gone to great lengths prior to the outbreak of war and during the early months to gather in-depth intelligence regarding the RAF's logistics infrastructure. It was fortunate for the RAF that the decisions taken by senior German commanders as the Battle of Britain and the Blitz progressed, failed to capitalize on this knowledge. A more concerted effort to target RAF's logistics, especially during the Battle of Britain and the following period of the Blitz, could have had a significant impact, resulting in a rapid deterioration in aircraft availability and a marked deterioration in air power effectiveness.

The security of overseas depots also proved a significant challenge and their more immediate proximity to battle fronts showed them to be vulnerable and they proved difficult to relocate when their security became threatened.

## Chapter Seven: Reaching Air Power – Outbound Logistics

### Introduction

The Value Chain model which has been used to provide an analytical structure to this thesis includes *Outbound Logistics* as one of the primary activities in its structure (see Introduction, page 30). The definition of this term is broad, but has a common theme of physical movement throughout. The model's originator, Michael Porter, expresses this (albeit in commercial terms) as 'activities associated with...physically distributing the product to buyers'.<sup>1</sup> In the context of RAF logistics, the term *product* needs a more specific interpretation and can be considered to include, not just stores and supplies, but also the less obvious requirement to move people.<sup>2</sup> From a commercial perspective, the need for the movement of goods from a manufacturer to a buyer or consumer is self-evident and enables a commercial transaction to take place. Transport in this respect can be described as simply '...moving inventory from point to point in the supply chain'.<sup>3</sup> The need from a military viewpoint, however, is more complex. As outlined in Chapter Six, the RAF's supply chain for its fixed base structure, consisted of three key 'links' in a supply chain<sup>4</sup>: the first of these was industry as the source of manufactured goods and supplies; the second link, a series of depots which accumulated delivered stock and the final link being the end user which was usually an RAF station at which operational, maintenance or training activities were taking place. As with the commercial requirement, transport is required to move goods between these stages.

There were, however, two other uses of transport which provided a wider supporting service for the employment of air power. The first of these was *Mobility*, a concept which was identified as one of the five characteristics which were seen as having the 'largest influence on the strategy and tactics of air warfare' in the RAF's *War Manual* of 1940.<sup>5</sup> The manual highlighted the fact

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<sup>1</sup> Porter, *Competitive Advantage*, p.40.

<sup>2</sup> The terms stores and supplies are defined in the Royal Air Force War Manual, Part II: Organization and Administration, Appendix I. Supplies are defined as food, forage, fuel, petrol, oil, light, disinfectants and medical comforts. Stores are defined as being air force material other than supplies.

<sup>3</sup> Chopra and Meindl, *Supply Chain Management*, p.60.

<sup>4</sup> C.M. Harland in E. Rhodes, J.P. Warren and R. Carter (eds), *Supply Chains and Total Product Systems: A Reader* (Oxford: Blackwell Publishing, 2006), p.41.

<sup>5</sup> Air Ministry, AP 1300, *Royal Air Force War Manual, Part I: Operations (Provisional)* (London: Air Ministry, 1940).

that aircraft, by their very nature, are highly mobile but their ground support services require a range of transportation to relocate in the field during operations away from main bases. Mobility was seen as complementary to the characteristic of flexibility of a given force of aircraft, defined as 'its power to attack, surprise and menace the enemy over a wide area'.<sup>6</sup> The significance of this supporting role was summarised by the manual, which asserted that '...to obtain the full advantage of the inherent flexibility of air forces constant attention must be paid to ways and means of extending their mobility'.<sup>7</sup> The second of the additional requirements for transport was to achieve *logistical reach*, a characteristic very closely related to mobility. As the war progressed, the RAF became involved in numerous operations away from established bases. This required many temporary supply chains to be established to enable stores, supplies and people to reach forward units. A good example of this is the supply chains which were established to support RAF units following amphibious operations such as the invasion of North Africa (Operation TORCH) in 1942 and the landings in Normandy (Operation OVERLORD) in 1944. This chapter examines the modes of transport which were used by RAF logistics (Road, Rail, Air, Water and Pipelines) throughout its supply chain, making comment, where appropriate, on their contribution to the wider concepts of *mobility* and *logistical reach*.<sup>8</sup>

## Road Transport

Throughout the First World War, the RFC had progressively increased the extent to which it used motor vehicles. Indeed, by the end of the War, the newly formed RAF had 23,260 vehicles on its MT strength.<sup>9</sup> The early 1920s saw much of the RAF MT fleet dominated by vehicles known as 'Tenders', produced by Leyland Motors and Crossley Motors Limited.<sup>10</sup> The Crossley Tender, however, was not an economical vehicle; with a fuel consumption of only six miles per gallon and with just a twenty-eight gallon tank, its range was limited without regular refuelling. Moreover, it was not cheap to purchase – at £510 per vehicle, it was just short of half the cost, for example, of a First World

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6 Ibid, Chapter V, Paragraph 28.

7 Ibid.

8 The modes of transport are based on contemporary definitions used in Lysons and Farrington, *Purchasing and Supply Chain Management*, p.528.

9 Robertson, *Wheels of the RAF*, p.29.

10 Ibid, p.36.

War SE5a Hispano-Suiza aero engine.<sup>11</sup> Despite this, its carrying capacity was good; it could, for example, transport 700 gallons of fuel in fifty-gallon barrels, so that one vehicle's load alone could refuel just over seven and a half DH-4A aircraft tanks from empty.<sup>12</sup> By 1922, Trojan Ltd began construction of light vans at Kingston-on-Thames and produced what was to be the RAF's first light utility vehicle; with a 1488 cc, two stroke engine, it proved to be a much more economical vehicle to buy and operate.<sup>13</sup> By 1927 the oldest of the Crossley and Leyland vehicles were being withdrawn from service and the Morris 6 x 4 trucks had begun to enter service. By 1934 Albion AM463 4 x 2 trucks were coming into service, with the Air Ministry purchasing most of the 1,900 vehicles that were built.<sup>14</sup>

Although the RAF's range and number of vehicles started to grow quite rapidly, MT was established on a unit/depot basis to enable them to look after their own requirements - there were no specialist MT units which could be tasked for *ad hoc* requirements which might have been beyond the capacity or capability of unit resources. The principle of this 'organic' MT capability was a planning assumption in the various iterations of the Air Ministry's Expeditionary Force Mobilization Instructions which, in various forms, evolved up until the outbreak of war in 1939. The 1934 plan, for example, included the requirement to deploy an overall HQ element, four Army co-operation squadrons, two bomber squadrons and a fighter squadron to the field. Given the collective size of such a deployment, the plan did acknowledge the need for reinforcements and authorised additional vehicles to be drawn from Reserve Pools.<sup>15</sup> This concept, in various iterations of the plan, remained in place for the RAF up to the beginning of Expansion Programme in 1934.

The geographical footprint of the RAF in the United Kingdom during the early 1930s was still (by later comparison) quite limited. The RAF's order of battle for 1932, for example, consisted of approximately fifty main operating

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<sup>11</sup> Jones, *The War in the Air*, Appendices, p.157. Price comparison is based on the Hispano Suiza engine with a price of £1,004. Figure shown as extracted from a Ministry of Munitions 'Priced Vocabulary of Aircraft Supplies', 1918-19.

<sup>12</sup> The DH-4A aircraft had a 91.6 gallon main tank. A.J, Jackson, *De Havilland Aircraft Since 1909* (London: Naval Institute Press, 1987).

<sup>13</sup> Robertson, *Wheels of the RAF*, p.54.

<sup>14</sup> *Ibid*, p.55.

<sup>15</sup> TNA, AIR 10/1571, Air Ministry S.D.93 Expeditionary Force Mobilization Instructions 1934. The supporting units for this deployment (known as Contingent "A") also included an Air Stores Park, Aircraft Depot, Port Detachment, Personnel Office, Accounts Office and an additional HQ element to administer the support functions.

locations (flying and non-flying bases) and just four stores' depots<sup>16</sup>; the majority of these locations were connected to the country's rail network and therefore well served in terms of transport links. The Expansion Programme of 1934 though, brought about not just large volumes of stores and supplies which needed to be distributed throughout the country, but a significant increase in the size of equipment which needed to be moved, for example, from depots to specialist repair units. This broadening of activity away from a unit focus, started to place ever increasing demands on MT resources and indicated that the Service required more transportation which was capable of moving cargo in larger volumes and sizes than hitherto.

It was, however, the growing threat of invasion to the United Kingdom by Nazi Germany in 1940 which accelerated the introduction of a new road transport capability. Although Hitler did not issue his directive for his forces to begin planning for an invasion of England until 16 July 1940, the German invasion of the Low Countries and France, which began on 10 May 1940, left little doubt that England would be next.<sup>17</sup> Amongst many in the country who were becoming increasingly concerned about the risk of invasion was the Commander-in-Chief Fighter Command, Air Chief Marshal Sir Hugh Dowding, who had highlighted this threat in a letter to the Air Ministry just after the British evacuation from Dunkirk.<sup>18</sup> As early as May 1940, joint-Service discussions were being held to consider what might need to be done to counter possible invasion. As far as the RAF was concerned, detailed plans were evolved for the role of Fighter, Bomber and Coastal Commands in the event of an invasion. The need to move operational flying squadrons to new bases is commented on by the author L.F.E. Coombs in his work on the preparation of the RAF for war, describing these as '...'scatter plans' for moving squadrons so as to render obsolete any data the Germans may have gathered on squadron locations'.<sup>19</sup> The amassing of such information on the RAF's order of battle had been made relatively easy for German intelligence as such data was readily available (by aircraft type, squadron and location) in the RAF Lists published up to, and including 1938, along with extensive air reconnaissance over England which

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16 K. Delve, *The Source Book of the RAF* (Shrewsbury: AirLife, 1994), pp.49-50.

17 Fleming, *Operation Sealion*, pp.15-24 and E. Kieser, *Hitler on the Doorstep* (London: Arms and Armour Press, 1997), pp.20-27 and M. Corby, 'Operation Sealion – The Invasion that Never was', *Military Times*, Issue No 8 (May 2011), 14-20.

18 Wood & Dempster, *The Narrow Margin*, p.102.

19 Coombs, *The Lion has Wings*, p.115.

had taken place since as early as 1938.<sup>20</sup> Many of these squadron moves were quite involved. Coombs provides an example of this when he describes how 90 and 101 Squadrons of Bomber Command (both flying Bristol Blenheim aircraft) were required to move from RAF Upwood and RAF West Raynham, to RAF Weston-on-the-Green, where they were to be joined by 104 and 108 Squadrons from RAF Bicester.<sup>21</sup>

The move of complete squadrons was but one requirement of the overall plan. It was recognized that, in the event of an invasion, the RAF operational commands would need to use as many aircraft as possible and the re-deployment of aircraft used in training roles within Flying Training and Technical Training Commands was factored in. In the case of Bomber Command, Operation BANQUET set out the requirement for fourteen of its bomber stations to receive a total of 169 additional aircraft from training units.<sup>22</sup> The respective Air Officer Commanding-in-Chiefs of Bomber, Fighter and Coastal Commands were formally alerted to the need for detailed planning by the Deputy Chief of the Air Staff (Air Vice-Marshal Douglas) on 24 June 1940 who commented that:

In view of the possibility of an attempted invasion of this country, I am directed to draw your attention to the necessity to maintain in operation from alternative locations squadrons whose aerodromes, especially in the vicinity of the coast, may be subject to a local threat by enemy land forces.<sup>23</sup>

Douglas suggested that the planning should not assume the wholesale evacuation of stations but the detachment of aircraft to alternative locations; it was acknowledged that ‘...the bulk of personnel should remain to defend the [parent] station and deny its use to the enemy’. As far as the logistics of this was concerned, Douglas added that ‘in order to move the essential minimum maintenance detachments to enable the squadrons to continue in operation from alternative aerodromes, local transport should be earmarked and, if

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20 Work in this respect had commenced as early as 1938 when a civilian Heinkel He-111 of the German airline Lufthansa, fitted with concealed cameras, carried out reconnaissance of the North Sea and channel coasts of England under the guise of ‘civil route proving flights’. Secret aerial photography had also been carried out by a Zeppelin which had been invited to tour the east coast in the summer of 1939. See RCAHMS, *Scotland from the Air*, p.4; Downing, *Spies in the Sky*, p.337, Liddell Hart, *History of the Second World War*, p.121 and Boog, *German Air Intelligence in Handel, Intelligence and Military Operations*, p.370.

21 Coombs, *The Lion has Wings*, p.115 and Delve, *The Source Book of the RAF*, p.50.

22 Wood & Dempster, *The Narrow Margin*, pp.105-106.

23 TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), Douglas to AOC in Cs Bomber, Fighter and Coastal Commands S.5293 dated 24 June 1940.

necessary, requisitioned'.<sup>24</sup> This was an underestimate of the size of the task and would have placed an inordinate strain on station MT resources. Moreover, it was not clear from where 'requisitioned' vehicles would be obtained. Earlier discussions though, had considered this requirement in more informed detail through the work of the Expansion and Re-Equipment Policy Committee which, largely as a result of discussion involving a much wider range of specialists (including the Air Ministry's Directorate of Equipment), had endorsed the proposal to form 'M.T. companies to provide centrally controlled pools of M.T. which could be used to move the operational squadrons of Bomber, Fighter and Coastal Commands from place to place to meet operational requirements'.<sup>25</sup> Initially, it was intended to form three MT companies: one company to be located in the area between the Tyne and Flamborough Head, with two companies further south between the Wash and Newhaven. The vehicle establishment of these units reflected not just the requirement to move equipment, but also personnel and were therefore initially established with thirty-two buses and eighty lorries. Each company was divided into four sections, each of which was designed to move one flying squadron.<sup>26</sup> Thus, on 16 July 1940, numbers 1, 2 and 3 Companies were officially formed at Darlington, Cambridge and West Malling respectively. All three companies were placed under the operational control of the Air Ministry's Directorate of Equipment (DDE9) but administratively supported by 40 Group, Maintenance Command.<sup>27</sup>

The planned German invasion of the United Kingdom, codenamed Operation SEA LION, never materialised although the Luftwaffe's failed attempt at achieving air superiority during the Battle of Britain did lead to a number of attacks on RAF airfields which, in a number of cases, required flying squadrons to be relocated; during the period 12 August to 6 September 1940, there were sixty significant attacks on RAF airfields, the lion's share borne by 11 Group in

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<sup>24</sup> Ibid.

<sup>25</sup> TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), D.D.W.O (Musgrave Whitham) to D of O, NS/W.O. 4/10 dated 29 June 1940.

<sup>26</sup> Ibid. By the time the first three companies had formed in mid- July 1940, the vehicle establishment had been increased by the addition of four articulated tenders, six 15 cwt. vans and twelve motor cycles (note from P/DDO reference 2449/P.D.D.O. dated 1 July 1940 on TNA, AIR 2/5379 refers).

<sup>27</sup> TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), S.D.155/1940 (717-718) – Formation of M.T. Companies dated 13 July 1940.

south east England.<sup>28</sup> The details of the MT companies' involvement in these squadron moves is difficult to assess due to an inconsistent level of detail in their respective Operational Record Books.<sup>29</sup> The most detailed record, though still relatively sparse as far as tasking information, is that of Number 2 MT Company which carried out three squadron moves in 11 Group during October 1940, along with the transportation of explosives consignments between some of Maintenance Command's 42 Group depots.<sup>30</sup> The number of squadron moves carried out by 2 MT Company the following year (1941) was quite different with some sixty-five moves.<sup>31</sup> Despite this increase, the resources of the MT companies came under close scrutiny as part of the RAF's on-going commitment to wartime economy. As part of his brief to lead a study into potential economies of RAF manpower establishments in the United Kingdom, Air Chief-Marshal Dowding visited Number 2 MT Company on 27 December 1941 and was less than complimentary about the achievement of this unit in his post-visit report. After a cursory summary of its tasking (based on his own scrutiny of the unit's records), Dowding expressed the view:

Considered as a whole however the work done by this Unit in the past year has been trivial in comparison with the personnel and vehicles employed. Every morning every engine is started up and run up for 10 minutes which involves a considerable expenditure of petrol in the aggregate.<sup>32</sup>

Although Dowding had not visited Numbers 1 and 3 MT Companies, he still made the point that '...evidence at my disposal indicates that their activity is on a lower scale even than that of the Cambridge unit'.<sup>33</sup> Dowding also commented that, in his view, the availability of Transport aircraft and greater mobility afforded through increases to unit MT establishments, the transfer of servicing echelons from squadrons to RAF station control (thereby reducing the equipment which squadrons might need to move) would enable fighter

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<sup>28</sup> Air Ministry, Air Historical Branch, *The Battle of Britain: A Narrative Prepared in the Air Historical Branch*, Volume II, Appendix 8, Table III.

<sup>29</sup> TNA, AIR 29/790 and AIR 29/791 refer.

<sup>30</sup> TNA, AIR 29/791, Operational Record Book 2 MT Company refers. The squadron moves were on 6 October 1940 – 17 Squadron (Hurricanes) from Debden to Martlesham Heath and 25 Squadron (Blenheims) from Martlesham Heath to North Weald and on 7 October 1940 relocating 25 Squadron from North Weald to Debden.

<sup>31</sup> TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), Enclosure 18A - No.2 Mechanical Transport Company – Moves of Squadron Personnel and/or Equipment January 1st 1941 – December 31st 1941.

<sup>32</sup> TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), Memorandum XI to SofS, CAS, AMSO, AMP, AMT, PUS, General Ismay & DDO/Est dated 31 December 1941. This is a surprisingly senior group of addressees for a visit to just a single MT company.

<sup>33</sup> Ibid.

squadron moves to be effected without MT company assistance. As far as Bomber squadron moves were concerned, he believed that these were considerably less frequent and less urgent than for fighter squadrons. His conclusion was that if a case did remain for their existence (and the tenor of his report suggests that he was not convinced of this) then all three should have their establishment reduced by 60 per cent.<sup>34</sup> Whilst there was some debate within the Air Ministry regarding the accuracy of Dowding's figures for the 1941 workload (he had not included moves of Operational Training Units, Service Flying Training Schools, Photographic Reconnaissance Units and Army Co-operation squadrons<sup>35</sup>), the Air Ministry maintained that 'it would be unwise to abolish the Companies altogether', but did agree to a slightly reduced establishment of 50 per cent, rather than Dowding's proposed 60 per cent.<sup>36</sup> With the risk of invasion diminishing, it was timely for the road transport resources of the three MT companies to be re-assessed and Dowding's economy proposals reflected the Government's wartime road transport policy of curtailing the use of road transport to economize in imported fuel.<sup>37</sup> The opportunity was also taken to consider wider vehicle utilization (especially on return journeys where vehicles were often empty) and a series of collection centres were nominated at specific MUs within 40, 41 and 43 Groups of Maintenance Command to enable inter-depot transfers to take place, much of which involved the movement of repairable equipment.<sup>38</sup>

There is, however, a significant point which emerges from the debate in the Air Ministry following Dowding's report, which is worthy of note in terms of broader RAF logistics capability in 1942. In his response to Dowding's report to the Air Ministry's Director General of Organization in January 1942, the Deputy Director of Movements (DD Movements) made the point that the '...need for additional transport is dependent upon the degree of the squadron's mobility'.<sup>39</sup> In this respect, DD Movements drew attention to Dowding's opinion that

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<sup>34</sup> Ibid.

<sup>35</sup> TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), Enclosure 18A, DD Movements to DGO dated 3 March 1942.

<sup>36</sup> TNA, AIR 2/5379, – RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), Enclosure 7A, Abraham (DUS) to Dowding dated 14 February 1942.

<sup>37</sup> Savage, *Inland Transport*, p.76 and p.306.

<sup>38</sup> TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), Enclosure 26g, Collection Centres.

<sup>39</sup> TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), DD Movements to DGO dated 16 January 1942.

'...Fighter Squadrons are sufficiently mobile for moves to be carried out without outside assistance'. He went on to highlight the fact, however, that of the 125 squadron moves made by the MT companies during 1941, ninety-three of these were made on behalf of Fighter Command, a point which strongly suggests that MT assistance was necessary.<sup>40</sup> The point also made by DD Movements was that, despite Dowding's claims, he had no record of transport aircraft having been specifically provided for operation moves of Fighter Command. He also made the point that, at that time, there were only two transport squadrons in the RAF at home (24 Squadron at Hendon and 271 Squadron at Doncaster), but these were '...available for use by all departments of the Crown, and all Commands of the Royal Air Force'.<sup>41</sup> The significance of this, according to DD Movements, was that '...assistance is still needed by Commands for the rapid interchange of squadrons to meet operation requirements'.<sup>42</sup> This debate illustrates the fine line between achieving economy of resources and maintaining operational capability. More often than not, decisions involving the adjustment of resources were judgments based on probability, a factor which in warfare is never easy to assess.

A further five MT companies (4 to 8 inclusive) were formed in the first half of 1941, but with quite different responsibilities from the first three. Number 4 MT Company, although still under the control of the Air Ministry, was established to act as a transport pool for the Ministry of Aircraft Production and was based at St John's Wood (London). Numbers 5, 6 and 7 were established at the ports of Liverpool, Glasgow and Hull (moved later to Cardiff). These units worked in close liaison with the Embarkation Offices at these ports and much of their work involved clearance of crated aircraft, aero engines and associated equipment, as well as urgently required machine tools flowing in to these West Coast ports from the United States. The wider work of these MT companies is difficult to ascertain from their operational record books due to inconsistent and incomplete detail, but a short monograph on RAF Movements produced by the Air Ministry's Air Historical Branch after the war provides an insight, albeit somewhat limited in detail.<sup>43</sup> From August 1941, the British-based MT

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40 Ibid.

41 Ibid.

42 Ibid.

43 MOD (AHB), Monograph, 'Royal Air Force Movements during the Second World War' (unreferenced & undated), p.6.

companies (most likely 5, 6 and 7) assisted with the export of aid to Russia. Initially this was shipped by the northern route to Murmansk but, by May 1943, a southern route via the Mediterranean and Persia was utilised. In total, 4,500 aircraft, 800 vehicles and 7,000 tons were dispatched. The movement of equipment consignments to British ports took much coordination as much of it came from the various stores' depots across Britain; most of the road moves were carried out using RAF vehicles of the MT companies, although there was some augmentation by civilian vehicles. Following Operation OVERLORD in June 1944, the RAF MT Companies provided urgently needed heavy lift transport when the Germans launched their V1 flying bomb attacks against Britain. As a response to this onslaught, Balloon Squadrons and RAF Regiment Anti-Aircraft (AA) squadrons, in conjunction with the Army's AA Command, formed a protective screen for London. The RAF's MT companies played a key part in moving many of these units to where they were needed, along with vehicles obtained from the Ministry of War Transport Road Haulage Organization. Road moves were carried out from as far afield as Scapa in the Orkneys, with unit equipment moved to the London area by sea.<sup>44</sup>

Two more MT companies were formed in Britain: Number 8 MT Company at Colerne in Wiltshire in December 1941 which was tasked with movements in the west and south west of the United Kingdom and Number 9 MT Company at Reykjavik (Iceland) in December 1943 which supported, at various times from this date on, eight different RAF squadrons based in Iceland, operating a wide range of aircraft including the Liberator, Catalina, Ventura, Hudson, Anson, Fortress, Warwick and Hurricane.<sup>45</sup> Unlike Numbers 1 to 3 MT Companies, which had been formed largely as an insurance measure, Numbers 4 to 9 had a more specific role and their utilization does not appear to have been subject to review. The operational control of all nine companies though was subject to review by the Air Ministry in March 1942, and resulted in most

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<sup>44</sup> Ibid.

<sup>45</sup> TNA, AIR 29/815, Operational Record Book and Appendices, Supply & Transport Columns 8-12, 15 & 16. The flying squadrons operating in Iceland were: 53, 86, 120, 190, 251, 269, 279 and 280. C.G. Jefford, *RAF Squadrons – a Comprehensive Record of the Movement and Equipment of all RAF Squadrons and their Antecedents since 1912* (Shrewsbury: Airlife, 1988) refers.

being transferred to 54 Wing, Maintenance Command, but with operational control being retained by DD Movements in the Air Ministry.<sup>46</sup>

The ebb and flow of Allied/Axis battles in North Africa saw the need for the RAF's Desert Air Force to remain highly mobile and two more MT Companies (Numbers 51 and 52) were formed in Egypt in 1942, with a third in Algeria (Number 53) in May 1944. These units came under the command and control of HQ RAF Middle East. The work of the two MT companies based in Egypt was quite different, as the early days of No 51 MT Company illustrates. The unit was formed on 25 April 1942 at Heliopolis and consisted of 162 personnel and an initial vehicle establishment of forty-eight 10-ton vehicles and twenty-four 5-ton trailers. The unit was initially tasked with daily distribution runs in the Nile Delta area, many of which were to and from the sea ports. With Rommel's capture of Tobruk on 20 June, the Company became heavily involved in the frantic efforts to stem the enemy's advance into Egypt and was reinforced by a further forty Thornycroft trucks. The unit was divided into convoy sized units with two main tasks in support of the RAF: firstly, deliveries in the area of Cairo – Suez – Port Said – Alexandria and back to Cairo and, secondly, providing long distance convoys to the Western Desert – Lebanon – Syria and collecting stores from the docks for all points.<sup>47</sup> The unit's significant role in the direct support of air power is illustrated by the role it played in supporting the RAF's Desert Air Force, following the German capture of Tobruk on 20 June 1942 and the subsequent advance to El Alamein; this saw the British Army in retreat with the RAF mounting maximum bombing rear-guard actions against the advancing enemy.<sup>48</sup> The MT Company's operational record book entry for 25 June opens with the comment: 'The big day, a total of sixty vehicles, leaving only one unserviceable in the camp, went out on urgent work'.<sup>49</sup> Much of this tasking was moving urgently required munitions and aviation fuel for the Desert Air Force. Indeed, in June 1942 alone, it moved 2,767 tons and covered some 50,000 miles.<sup>50</sup> The high intensity operations

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46 TNA, AIR 2/5379, RAF Motor Transport Companies: Report by ACM Sir Hugh Dowding (G.S. 12416), Enclosure 23A – Minutes of a Conference to Discuss the Proposed Transfer of the Operational Control of M.T. Companies from D.D. Movements to Maintenance Command, Held at 1100 Hours on 16th March 1942 in Room 271 Adastral House, Kingsway.

47 Blow, *The History of 51 (RAF) MT Company*.

48 P. Young (ed), *Atlas of the Second World War* (London: Military Book Society, 1973), pp.62-63.

49 Blow, *The History of 51 (RAF) MT Company*, p 8.

50 Ibid, p.10.

lasted until the end of July when the threat to Egypt from Rommel's Africa Corps had diminished. Although it was not until May 1943 that organised German resistance ceased in Tunisia, the year still saw a significant effort by the unit with it covering 1,700,136 miles and carrying 119,864 tons.<sup>51</sup> The overseas requirement for specialist MT support saw the formation of a final three MT companies before the end of the war: two companies were established in Italy in July 1944 (Number 54) and April 1945 (Number 58) and one in India/Burma in November 1944 (Number 57); the work of these units was similar in nature to those in North Africa.<sup>52</sup>

Whilst the MT Companies were largely established to meet specific taskings which could not be met by unit resources, or for commitments which did not sit clearly with one unit or another, the RAF's order of battle for specific campaigns used a variation on the MT Company concept and involved what were known as Supply and Transport Columns (S&TC). The exact role of these units does not appear to be clearly defined in Air Ministry publications but an analysis of their work in the AHB Narratives and their Operational Record Books suggests that they were intended to enable the mobility of flying squadrons operating in the field, by transporting POL and explosives direct to units, along with resupplying stores and supplies from semi-static depots to the mobile Air Stores Parks. These units did not appear in the planned order of battle detailed in the pre-war Expeditionary Force Mobilization Instructions<sup>53</sup>; the structure of this included a Port Detachment (where consignments arrived by sea), an Aircraft Depot (where, inter alia, stocks could be accumulated) and an Air Stores Park (which re-supplied the flying squadrons in the field). What was not included was any MT resource to clear consignments from a port to the Aircraft Depot, and from there to the Air Stores Parks; the planning appears to assume that there would be sufficient MT available to meet this need. Notwithstanding this planning assumption, the RAF's order of battle for the campaign in France in 1939/1940 did include three Supply & Transport Sections which were established as part of the Advanced Air Striking Force (AASF).

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51 Ibid, p.30.

52 TNA, AIR 29/793, Operational Record Book and Appendices, MT Companies 52-55, 57-59 & 300.

53 TNA, AIR 10/1571, Air Ministry S.D.93 Expeditionary Force Mobilization Instructions 1934.Composition of Contingent "A".

Mobility for the RAF (in terms of MT) was a constant problem from the outset of the campaign and persisted through to the eventual evacuation from France in May/June 1940. The establishment of MT for both the AASF and the Air Component was largely governed by the overall concept of the campaign. On the whole, it was envisaged that the Allies' role would be largely defensive and that a significant mobility capability across the board would not be required. In the original planning, it was intended that the Air Component would be established for greater mobility than the AASF and its squadrons were designed to be completely mobile; this was based on the expectation that they would need sufficient mobility to advance into Belgium with the BEF land forces if required. As far as the AASF was concerned, neither its squadrons nor ancillary units were completely mobile and they had to rely on the Supply & Transport Sections. However, some of the early basing decisions for the AASF soon caused problems when it was decided to locate not more than one squadron on each airfield. This led to significant overstretch and resulted in a visit by a Sub-Committee of the Air Ministry Establishments Committee in January 1940. The outcome was that AASF Wing MT companies were created, each consisting of a 'pool' of vehicles intended to look after four flying squadrons, one Air Stores Park and ancillary units. Having done this, the Supply & Transport Sections in France were disbanded.<sup>54</sup>

The requirement was one thing, but the actual process of physically acquiring the vehicles and associated personnel in the right places proved to be problematical. On 17 April 1940, the AOC-in-C AASF wrote to the Air Ministry complaining of the lack of acceptable progress; at this point, the overall deficiency was some 1,000 vehicles. In a letter to the Air Member for Supply & Organization a few days later, the AOC-in-C left no doubt as to the potential severity of his concerns: '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 MT which I do possess is damaged by air action, the position is going to be even worse'.<sup>55</sup> At the heart of the difficulties were three complications. First, some contractors had failed to deliver in accordance with Air Ministry contracts; second, some vehicles were of a

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<sup>54</sup> Air Ministry, Air Historical Branch (1), R.A.F. Narrative – The Campaign in France and the Low Countries (First Draft), Part II, pp.126-127.

<sup>55</sup> *Ibid.*, p.132.

relatively new design for the continental units and supplies of these had only just become available; third, a number of vehicles had been re-directed to other urgent requirements.<sup>56</sup> By the time of the withdrawal from France in late May/early June 1940 the improvement in mobility had been marginal; the Air Component had managed to form the new Wing MT companies but the AASF struggled and ended up 'borrowing MT from the French and by reducing the number of its operational bomber squadrons from ten to six'.<sup>57</sup> The concept of the Supply & Transport Section came unstuck, not through its intended role, but through the available resources at an early stage of the war where the British motor vehicle industry was trying to meet the growing number of war contracts being placed on it. The progressive increase in British production and the availability of American-sourced vehicles under the Lend-Lease Scheme, enabled greater numbers of vehicles to be acquired by the RAF as the war progressed. Despite these early difficulties, the concept of specialist Supply & Transport units endured and a further twenty-one Columns (as they were renamed) were formed, following the campaign in France; fourteen of these were formed in the Middle East and North Africa to support the campaign in the Western Desert and the invasion of North Africa; two in Sicily and Italy to support these campaigns and five as part of the RAF's order of battle for the invasion of North West Europe in 1944.<sup>58</sup> The roles of these units varied depending on local needs but the role description which appeared in the administrative planning preparations for Operation OVERLORD provides a flavour of their role in this campaign, stating that the function of each column was to:

...provide a central pool of load carrying vehicles, for the purpose of transporting aviation P.O.L., S.A.A. [small arms ammunition], and bombs from the Air Ammunition Parks to airfields, and for assisting in the movement of non-mobile units.<sup>59</sup>

The overall achievement of the Supply & Transport Columns is difficult to summarise - their operational record books list thousands of miles travelled and tonnages carried, but without specific credit to the success or otherwise of the

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<sup>56</sup> Ibid.

<sup>57</sup> Ibid, p.133.

<sup>58</sup> TNA, AIR 29/814, Operational Record Book, S&TC 2, 4-7; AIR 29/815 – Operational Record Book, S&TC 8-12, 15&16; AIR 29/816 Operational Record Book, S&TC 19-21 & 309 and AIR 29/817, 816 Operational Record Book, S&TC 314-317.

<sup>59</sup> Air Ministry, Air Historical Branch (I), R.A.F. Narrative (First Draft), The Liberation of North West Europe, Volume II: Administrative Preparations, pp.257-258.

operations they supported. The record of No 7 S&TC, however, does record a message of appreciation from the AOC Eastern Mediterranean on the unit's disbandment at the end of July 1944:

Please convey to all ranks my appreciation of the splendid work carried out by the unit during its long period in the desert. I am very sorry to lose you and wish you all the very best of luck in the future.<sup>60</sup>

By the time that planning had commenced in 1943 for the invasion of mainland Europe, a significant number of specialist vehicles had been adopted to meet the needs of the RAF; much of this adaptation occurred as technology developed but was driven by the need to provide a mobile capability for functions that, hitherto, had been statically based, such as photographic processing and various mobile workshops. From the logistics' perspective, vehicles such as a stores' vehicle, mobile stores' trailer and a mobile office had entered service to meet the needs of mobile units such as the Air Stores Parks. By 1944, there were just fewer than 170 of these specialist vehicles in RAF service. Such a diverse range presented a real challenge to the RAF logistics' system and a 'type number' identification method was introduced (with numbers allocated in blocks according to the class of vehicle) to facilitate the ordering of the correct vehicle spares.<sup>61</sup>

## Rail Transport

The use of the railways had been an important part of the military effort during the First World War, both at home and overseas. On the Continent alone, the British had laid some 800 miles of railway throughout the course of the war.<sup>62</sup> The early 1920s, however, were not an easy time for the railways, with a growing threat of competition from motor vehicles, a point articulated by the railway historian Christian Wolmar who highlights that '...thousands of former soldiers, who had learnt to drive in the services, were able to turn themselves into one-man freight haulage businesses by buying cheap ex-army vehicles with their demob money and greatly undercutting the railways'.<sup>63</sup>

<sup>60</sup> TNA, AIR 29/814, Operational Record Book, 7 S&TC, entry for 4 August 1944.

<sup>61</sup> Robertson, *Wheels of the RAF*, pp.65-68. The identification numbers were painted in three inch high letters on the nearside cab door of the prime movers and on a conspicuous place on trailers.

<sup>62</sup> Wolmar, *Engines of War*, p.183

<sup>63</sup> Wolmar, *Fire & Steam*, p.229.

Despite this competition, the railways still provided the only way to move large and heavy volumes of freight around the country, especially to and from the RAF's stores' depots. Indeed, before the rail company amalgamation in 1923, thirteen different companies were involved with moving RAF stores.<sup>64</sup> By the mid-1930s, the Air Ministry had significantly increased its ownership of rolling stock and was operating twenty-two of its own locomotives, a figure which was to rise to a peak of 112 during the Second World War.<sup>65</sup> The day-to-day operation of the locomotives and rolling stock was overseen by the Air Ministry Works Department.<sup>66</sup>

The pre-Second World War Expansion Schemes, which brought with them a growing number of airfields and associated infrastructure, generated a similar increase in the need for links with the nation's railways. The five depots at Quedgeley, Carlisle, Stafford, Hartlebury and Heywood, constructed in 1938 and 1939, were all built with rail links to their dispersed sites.<sup>67</sup> Similarly, the main Ammunition Depots at Chilmark, Fauld and Harpur Hill were all established close to main railway lines.<sup>68</sup> The line into the depot at Chilmark, established in 1937, developed into probably the most extensive internal rail network, with 2½ miles of standard-gauge and more than nine miles of 2 ft-gauge tracks for the three main sites.<sup>69</sup> For general work above ground, diesel engines were utilised, whilst battery electric locomotives were used in the underground tunnels.<sup>70</sup> Rail links were also a vital feature of the many Air Ammunition Parks that were built to serve the British bomber bases and these were the only practical way of transporting heavy munitions from the ordnance factories to the storage sites.<sup>71</sup>

It was not just munitions that were best moved by rail – the bulk nature of aviation and ground fuels was also ideally suited. In 1938, the decision was taken by the Air Ministry to divert 75 per cent of petroleum imports to Britain, to the west coast ports to minimize the risk of air attack. With most of the RAF's

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64 Robertson, 'Railways and Air Warfare', Part 2, p.159.

65 Ibid.

66 Corser, 'Railways & Military Aviation', Part 2, p.25.

67 Corser, *Wings on Rails*, pp.63, 24, 69, 41 and 44.

68 Corser, *Wings on Rails*, pp.5, 25, 33 and 40.

69 Saunders, 'The Little Trains of Chilmark', p.117.

70 Air Ministry, *Works*, p.263.

71 Corser, *Wings on Rails*, p.5.

airfields being sited towards the east coast, this fuel had to be transported cross-country and rail was clearly the best way to move the large volumes that were being imported. It was not without additional cost and the Air Ministry purchased 300 extra tank wagons, which were operated for them by the railway companies.<sup>72</sup>

In 1939 most of the RAF units and their equipment that deployed to France as part of the expeditionary force, travelled to their ports of embarkation by train, an experience not too dissimilar from their BEF predecessors in 1914. The proximity to rail links on the Continent was quite different and many units found that their forward operating bases were nowhere near a local railway station that could receive the inbound supplies. They therefore had to rely heavily on road transport from the ports; these, along with the base depots, were controlled by the Army and the RAF was responsible for moving its own equipment and supplies up to forty miles from the railheads. The use of the railways proved to be just as valuable in Britain following the Battle of France and, in the eight days following the evacuation from France in June 1940, 620 trains carrying 300,000 troops were run; all of this was without any prior knowledge of what numbers would arrive at seven ports in south-east England and was coordinated almost entirely by telephone.<sup>73</sup> Surviving wartime statistics for the movement of goods by rail in Britain do not show figures pertinent to RAF usage. However, the rail companies estimated that in 1943, approximately 140,000,000 wagon loads of traffic had been despatched by rail since the beginning of the war.<sup>74</sup>

The railway network proved to be remarkably resilient within the United Kingdom with perhaps the volume of traffic moving across its network proving to be the greatest challenge. Prior to the outbreak of war, it had been recognized that heavy demands would be placed on the United Kingdom's rail network. Indeed, in a memorandum prepared by the Chairman of the Railway Executive Committee in May 1939, it was suggested that in the first three months of the war alone, 'the goods traffic of the railways (as measured by ton-mileage) will

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72 Corser, 'Railways & Military Aviation', Part Two, p.26.

73 British Railways Press Office, *Facts About British Railways in Wartime* (London: British Railways Press Office, 1943), p.20.

74 *Ibid.*, p.10.

increase by 100 per cent'.<sup>75</sup> The Railway Executive Committee was directly responsible to the Minister of Transport and was charged with ensuring the operation of national railways as 'a unified whole' and for communicating the needs (especially priorities and expected volumes of traffic) of the Navy, Army and Air Force.<sup>76</sup> At a working level, a Railway Communications Committee was formed in November 1938. This was an inter-departmental committee which, in addition to representatives from the three armed Services, consisted of members (inter alia) from departments such as the Board of Trade, the Mines Department and the Air Raid Precautions Department. The Committee's role was to 'bring the larger war-time demands of other Government departments for rail transport before the Ministry of Transport'.<sup>77</sup> Pre-war planning had recognized that the rail network in the United Kingdom faced a greater threat of enemy attack from the air than in the First World War and Air Raid Precautions work in this respect was especially pro-active in the late 1930s.<sup>78</sup> From the enemy's perspective, the significance of disrupting the rail network was quite clearly reflected in its plans for the invasion of the British Isles which noted that:

...the individual sections of the English rail network offer excellent opportunities for disruption because of their many embankments, underpasses, and bridges, as well as the numerous short tunnels.<sup>79</sup>

Notwithstanding, the rail network managed to maintain nearly normal services throughout 1940, a period when the greatest disruption from enemy attack might have been expected. There were, however, significant problems with congestion resulting mainly from an increase in industrial and commercial activity in the western half of the United Kingdom, largely as a result of the diversion of shipping traffic to the west coast ports.<sup>80</sup> Rail transport formed an important part of the RAF's transport network in the United Kingdom for the rest of the war, enabling large volumes of bulky and heavy goods to be shipped. This proved to be particularly valuable for the MUs which were able to receive and despatch large tonnages by rail. The official histories do not include

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<sup>75</sup> Savage, *Inland Transport*, Appendix IV, p.97.

<sup>76</sup> Savage, *Inland Transport*, p.61.

<sup>77</sup> *Ibid*, p.59.

<sup>78</sup> *Ibid*, pp.39-41.

<sup>79</sup> German Military High Command, *German Invasion Plans for the British Isles 1940* (Oxford: republished by the Bodleian Library, 2007), p.43.

<sup>80</sup> TNA, AIR 14/282, *Vulnerability of Railways to Air Attack*. Memorandum by Director of Transportation, War Office – Air Attack on Railways, dated 18th December 1940.

detailed figures for the Air Ministry and RAF usage of rail, but the operational record books of the MUs do provide some indication. During 1942, for example, approximately 50 per cent of the freight turnover (tons) at Number 25 MU Hartlebury was carried by rail.<sup>81</sup> This appears to be a typical figure for most of the equipment MUs. Perhaps the most significant value of rail transport for the RAF though was for the movement of bulk fuel and explosives. Until the construction of the fuel pipeline in 1941, which connected the west coast ports to the operational airfield areas of the east of England, movement of fuel by rail was the only means of transporting the substantial quantities required by the operational bomber squadrons in particular. The size of the requirement is well illustrated by the example of the 1,000 bomber raids, the first of which the RAF carried out in May 1942. For one raid alone, the aircraft fuel load required some 2,600,000 gallons, all transported by twenty-five train loads in a total of 650 tank cars.<sup>82</sup> Even after the construction of the pipeline system, rail transport remained a vital link in the fuel supply chain and continued to be used to move fuel from pipeline terminal depots in the east of England to the operational flying units.<sup>83</sup>

## Air Transport

The relative infancy of aircraft design and development during the First World War precluded their use for the practical transport of personnel and equipment in any sizeable volume. Moreover, the predominantly static nature of 'trench' warfare on the Western Front saw little need for the development of such a capability. Military aircraft of the RFC and RNAS were, however, used in a transport role to air drop supplies to the British 6<sup>th</sup> Division at Kut el Amara in Mesopotamia which had become surrounded by Turkish forces; during the period 17 to 29 April 1916, the end of which saw the garrison in Kut having to surrender to the Turkish forces, 19,000 lbs of supplies (mainly food) were dropped in 140 sorties.<sup>84</sup> This was, however, a temporary measure to meet an urgent need and largely used modified bomb-dropping apparatus under the

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81 TNA, AIR 29/987, Operational Record Book, 25 MU Hartlebury, entries for January to December inclusive.

82 J. Grehan, 'Behind the Offensive', *Britain at War*, October 2008, p.20.

83 *Ibid.*, pp.20-21.

84 W.F Buckingham, 'The Establishment and Initial Development of a British Airborne Force June 1940 – January 1942', (unpublished doctoral thesis, University of Glasgow, 2001), p.10; I. Knight, 'British in Iraq – 1915', *Military Illustrated*, September 2003, pp.9-15; Imperial War Museum, *History of No.30 Squadron – Egypt and Mesopotamia 1914 to 1919* (Eastbourne: Naval & Military Press, Undated), pp.47-49 and Cole & Grant, *But Not in Anger*, pp.7-14.

aircraft's lower wings to release supplies contained in sacks. The operation at Kut was innovative but not part of any wider initiative to develop an RAF air transport capability.

It was at about this time that the RFC is believed to have dropped supplies of small arms ammunition by air to ground forces for the first time. The task fell to Number 9 Squadron, operating RE8 aircraft with modified bomb racks which could hold two boxes, each holding 2,000 rounds of .303 ammunition (with an attached parachute); the containers were released by the aircraft's observer using a cable release mechanism. To indicate where the main drops were required, ground troops marked the required point with a white 'N'; specific machine gun posts were able to seek specific drops at their location by displaying a white 'V'. The technique proved highly successful and on 4 July 1918, during the advance of the 4<sup>th</sup> Australian Division, ninety-three boxes of ammunition containing 111,600 rounds of ammunition were dropped with the loss of just two RE8s.<sup>85</sup> Further air dropping of supplies continued through to the end of the War with the nature of stores dropped being extended to include signal flares, barbed wire and food. The first large aircraft to enter RFC/RAF service were the Handley Page O/400 and Vickers Vimy, but both of these were originally designed and entered service as bombers in 1918. They did, however, see service as air transport with 70 and 216 squadrons in the early 1920s.<sup>86</sup>

The early post-First World War years saw a clear divide in the air transport needs of the RAF in the United Kingdom and overseas, with a marked difference in requirement and capability. The RAF's presence in Iraq and Afghanistan, with large distances between its bases and inhospitable terrain, saw a very clear need for air transport.<sup>87</sup> From its introduction to service in 1922, the Vickers Vernon aircraft was used extensively in the Middle East, enabling the movement of a significant volume of spares to be undertaken, beyond what could realistically be carried by much smaller, two-seat aircraft as well as enabling the transport of engineering servicing parties to the sites of stranded aircraft.<sup>88</sup> In due course, the Vernon was replaced by two further Vickers aircraft

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<sup>85</sup> Cole & Grant, *But Not in Anger*, p.14-15 and Saunders, *Per Ardua*, p.268.

<sup>86</sup> Wynn, *Forged in War*, p.5 and Thetford, *Aircraft of the Royal Air Force*, p. 315 & 367.

<sup>87</sup> Wynn, *Forged in War*, p.5.

<sup>88</sup> MOD (AHB), Notes on Royal Air Force Early Air Transport Operations (Unpublished & Undated).

of similar design: the Victoria in 1926 and the Valentia in 1934. These aircraft were almost exclusively operated by 70 and 216 Squadrons who, by the mid-1920s, were the RAF's sole air transport operators in the Middle East.<sup>89</sup> The introduction of the Victoria and Valentia almost doubled the troop-carrying capacity of the Vernon, with a substantially increased operating range of 800 miles.<sup>90</sup>

Although the introduction of new types of aircraft from 1926 onwards brought an evolutionary improvement in air transport, the broader contribution to RAF logistics' capability was relatively small. The aircraft's limited carrying capacity meant that it would still take a large number of aircraft to transport the ground personnel of a flying squadron, let alone the panoply of spares and equipment, much of which would have been too bulky to have been accommodated in interiors which were primarily designed to accommodate passengers. As far as the Army was concerned, a single aircraft alone could not even move a complete platoon. Geographically, the aircraft were almost entirely based in the Middle East and India - there was little requirement for such a capability in the United Kingdom where distances between bases was much shorter, terrain and climate more moderate and where there was a more well-developed road and rail infrastructure. Thus, by the beginning of the Expansion Programme in 1934, the RAF had developed an air transport capability which reflected the geographical needs of its foreign policy at the time, rather than one which would support operational doctrine for future warfare. At the heart of this disparity is the fundamental issue of how it was envisaged that the RAF was to be employed in support of a ground campaign; a number of scholars have gone as far as suggesting that there was a complete lack of any progressive thinking on Army/RAF cooperation. Indeed, Brian Bond and Michael Taylor make the point that the RAF was:

...pre-occupied with many issues in the inter-war period but thinking deeply about army support, and in particular how to influence a major campaign on the Continent [of Europe] had not been high on the agenda.<sup>91</sup>

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89 Cole & Grant, *But Not in Anger*, pp.54-70.

90 Thetford, *Aircraft of the Royal Air Force*, pp. 320 & 324.

91 B. Bond & M.D. Taylor, *The Battle for France and Flanders 1940 – Sixty Years On* (Barnsley: Leo Cooper, 2001), p.119.

Unless future conflict occurred in the Middle East, the Service was largely dependent on surface methods of transport such as road, rail and sea. Surprisingly though, the RAF's 1932 *Field Pocket Book* made a very clear reference to movement by air which, in reality, was at odds with actual capability :

Whenever practicable, aircraft should move by air with as many of the unit's personnel as the type will permit. The distance of such movement should be calculated not only in accordance with the range and type of aircraft, but also to ensure that they are not separated from their essential stores, etc, for a longer period than is absolutely necessary.<sup>92</sup>

The guidance went on to recommend that:

Small forces intended to operate for a short period from an advanced air station may be moved by means of transport aircraft. Under special arrangements, more elaborate air movements may be undertaken, but such movements will require very careful organization.<sup>93</sup>

Notwithstanding the clear doctrinal intent, the development of actual air transport capability during the inter-war years was largely focused on the Middle East theatre; its role here was more aligned with inter-base transport, rather than as part of supporting the RAF's mobile role in expeditionary warfare. By the outbreak of war in September 1939, the RAF had just three air transport squadrons operating solely the Vickers Valentia overseas: 70 Squadron operating at Helwan in Egypt, with a detachment at Habbaniyah in Iraq; 216 Squadron at Heliopolis in Egypt and 31 Squadron at Lahore in India.<sup>94</sup> The number of squadrons committed to air transport changed in 1940, a year which saw 267 Squadron established at Heliopolis operating a mixture of transport aircraft and 70 Squadron changing its role to a bomber squadron with the Vickers Wellington in September 1940. Two further squadrons joined the air transport fleet in the Middle East: 117 Squadron operating the Bristol Bombay at Khartoum in the Sudan from April 1941 and 173 Squadron operating a mixture of transport aircraft at Heliopolis from July 1942.<sup>95</sup> By September 1942, 117, 173, 267 and 216 Squadrons were brought under the control of Number 216 Group in the Middle East theatre Group, much of which supported the 8<sup>th</sup> Army

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<sup>92</sup> Air Ministry, Air Publication 1081, *Royal Air Force Pocket Book 1932*, (London: HMSO, 1932), Chapter XI p.112.

<sup>93</sup> Ibid.

<sup>94</sup> Delve, *The Source Book of the RAF*, p.52 and Jefford, *RAF Squadrons*, pp. 46, 71 & 35.

<sup>95</sup> Jefford, *RAF Squadrons*, pp.81, 46, 57 & 65.

in North Africa.<sup>96</sup> The scope of this thesis does not permit a detailed examination of the part that each of the 216 Group squadrons played in logistics but an example is related in Chapter Eight and highlights the significant role which the squadron played in supporting 40 ASP during the Battle of El Alamein in October 1942.

Air transport support in India during the inter-war years had been on a much smaller scale, primarily due to the RAF's operations and basing being predominantly focused on the North West Frontier region of the country.<sup>97</sup> A Heavy Transport Flight was formed at Lahore in March 1929 which operated the Handley Page Clive troop carrier aircraft, a modified version of the Hindii bomber.<sup>98</sup> The unit was re-designated the Bomber Transport Flight in July 1932 and by the outbreak of war had been absorbed into 31 (Bomber Transport) Squadron operating the Vickers Valentia at Lahore.<sup>99</sup> The air transport resource in India was strengthened by the newly formed 353 Squadron operating Lockheed Hudsons at Dum Dum in June 1942 with a detachment from 216 squadron at Karachi and Agartala, also operating Hudsons, in November 1942. These squadrons came under the control of 229 Group in December 1943.<sup>100</sup> The value to logistics is more difficult to assess in this theatre due to the limited level of detail in squadron operational record books. The role of 31 Squadron, however, stands out for particular note in its support of ground forces after the Japanese advance into Burma in 1942, flying in supplies and reinforcements, along with evacuating the wounded. The squadron was also actively involved in supply dropping to the Chindit Special Forces' expeditions in Burma during 1943 and 1944.<sup>101</sup>

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96 Wynn, *Forged in War*, p.6 and Jefford, *RAF Squadrons*, pp. 57, 65, 71 & 81. These squadrons operated the following aircraft: 117 Squadron - Lockheed Hudson, the Douglas DC2 from February 1943 and Douglas Dakota from June 1943; 173 Squadron - variety of aircraft types; 216 Squadron - Lockheed Hudson and then the Douglas Dakota from April 1943 and 267 Squadron - operating the Lockheed Hudson, Douglas Boston and DC3 from August 1942.

97 Bowyer, *RAF Operations*, pp.144-169 and Jefford, *RAF Squadrons*, Appendix 11, Map 44, pp. 256-257.

98 Cole and Grant, *But Not In Anger*, p.80, Sturtivant *et al*, *Royal Air Force Flying Training and Support Units*, p.191 and Thetford, *Aircraft of the Royal Air Force*, p.368.

99 Sturtivant *et al*, *Royal Air Force Flying Training and Support Units*, p.83 and Jefford, *RAF Squadrons*, p.35.

100 Wynn, *Forged in War*, p.57, Delve, *The Source Book of the R.A.F.*, p.129 and Jefford, *RAF Squadrons*, pp.35, 71 & 88. The 216 Squadron detachment converted to the Douglas Dakota in April 1943, 31 Squadron converted to DC2s in April 1941, the DC3 in April 1942 & Douglas Dakota in April 1943 and 353 Squadron converted to the Douglas Dakota in April 1944.

101 Cole & Grant, *But Not in Anger*, pp.123-134 and G.Pitchfork, *Men Behind the Medals* (Barnsley: Leo Cooper, 2003), pp.139-143. Supply dropping in Burma is also covered in some detail in Annett, *Drop Zone Burma*, pp.1-201.

The development of air transport in the European theatre of war got off to a much slower start. The position before the Second World War, as described by Wynn in his history of RAF Transport Command, was:

...quite different, not only in geographical but also in organisational terms, and it was quite clear that this role was a Cinderella to bomber, fighter and maritime squadrons.<sup>102</sup>

Dean, in his wide ranging work on the RAF and Two World Wars, makes the statement: 'when war broke out the Royal Air Force possessed for practical purpose no transport aircraft' and describes the transport aircraft in Egypt as primarily troop carriers. He goes on to suggest that:

The failure to develop a modern transport was in part a facet of the Trenchard doctrine which required that the Royal Air Force should not be over-anxious to invest in forms of air activity which could be used as an ancillary service by the Army and Royal Navy.<sup>103</sup>

Dean comments that a 'shortage of funds' was also a contributory factor and, perhaps the most telling of all, that the '...Air Staff put out no specification for a transport aircraft in the Thirties'.<sup>104</sup> This was very much at odds with the organisation of the German Air Force at the time which, with a policy of ensuring that its operational units had a high degree of mobility, attached two transport aircraft (Junkers 52) to each of its flying squadrons or staffels; the normal establishment of aircraft per staffel was nine with three reserve aircraft.<sup>105</sup>

At the outbreak of war in September 1939 there were just two air transport units in the United Kingdom: Number 24 Squadron based at Hendon and Number 1680 Flight at Doncaster – both units were controlled by RAF Fighter Command.<sup>106</sup> Number 24 Squadron had been at Hendon since July 1933 and, as described by Wynn, operated a '...motley collection of aircraft, some of which came from internal airlines'.<sup>107</sup> Its role had limited logistical value

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102 Wynn, *Forged in War*, p.6.

103 Dean, *The Royal Air Force and Two World Wars*, p.80.

104 Ibid.

105 TNA, AIR 2/5054, Formation of an Air Transport Unit, Unreferenced note by HQ Bomber Command dated 8 December 1939- The Need for the Establishment of a Transport Flight in the Bomber Command, p.1.

106 Wynn, *Forged in War*, p.6.

107 Ibid, p.7.

in the context of this thesis and was largely confined to the transport of VIPs and the carriage of mail for the Services. The role of 1680 Flight was, however, of more significant logistical value.<sup>108</sup> The 'motley' collection which Wynn refers to came about through a pre-war enabling measure known as the 'Dormant Contract' which had earmarked sixty-eight transport aircraft from thirteen civil operators. Many of these aircraft were allotted to specific RAF stations just before the outbreak of war on 1 September 1939; this proved to be a timely and important source of additional aircraft, not just for 24 Squadron, but also for 1680 Flight. The same day the British government also introduced the *Air Navigation (Restriction in Time of War) Order 1939* which placed most civil airfields in the United Kingdom under military control.

The beginning of September 1939 also saw the aircraft of a number of private air transport companies relocated to airports at Bristol, Exeter, Coventry and Poole. The administration of these wartime measures was carried out by the National Air Communications (NAC) organisation, a new statutory department which was established within the Air Ministry.<sup>109</sup> By the end of March 1940, most of the work of NAC was taken over by the RAF, with the exception of wartime regular scheduled air services within the United Kingdom and to some overseas destinations. The RAF takeover saw some 150 aircraft being impressed into military service.<sup>110</sup> This influx of aircraft, inter alia, saw the need to upgrade the status of 1680 Flight, with it becoming Number 271 Squadron on 26 March 1940. The new squadron benefitted significantly as, on its formation, the number of ex-civilian aircraft represented just over 50 per cent of its aircraft fleet.<sup>111</sup> The formation of 271 Squadron broadened its operational responsibility from just Fighter Command to include taskings from Bomber and Training Commands. These taskings included a liability for the movement to, and support of, squadrons deployed to France, along with the movement of bomber and fighter squadrons in the United Kingdom when required.<sup>112</sup> Along with a number of chartered civilian aircraft controlled through NAC, 271 Squadron had

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108 TNA, AIR 2/5054, Formation of an Air Transport Unit, Secret Organisation Memorandum - Formation of No. 271 (Transport) Squadron, unreferenced and undated and Wynn, *Forged in War*, pp.6-8.

109 J. Havers, 'National Air Communications, September 1939 - April 1940', *Air-Britain Digest*, Volume 48, No 4 (Winter 1996), 111-121 (p.111).

110 Ibid, p.116.

111 TNA, AIR 2/5054, Formation of an Air Transport Unit, Secret Organisation Memorandum - Formation of No. 271 (Transport) Squadron, Air Ministry Secret Organisation Memorandum - Formation of No. 271 (Transport) Squadron, undated.

112 Ibid, Air Ministry note to AOC in Cs Bomber, Fighter, Training and Coastal Commands dated February 1940.

an active part in the campaign in France during 1939/1940.<sup>113</sup> The operational records for 1680 Flight do not appear to survive, but the records for 271 do remain, but only from May 1940. Although this is late on in the campaign in France, it is clear that the squadron was actively involved in numerous flights to, from, and within France, conveying stores and personnel for the RAF's squadrons on the continent.<sup>114</sup> The use of air transport during this campaign proved to be highly significant, a point made in the despatch by the commander of British Air Forces, France (Air Marshall Barratt) who commented that '...the importance of having an adequate number of transport aircraft available was emphasised on numerous occasions...'. Barratt also observed that '...more aircraft and a large transport organization would have been invaluable'.<sup>115</sup> The squadron also performed valuable work during the Battle of Britain with the movement of combat squadrons between airfields. During what the historians Derek Wood and Derek Dempster classify as the fourth phase of the Battle (7 September – 30 September 1940), the transport aircraft of 271 Squadron carried out some thirty-four taskings for Fighter Command, much of which involved moves of complete squadrons.<sup>116</sup> These taskings supported the work of the first three of the RAF's Motor Transport companies which had been formed in July 1940 for this very purpose. The squadron remained in Britain throughout the war, eventually becoming part of 46 Group and playing a key part in the airborne element of operation OVERLORD in 1944.

There were two significant changes in command and control which enabled a more focused approach to air transport. The first of these came on 5 August 1941 when the Air Ministry's Directorate-General of Equipment's branch DDE9 was renamed the Deputy Directorate of Movements (DD Movements) and transferred to the control of the Directorate-General of Organisation (DGO).<sup>117</sup> The new Directorate was similar in structure to its predecessor, but with a strengthened planning/policy function and the notable addition of a

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113 TNA, AIR 35/336, AASF Use of Air Transport, Administrative Instruction No. 12, Organisation of Air Transportation Service dated 7 September 1939.

114 TNA, AIR 27/1573, Operations Record Book for 271 Squadron, entries for May and Jun 1940.

115 TNA, AIR 35/354, Barratt's Despatch on France, original and unpublished copy, Barratt to Secretary of State for Air dated July 1940.

116 Wood and Dempster, *The Narrow Margin*, p.212 and TNA, AIR 2/5054, Formation of an Air Transport Unit, list of taskings. The details shown in the Air Ministry file include taskings for the period 1 to 20 September 1940. This is not an exact match with Wood and Dempster's dates but are sufficiently close for illustrative purposes.

117 MOD (AHB), Notes - Royal Air Force Movements During the Second World War (Unpublished & Undated). Attached copy of Air Ministry Office Memorandum (OM) 110/41 dated 5 August 1941 refers.

section responsible for the intake of American aircraft to the United Kingdom.<sup>118</sup> The DD Movements' organisation was upgraded to Directorate status (still within DGO's area) on 23 May 1942.<sup>119</sup> The second and more significant change for the RAF came on 25 March 1943 with the formation of RAF Transport Command. This placed transport aircraft resources under the command and control of a single RAF Command which was responsible for '...the organisation and control of strategic air routes, for all overseas ferrying, for reinforcement moves of squadrons to and between overseas theatres and for air movements of freight and personnel'.<sup>120</sup> By early 1944, the transport assets and related activity of the RAF were, broadly speaking, overseen by five groups and one wing. Within Transport Command, 44 and 45 Groups were responsible for ferry services and Atlantic transport, with 46 Group responsible for transport aircraft units within Britain. Overseas units were covered by 216 Group (within Mediterranean Allied Air Forces) for the Middle East, 229 Group (within Air Command South East Asia) for India and 114 Wing (within Mediterranean Allied Air Forces) for West Africa. As part of the preparations for Operation OVERLORD, 38 Group was formed in October 1943 with its transport squadrons assigned to the Allied Expeditionary Air Force.<sup>121</sup> By and large, the significant expansion of RAF air transport capability can be attributed to the purchase of large numbers of the Douglas C-47 Dakota from the United States of America under the Lend-Lease Agreement. Unlike many of the RAF's earlier aircraft used for transport duties, the C-47 Dakota was produced with larger cargo doors and strengthened floors; this, coupled with its ability to operate from rough terrain airstrips made it an ideal aircraft for general purpose transport.<sup>122</sup>

Thus, by the beginning of 1944, the RAF had developed a much stronger air transport capability, although by this point in the war it had been driven by the planning requirements for the invasion of Europe through Operation OVERLORD. The wider air transport activities (mainly delivery of airborne

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118 Ibid. The other sections included: Administration; Movement of Personnel by Sea and Rail; Movement of Freight by Sea; Movement of Equipment by Road and Rail; Movement of Personnel and Equipment by Air and the responsibility for petrol rationing.

119 MOD (AHB), Notes - Royal Air Force - Movements, OM 75/42 dated 23 May 1942.

120 Delve, *The Source Book of the RAF*, p.101.

121 Ibid, pp.107, 118, 121 and 127.

122 P.Butler, *Air Arsenal North America - Aircraft for the Allies 1938-1945, Purchases and Lend-Lease* (Hinckley: Midland Publishing, 2004), pp.191-193 and Thetford, *Aircraft of the Royal Air Force*, p.151.

forces and their equipment) connected with OVERLORD and other airborne operations which took place in Europe up until the end of the war are well covered in the literature so there is little more which can be added as far as this thesis is concerned.<sup>123</sup> The dominance of this aspect in published works masks the fact that RAF transport aircraft of 46 Group also made a much wider contribution to the logistical support of both the 2<sup>nd</sup> Tactical Air Force and 21<sup>st</sup> Army Group through what was known as supply-by-air.<sup>124</sup> The overall control and tasking of all scheduled and emergency airlift was carried out by the Combined Air Transport Operations' Room at the Headquarters of the Commander in Chief Allied Expeditionary Air Force (AEAF) at Stanmore, just outside of London, with an Air Freight Control Centre at Poulton, close to the main 46 Group airfields in Wiltshire (Broadwell, Down Ampney and Blakehill Farm). Poulton received freight from both the Army and RAF and ensured that it was prepared for air transport before moving it to the nominated departure airfield.<sup>125</sup> The first supplies were flown into France (Bazenville, near Bayeaux) by 271 Squadron on 13 June 1944 (D+7); the first dedicated transport airstrip in France (Creully, near Bayeaux) was established on 6 July 1944. The size of the RAF's air supply operation into Normandy was substantial; it included a diverse range of freight ranging from explosives and fuel to medical stores and vehicles. By the end of August 1944, 46 Group had carried some 2,636 long tons of freight plus 8,815 passengers to the Continent and evacuated 22,814 casualties to Britain.<sup>126</sup> Perhaps the most critical contribution made by RAF logistics during the campaign was in direct support of the British Army as it advanced north east through France, Belgium and into Holland during August and September 1944. There was a significant logistical issue here in that the source of supply for the advancing Army was still in Normandy, much of which was coming in through the Mulberry harbour at Arromanches. Although the famous American 'Red Ball

123 See, for example, Air Ministry, AP 3232, *The Second World War 1939 – 1945, Airborne Forces* (London: Air Ministry, 1951), pp.101-113, 115-140 and 179-204; L.Buist, P.Reinders and G.Maassen, *The Royal Air Force at Arnhem – Gliders and Re-Supply Missions in September 1944* (Dodewaard (Netherlands): Society of Friends of the Airborne Museum Oosterbeek, 2005), pp.11-135; A.W.Cooper, *Air Battle for Arnhem* (Barnsley: Pen & Sword, 2012), pp.11-16; K.Delve, *D-Day – The Air Battle* (Marlborough: Crowood Press, 1994), pp. 96-130; S.Ritchie, *Arnhem – Myth and Reality* (London: Robert Hale, 2011), pp.57-82 and 212-228 and C.Ryan, *A Bridge too Far* (London: Hamish Hamilton, 1974), pp.75-130 and 133-222.

124 TNA, AIR 37/13, An Account of the Organisation, Training and Operations (and lessons learned) of 46 (Transport Support) Group, Royal Air Force during the Invasion of Hitler's Europe, p.4. See also Air Ministry, *Airborne Forces*, pp. 107-109 and 135-136. Re-supply missions were also carried out by 38 Group aircraft from 8 June 1944.

125 Fourth Supplement to the London Gazette, *Air Operations by the Allied Expeditionary Air Force in N.W. Europe from November 15th to September 30th 1944*, Issue 37838, 2 January 1947, p.83 and TNA, AIR 37/13, An Account of the Organisation, Training and Operations (and lessons learned) of 46 (Transport Support) Group, Royal Air Force during the Invasion of Hitler's Europe, pp.3-5.

126 TNA, AIR 37/13, An Account of the Organisation, Training and Operations (and lessons learned) of 46 (Transport Support) Group, Royal Air Force during the Invasion of Hitler's Europe, p.62 (outbound and inbound tables).

Express' vehicle convoy system did its best to keep pace with the advancing British and American armies, re-supply lines of communication grew ever longer. Indeed, even by early September 1944, RAF transport aircraft of the Allied Air Force assisted with '...rushing petrol, ammunition and rations to the armies in France and Belgium in order to keep them fighting and they had become entirely dependent upon air supply'.<sup>127</sup> Of all the resupply needs, vehicle fuel became one of the most urgent and pressing of requirements. The withdrawal of 46 Group aircraft from re-supply operations and commitment to the airborne operation in Holland during the period 1 – 25 September (Operation MARKET GARDEN) posed an unwelcome threat to the support of the advancing ground forces and saw direct intervention from Eisenhower, who requested (through AEAFF) a temporary daily assignment of seventy RAF Bomber Command aircraft to supply fuel by air for 21<sup>st</sup> Army group. This task was carried out by Halifax aircraft of 4 Group Bomber Command in late September 1944 operating mainly from RAF Pocklington and RAF Elvington near York, to airfields near Brussels.<sup>128</sup> Such was the significance of the air transport contribution that it warranted specific comment in the post-campaign despatch by the Air Commander-in-Chief AEAFF, Air Chief Marshall Sir Trafford Leigh-Mallory:

The principal lesson so far from the campaign is that the tactical use of air transport to supply a rapidly advancing army can be of decisive importance, and that the limiting factor in its employment is not so much the availability of suitable aircraft as the availability of sufficient landing strips in the forward area and adequate loading and re-loading arrangements at the terminus.<sup>129</sup>

### **Water Transport (Sea)**

The use of water as a means of transportation is not as tactically significant as road, rail or air as far as logistics is concerned but, nonetheless was still an essential option for strategic transport. With such an extensive

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<sup>127</sup> Ibid, p.64. The British Second Army, for example, had advanced about 250 miles from the River Seine since the end of August 1944. Although the Red Ball Express was predominantly to support American forces, it also ran an operation known as the Red Lion Express which supported British and Canadian forces on Operation MARKET GARDEN. P.Ware, *Red Ball Express – Supply Line from the D-Day Beaches* (Hersham: Ian Allan Publishing, 2007), p.153 refers.

<sup>128</sup> TNA, AIR 14/1025, Air Freight Bomber Command, Eisenhower to AEAFF dated 21 September 1944 and minutes of a meeting held at Headquarters Bomber Command to discuss Using Bomber Command Aircraft for Transportation Supplies to the Continent dated 24 September 1944. Each Halifax aircraft was modified to carry 730 gallons of fuel in 163 jerry cans.

<sup>129</sup> Fourth Supplement to the London Gazette, *Air Operations by the Allied Expeditionary Air Force in N.W. Europe from November 15th to September 30th 1944*, Issue 37838, 2 January 1947, p.83.

network of road and rail routes within the United Kingdom, there was little need for the transport of equipment and supplies by sea on the home front. The key role for sea transport was for moving RAF personnel, supplies and equipment to overseas theatres of operation. This was achieved through extensive use of merchant shipping for routine movement or directly embarked on Naval vessels (and offloading vessels such as landing craft) when landing as part of amphibious operations such as the invasions of North Africa, Sicily, Italy and Normandy; the RAF did have marine craft, but these were used primarily for air/sea rescue duties and supporting amphibious aircraft such as the Catalina and Sunderland.<sup>130</sup> There was no tri-Service organization in the period up to and during the Second World War to interface with ships in port and the RAF therefore established its own specialist capability. Initially, these were known as embarkation offices, embarkation staff or port detachments; this miscellany of units was renamed Embarkation Units (EU) during the Autumn/Winter of 1941/1942.<sup>131</sup>

By the end of the war, nearly fifty EUs had been formed at home and overseas, most of which were based in or around sea ports. In the very early days of the war, the role of the British units was not just to support the feed-in of freight and RAF passengers to the troopships, but also to assist the other Services. One such example was assisting the Royal Navy who did not have any facilities for embarking aircraft onto their carriers whilst in port; this work was carried out by the EUs, in conjunction with the RAF MT Companies on the Mersey and the Clyde. The EUs became an important part of the RAF's Movements organization and were used with great success overseas to provide a loading and unloading capability at captured ports. Following the work of the RAF Beach Squadrons in the opening stages of Operation OVERLORD, the RAF EUs took on the role of unloading RAF supplies and personnel through the Mulberry Harbour at Arromanches.

The EUs were also involved in the staffing of British troopships. Not only was there a significant number of RAF personnel arriving in Britain during the war, but also a sizeable number embarking for overseas, many of whom were

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130 G. Pitchfork, 'The Evolution of the Air/Sea Rescue Organization', *Royal Air Force Historical Society Journal*, 40 (2007), 7-24.

131 This renaming and the date range is supported by an analysis of the TNA Catalogue entries for the EU Operational Record Books in TNA, AIR 29/1 to AIR 29/19, Air 29/19, AIR 29/1093-1094, AIR 29/1097, AIR 29/1111-1112, AIR 29/1606-1619, AIR 29/1621 AND AIR 37/105.

trainee aircrew departing for and returning from overseas training in countries such as Canada, Australia, New Zealand and South Africa.<sup>132</sup> The sheer number of personnel on the move by sea brought with it a requirement for the RAF to contribute to the staffing of the troopships which were then the only means of moving large numbers of personnel over long distances. On the whole, if more than 50 per cent of the troops to be shipped were Army, then the permanent staff on board were drawn from that Service; if, however, that percentage was in favour of the RAF, then the permanent staff were drawn from the ranks of the EUs.

### **Water Transport (Inland Waterways)**

Although the use of inland waterways and canals in Britain can be traced back to the days of Roman occupation, canals began to be developed continuously from the second half of the sixteenth century.<sup>133</sup> The period of significant growth, however, was from the late eighteenth century onwards, with an inland waterway network developing, linking many of the country's rivers and playing a significant part in the transportation requirements of the industrial revolution. At the peak of its growth, there were some 4,000 miles of inland waterways in England.<sup>134</sup> The growth of the railways saw a progressive decline in the significance and usage of the canals. The inland waterways in Britain had been of relatively small value during the First World War and pre-Second World War thinking by the Committee of Imperial Defence considered that:

...instead of being a second means of inland transport they had become a bad third. Since canals were expected to carry only a small volume of traffic compared with rail and road in a future war, no special measures for war-time control were favoured.<sup>135</sup>

Notwithstanding, the Air Ministry did consider the use of inland waterways as an alternative means of transport and a series of experiments were conducted between January and April 1942. Set against an overall aim of saving on road transport as well as relieving the load on the railways, it was

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132 This flying training was carried out under the British Commonwealth Air Training Plan and the Joint Air Training Plan.

133 A. Briggs, *A Social History of England (New Edition)* (London: BCA, 1994), p.37 and P. Mathias, *The First Industrial Nation – An Economic History of Britain 1700-1914* (Second Edition)(London: Methuen, 1984), pp.98-102.

134 *Ibid.*, pp.226-228.

135 Savage, *Inland Transport*, pp.82-83.

believed that the inland waterways could offer an alternative means of transport which could be used in the event of disruption by enemy action. The concept was not seen as being of value to the growing number of RAF units, but as a means of shipping manufactured goods from contractors (mainly from contracts placed by the Air Ministry and Ministry of Aircraft Production) in the large industrial areas of London, Birmingham and Manchester, a role which was very similar to that played by the inland waterways during the industrial revolution.<sup>136</sup> Following the trial, three Canal Clearing Depots (CCD) were established at Paddington, Birmingham and Manchester, located within ten to twenty-five miles of the contractors which they served; the flow of goods to the CCDs was controlled by the RAF's Master Provision Offices. During 1942 alone, some 14,983 tons was shipped by the CCDs.<sup>137</sup> Despite what appeared to be a promising start, the scheme was short-lived. Not surprisingly, the transit time (by comparison with road and rail) was lengthy, often running into many weeks. This was not just as a result of the relatively slow speed of the barges but because of the numerous locks which had to be negotiated. Additionally, collections to and from the CCDs had to be carried out by road and this led to a large expenditure on petrol, a fact which conflicted with one of the Government's principles, to conserve petrol.<sup>138</sup> With such lengthy transit times, the various Ministries became increasingly reluctant to divert their cargoes from road and rail and this progressively led to the termination of the Scheme by the end of October 1944; the three CCDs were disbanded at the beginning of November 1944. Although the scheme was not a great success, some 61,419 tons of equipment were moved via the canals. It was estimated that the closure of the scheme placed an additional fourteen trucks per day on the national railway system or an additional two trucks per day into each of the AEDs.<sup>139</sup>

## Fuel Pipelines

Fuel, of all the supplies required to meet the needs of air power, was one of the most challenging in terms of transport from the refineries to the point of use; the main factors which influenced this were weight and volume. The inter-

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<sup>136</sup> Air Ministry, *Maintenance*, p.163.

<sup>137</sup> *Ibid.*, p.147.

<sup>138</sup> Savage, *Inland Transport*, p.621.

<sup>139</sup> *Ibid.*, p.163.

war years, with the financial constraints on the growth of the RAF, saw little opportunity or pressing need for any change to the largely road-based movement of fuel. On flying units, fuel was supplied to aircraft on the flight line by bowser or by fuel can. Evidence does exist, however, to show that the relatively small grass airfield at RAF Halton in Buckinghamshire was using perhaps one of the earliest fuel hydrant systems in Britain which enabled fuel to be piped from the on-site bulk petrol storage tanks to a refuelling point in the flight line area.<sup>140</sup> By 1940, however, it had become clear that the rapidly increasing fuel requirements of RAF aircraft in the United Kingdom would place significant pressure on the existing system of fuel distribution to flying units which, by then, were mostly served by road tanker from the various Petroleum Storage Depots (PSD) throughout the country. The PSDs were resupplied from the petroleum company storage installations by canal barge, rail and sea. To improve this situation, a fuel pipeline was constructed in 1941 by the Ministry of Fuel and Power which connected five major estuaries to forty of the PSDs, twenty-four RAF stations in East Anglia and to RAF Scampton in Lincolnshire (see Figure 13). This enabled the flying units to receive fuel at the rate of seventy-five tons (18,000 lbs.) per hour<sup>141</sup>; this quantity would have kept just one Lancaster bomber airborne for approximately twelve hours – many of the longer duration missions could last up to ten hours.<sup>142</sup> In 1944 alone, some 4,400,000 tons of petroleum products were moved by the UK Pipeline System.<sup>143</sup> By 1945, the UK pipeline system was some 1,000 miles in length linking west coast ports to installations and units towards the east of the UK. The main component of the network was in the Midlands and Southern England with a separate component in Scotland running from the west coast to Grangemouth.<sup>144</sup>

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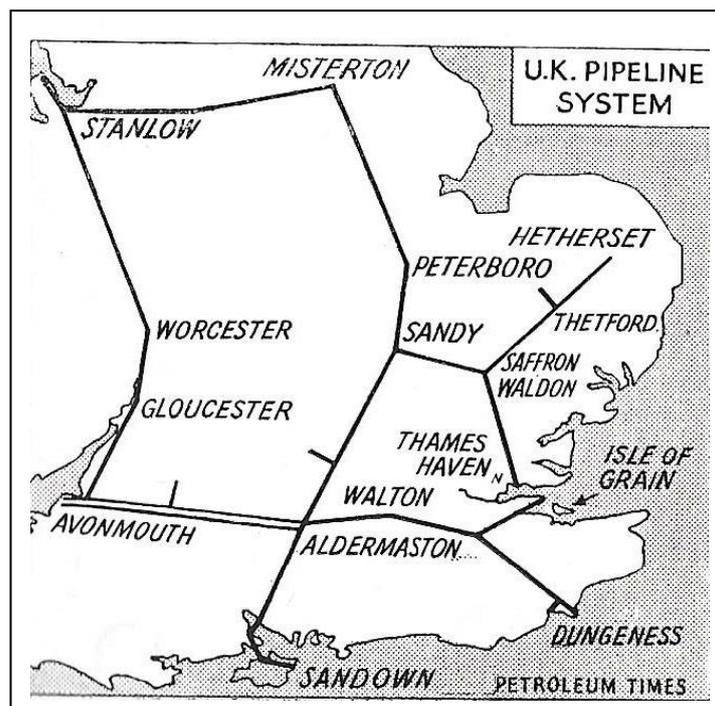
140 TMA, Site Plan of Halton Park Aerodrome (SE 76B) dated 1921.

141 A.G. Lloyd, 'Pipeline Supply of Aviation Fuel to the RAF – Part 1', *RAF Supply Magazine*, Issue 20 (1980), Part 1, 22-25.

142 Based on a fuel consumption of approximately 215 gallons of fuel per hour. C.R. Scott-Jackson, Air Ministry (E.19) lecture notes for fuels training 'Provision of POL and Air Ministry POL Organisation' G.335387/HC/5/52/40 dated May 1952, p.1 refers.

143 Petroleum Board, *British Oil Distribution in Wartime*, p.70.

144 Edgerton, *Britain's War Machine*, pp.191 & 199.



**Figure 13**  
**The UK Pipeline System**<sup>145</sup>

The final extension of the UK network came in 1944 with the development and implementation of the Pipe Line Under the Ocean or PLUTO as it became more commonly known. The need for this resulted from a planning requirement identified in the preparation for the invasion of North West Europe (Operation OVERLORD) in which a clear need emerged for an efficient and uninterrupted tri-Service supply of fuel for units operating on the Continent after the landings. This pipeline, however, was of little operational value to the RAF as aviation fuel, with its more stringent quality requirements, was transported across the English Channel by ocean tanker and then by a ship-to-shore pipeline at Port-en-Bessin near Arromanches and then via an on-shore pipeline to storage installations in the Rear Maintenance Area.<sup>146</sup> Pipelines also played a key part in the logistics operation in North Africa and by 1943 had been constructed to link protected bulk fuel storage in the Suez Canal Zone to Ghamara in Cairo to a 6,000-ton storage facility from which two nearby airfields were supplied. Pipelines were also built in Iraq to connect the refineries at Abadan in Iran, to the RAF airfields at Shaiba and Habbaniya.<sup>147</sup>

<sup>145</sup> Source: Petroleum Board, *Petroleum at War*, p.70.

<sup>146</sup> A. Searle, *PLUTO – Pipeline Under the Ocean* (Shanklin: Crossprint Design, 1995), p.64 and P. Bauduin, *Quand l'or noir coulait à flots – The Supply Problem of the Allies* (Bayeaux (France): Heimdal, 2004), pp.9-10.

<sup>147</sup> R.Higham, *Bases of Air Strategy – Building Airfields for the RAF 1914-1945* (Shrewsbury: Airline Publishing, 1998), p.138.

## Conclusion

Outbound logistics, the process of reaching the RAF's front line, whether in the United Kingdom or overseas, was a critical part of its supply chain operation. As the war progressed, the lines of communication between *links* in this chain became ever longer. The distance from the industrial manufacturing base to the main storage depots of Maintenance Command remained relatively constant. The distance from these depots to RAF units, however, increased markedly, as new operating locations were established in overseas theatres of operation which ranged from North Africa, Sicily and Italy to Continental Europe and the Far East. Within the United Kingdom, road and rail transport remained the prime means of movement. Inland waterways were used for a short period between mid-1942 and the autumn of 1944 but the scheme was discontinued due to the lengthy transit time and the tortuous process of navigating through numerous locks on the canals.

The situation overseas was more complex. Transport by sea was the only viable way of reaching overseas theatres of operation and then a combination of road and rail from ports and railheads to RAF units. The greater challenge came with operations which required RAF flying squadrons to move forward of their main operating bases as new ground was captured and secured, especially following amphibious operations such as the landings in North Africa in 1942, the invasion of Sicily and Italy in 1943 and the invasion of France in 1944. It was these operations which used the highly successful 1928 maintenance concept in the RAF's *War Manual*, with port units and the ASPs providing much needed *logistical reach*. Road transport was vital in this respect but, as the RAF found in the campaign in France during 1939/1940, the provision of sufficient MT was absolutely critical.

The one significant means of transport which this research has examined and does not receive warranted credit in the wider air power literature, is the use of air transport. Its development, however, appeared to be more of an afterthought, rather than as part of the logistics doctrine developed during the late 1920s. The outbreak of war saw a disjointed air transport capability, with a

clear division between the Middle East where the capability reflected the air trooping needs of imperial policing, to the hastily assembled mixed fleet of largely civilian aircraft types of just two transport squadrons in the United Kingdom. This capability was a very slow development and it was not until the introduction of more purpose-built air transport aircraft such as the Dakota that the RAF began to achieve more effective capability. Whilst air transport was used to limited effect to resupply ground and air forces in France during 1939/1940, it was used to much greater effect in the North African campaign during 1942/1943 and following the Normandy landings in 1944.

By and large, the RAF's outbound logistics function worked well throughout the war but it did require careful coordination between the land, sea and air methods of transportation to ensure that freight reached its intended destination on time and in the right place. In this respect, the Air Ministry's DD Movements organisation within the United Kingdom and overseas was an important coordinator, both in terms of practice and policy. It must be said, however, that the RAF did not achieve outbound logistics alone and, in addition to assistance from the Royal Navy and the Army, it also required the support and cooperation of many external organisations such as the railway companies, port authorities and civilian air transport companies to name but a few.

## Chapter Eight: On the Doorstep of Air Power - Service Delivery

### Introduction

From Chapter Five onwards, this thesis has analysed the RAF's supply chain from a linear perspective. In doing so, it has considered the origin of its stores and supplies at one end of the chain, the delivery of that materiel into the RAF depots and then the transportation used between links in the supply chain. This chapter completes the detailed examination of RAF logistics and considers the final stage in the RAF's supply chain which Porter's Value Chain model terms as Service; this can be considered to be the point at which the stores and supplies are passed to the end user.<sup>1</sup> The importance of this process is summed up by the American military historian Albert Garland who observed that 'many battles have been lost, many campaigns have failed, simply because supplies could not be put into the hands of the users'.<sup>2</sup>

Firstly, the chapter considers the operation of the Equipment Sections which were the mainstay of RAF logistics' service provision on its main bases. It then moves on to examine two specialist organizations which were formed to enable both the mobility of flying squadrons and the achievement of *logistical reach*. The first of these organizations is the Air Stores Parks (ASP). Whilst these have been referred to in various places throughout this thesis, their significant role deserves a more in-depth analysis, enabling a deeper understanding of how the deployment of air power, forward of fixed bases was achieved. The second of these organizations is the RAF Beach Squadrons. The role of these was quite different from the ASPs, but they enabled the successful participation of RAF ground support formations in amphibious landings such as the invasion of North Africa, Sicily, Italy and Normandy.

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<sup>1</sup> Porter, *Competitive Advantage*, p.40.

<sup>2</sup> Garland, 'Some Thoughts on the Writing of Military History', 19.

## Equipment Services on RAF Stations

During the inter-war years, with much of the RAF operating from established bases, on-site stores complexes were established on RAF stations. On the whole, these were manned by officers and tradesmen of the Stores' discipline (renamed Equipment from November 1936). The facilities they worked in were relatively self-contained (many with other outbuildings for specialist storage such as POL and explosives) and usually consisted of a goods inwards/outwards section (often with a forward delivery function on the unit), a stockholding component (usually divided into generic groups such as technical stores, clothing and barrack stores) and a stock control & accounting section.<sup>3</sup> This concept remained in use (although referred to as Equipment Sections from 1936 with the introduction of the term Equipment) throughout the war on established bases at home and overseas. On large stations, where the main store was some distance from the various units, sub-stores were established and staffed by logistics personnel from the Equipment Section.<sup>4</sup> These sections were the *retail outlet* on RAF bases and were responsible for ensuring that the units which they were charged with supporting were provided with the equipment they required. This equipment was wide ranging in nature and was broadly categorised under three main headings: *Stores* (technical and barrack); *Machines* (airframes, aero engines, MT vehicles and marine craft) and *Supplies* (food, solid fuels, electricity, gas water and medical comforts).<sup>5</sup> The work involved in providing this service was diverse and for *Stores*, broadly speaking, consisted of obtaining equipment from the area depot, receiving and unpacking the consignments and bringing the items on to the stock record account – equipment was then issued as required; separate procedures were employed for *Machines* and *Supplies*.<sup>6</sup> Stocktaking was required by Air Ministry regulations to be carried out annually, although in practice this was usually conducted out progressively throughout the year.<sup>7</sup>

<sup>3</sup> Air Ministry, *The Royal Air Force Builds for War – A History of Design and Construction in The RAF 1935-1945* (London: HMSO, 1997), pp.44-45 and Francis, *British Military Airfield Architecture*, pp.54-57.

<sup>4</sup> RAF LHCA, *Royal Air Force Equipment Training School – Standard Notes for Equipment Assistants (74185-1)* dated 1942., p.2. The RAF's concept of logistical support up to 1939 is also broadly covered in: Philpott, *The Royal Air Force, Volume I*, pp. 261-266 and Philpott, *The Royal Air Force, Volume II*, pp. 325-329. A general flavour of day-to-day equipment issues throughout 1942 can be found in the minutes of the Station Equipment Officers' Conferences in TNA, AIR 14/1023, Station Equipment Officers' Conference at 91 Group HQ.

<sup>5</sup> RAF LHCA, *Royal Air Force Equipment Training School – Standard Notes for Equipment Assistants (74185-1)* dated 1942, pp.40-41.

<sup>6</sup> *Ibid*, pp.6-9.

<sup>7</sup> *Ibid*, p.34.

Equipment was not always available when required and much time and effort was also employed in managing what were known as inabilities and short supply items which were grounding aircraft.<sup>8</sup> The performance of the logistics' organization was the subject of numerous conferences held by the RAF's Equipment Branch throughout the war, at both individual command and RAF level.<sup>9</sup> These provided a valuable opportunity to raise issues and to identify opportunities for continuous improvement. The issues discussed were wide ranging. At an RAF-level conference held in October 1942, for example, the topics (inter alia) of the maintenance of civilian impressed aircraft, the storage of propellers and an overview of the lists of items in short supply were discussed in detail. The opportunity was also taken at these meetings to take suggestions for improvement; these could range from useful and practical recommendations to the highly imaginative. At the October 1942 meeting, for example, Maintenance Command '...wondered whether any use could be made of the large number of tricycles which must have become redundant as a result of the recent cessation of manufacture of ice-cream'. They went on to suggest that perhaps these tricycles could be used to convey cooked food to airfield dispersal points.<sup>10</sup> Broadly speaking, it is clear that the overall management of the logistics' process was carried out diligently and in great detail. Logistics' support in the United Kingdom was relatively straightforward, largely due to the fact that the RAF's supply chain was operating on home soil and therefore much easier to manage. Additionally, good and reasonably short lines of communication between industrial manufacturing sites, the MUs and user units enabled a responsive supply chain to be maintained.

### **The Air Stores Parks**

The first four ASPs (numbered 1 to 4 respectively) were intended to be formed in the Middle East during October/November 1935 in response to the Abyssinian crisis.<sup>11</sup> In practice, only one was formed and saw very limited employment during the duration of the emergency. This ASP had been

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8 Ibid, pp.8-9.

9 See for example: TNA, AIR 20/1860, Director of Equipment (B): War Diary Miscellaneous Papers 1 July 1941 to 31 October 1943 and AIR 20/1861, Director of Equipment (D): War Diary 1 June 1942 to 31 October 1943.

10 TNA, AIR 14/1023, Station Equipment Officers Conference at No 91 Group HQ 1 April 1942-31 August 1946. Enclosure 20L, Notes of and Decisions Reached at the Equipment Service Conference held on 20 October 1942.

11 Sturtivant et al, *Royal Air Force Flying Training and Support Units*, p.62.

disbanded by early 1936, most likely as a result of uncertain employment at the time. The first six ASPs were formed in earnest back in the United Kingdom in August and September 1939 at RAF Henlow and RAF St Athan.<sup>12</sup> All six ASPs went into action for the first time during the campaign in France during 1939-40; Numbers 1, 2 & 3 ASPs were assigned to the Air Component, whilst Numbers 4, 5 & 6 were assigned to the Advanced Air Striking Force (AASF).<sup>13</sup> The latter was intended to be a bomber force only, made up of squadrons from Bomber Command and based in France because of the comparatively short range of their aircraft. The Air Component was designed to be a completely integral part of the British Expeditionary Force with the aim of providing air reconnaissance and protection for the ground forces. A Base Depot to re-supply the ASPs was established at Nantes, with eventually up to ten port detachments to receive shipments of equipment from Britain.<sup>14</sup> In May 1940, with the German advance, the parks were stretched to the limit endeavouring to support the squadrons during the British withdrawal; all six parks were evacuated to the United Kingdom during mid-June 1940, mostly through the port of Brest.<sup>15</sup> The campaign was a valuable operating experience for the ASPs, albeit costly in terms of equipment lost in the hasty withdrawal from the Continent. It was estimated that the RAF lost the equivalent of four complete ASPs, or stock to the value of about £1,000,000 at 1940 prices.<sup>16</sup> The wider operational value of the ASPs deployed to France in 1939/1940 is not easy to sum up but the flying squadrons could not have deployed forward of the base depot at Nantes and later sustain a retreat to the coast, without spares and maintenance support; it could be argued that, as this service was provided by the ASPs, their value is therefore implicit. There are a few anecdotal sources, however, which comment on value. In the BBC war correspondent Charles Gardner's account of the AASF's work in France at this time, a comment is made in connection with a welfare/entertainment concert which was held at the field location of Number 5

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<sup>12</sup> Ibid.

<sup>13</sup> TNA, AIR 29/779, ORB for Numbers 1, 2 and 3 ASP; AIR 29/780 – ORB for Number 4 ASP and AIR 29/781 – ORB for Numbers 5 and 6 ASP. The order of battle for the deployment of ASPs to France is detailed in Air Ministry, Air Historical Branch (1), *RAF Narrative – The Campaign in France and the Low Countries*, Appendix B (Location of Units Administered by AASF 15 October 1939) and Appendix C1 (Location of Units Administered by RAF Component 10 May 1940).

<sup>14</sup> Air Ministry, Air Historical Branch (1), *RAF Narrative – The Campaign in France and the Low Countries*, Appendix C.3.

<sup>15</sup> Sturtivant et al, *Royal Air Force Flying Training and Support Units*, p.62. See also TNA, AIR 29/779, Operations Records Books for Numbers 1, 2 and 3 ASPs; AIR 29/780, Operations Records Books for Number 4 ASP and AIR 29/781, Operations Records Books for 5 and 6 ASPs.

<sup>16</sup> Air Ministry (AHB), *RAF Narrative – The Campaign in France and the Low Countries*, p.474. This figure excludes aircraft and equipment in squadrons and smaller units in the forward area.

ASP in March 1940. In describing the location of the Park, the AASF wing commander who was hosting the author related how:

...an Air Stores Park is normally a pretty grim place. They usually put it in farm buildings in some very small village or other, on the principle that our spares and stores should be kept in the last place anyone would think of looking for them. By anyone, of course, I mean odd German aeroplanes – or even spies - because stores parks are very important places.<sup>17</sup>

An account by a veteran of the campaign who served as the Equipment Officer with Number 1 Squadron (operating Hawker Hurricane fighters) provides a useful indication of how efficient the provision of equipment was. The squadron was one of the first of the fighter squadrons to arrive in France and had established its first footing on the Continent at Octeville (just North of Le Havre) on 5 September 1939, just two days after Britain's declaration of war on Germany. By 16 May, Number 1 Squadron started their withdrawal westwards from their then base at Berry-au-Bac, relocating to a further five airfields before eventually reaching Nantes on 14 June.<sup>18</sup> Although this was a chaotic period for the squadron, the logistics' organization worked hard to ensure that their needs were met as the Equipment Officer recalled:

I suppose someone from the supply point of view at the headquarters' staff must have done a jolly good job because every time we got to a new field there was always fuel, always fuel. Food and oxygen and things like this I used to have to scavenge for a bit. But fuel just came and .303 ammunition which was all we wanted; that just appeared as magic so the staff must have done their job extremely well.<sup>19</sup>

Although the campaign in France during 1939 and 1940 resulted in a defeat for the British and French, it did provide a number of valuable operating experiences for the RAF, not least of which was recognition of the utility of the ASPs.

Soon after France, the parks played a key part in the ebb and flow of the North African campaign, initially supporting the RAF flying squadrons which participated in General Wavell's opening offensive against the Italians who, in

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17 C. Gardner, *AASF* (London: Hutchinson & Co, 1940), p.105.

18 Jefford, *RAF Squadrons*, p.23.

19 RAF LHCA, Taped Interview Collection, Transcript of a taped interview with Air Vice-Marshal E.D Hills CB CBE RAF (Retd) in December 2004.

September 1940, had advanced some sixty miles from Cyrenaica into Egypt.<sup>20</sup> To reinforce the RAF already in the Western Desert, a number of squadrons and flights were relocated from Aden, Sudan, Alexandria and the Canal area; thus enabling the RAF to muster what amounted to the equivalent of ten squadrons to support the British Army in their offensive against the Italians which commenced on 9 December 1940.<sup>21</sup> Although this number of squadrons should have been supported by at least three ASPs, there was only 1 ASP in North Africa at the time (31 ASP which had been formed in November 1939) and this provided the support throughout the offensive. Two other ASPs had been formed in the Middle East in October and November 1940 (32 and 33 ASPs) but both were sent to Greece in November 1940 as part of Operation BARBARITY, to support the RAF squadrons which provided air assistance to the Greeks following the Italian invasion.<sup>22</sup> It was a difficult period for the ASP as they had very little transport; this became so acute that the heavy vehicles required for moving fuel and explosives often had to be augmented by resources from the supporting Supply and Transport Column and, in some cases, even by Squadron MT. At one stage, 31 ASP became non-mobile at El Adem due to vehicles being purloined for other purposes. It was fortunate that the British advance was relatively swift, reaching El Aghelia in Libya by 9 February 1941 - a distance just short of 700 miles.<sup>23</sup>

Despite the initial British success, their fortunes in North Africa changed for the worse on 14 February 1941 with the arrival of Generalleutnant Rommel in Cyrenaica; German land and air forces arrived in Tripoli two days later. With the exception of the Operation CRUSADER battles in early January 1942, during which the British managed to push the Germans back westwards to El Aghelia in Libya, Rommel turned this around and progressively drove the British eastwards to El Alamein in Egypt by the end of June 1942; this situation, unchecked, would have allowed the Germans to eventually reach the heart of the British command and control network, along with its logistics and maintenance operations in the Nile Delta area.<sup>24</sup> Throughout this period, aircraft of the Desert Air Force operated from a large number of temporary air strips,

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20 Young, *Atlas of the Second World War*, pp.50-51.

21 Air Ministry, *Maintenance*, p.209.

22 Air Ministry, *Maintenance*, pp.207-209.

23 Young, *Atlas of the Second World War*, pp.50-51 and Air Ministry, *Maintenance*, p.210.

24 Young, *Atlas of the Second World War*, pp.54-63.

many of which were known simply as Landing Grounds (LG), a significant number of which were identified by a number, rather than a name. In the Western Desert area alone, there were some seventy of these air strips.<sup>25</sup> As the number of squadrons in the Desert Air Force increased, more ASPs were required and between May 1941 and July 1942, a further six parks were formed.<sup>26</sup>

Of these new parks, the experience of Number 40 ASP provides one of the clearest and most detailed pictures of the challenges which these units faced and their critical significance to deployed air power. Formed at Padgate (Cheshire) in the United Kingdom during November 1941, 40 ASP embarked for Egypt on 10 November 1941, eventually disembarking at Port Tewfik on 9 January 1942. Initially operating from Burg-El-Arab in the coastal area south west of Alexandria, the park was given the responsibility for the supply of equipment for all fighter aircraft types which were operating from temporary landing grounds in the forward area of the Western Desert.<sup>27</sup> The arrival of 40 ASP coincided with the German advance to El Alamein, a position which the British Eighth Army found itself desperately trying to hold at the end of June 1942.<sup>28</sup> In early June, the forward section of the Park was still operating west of El Alamein at Gambut, some forty miles to the east of Tobruk. Although not in direct contact with the enemy, the park's operational area still placed it at high risk of attack from the Luftwaffe supporting the advancing German Africa Corps. From as early as 21 March 1942, 40 ASP had been at a state of high readiness with a general warning from RAF Middle East Command that German paratrooper attack was likely. Whilst that threat did not materialise, the advance section of the park was subject to strafing by Messerschmitt 109 fighters and bombing on 5, 6 and 10 June 1942, although with no casualties and little damage to their equipment. The rate of enemy advance led to the park being progressively withdrawn to the east from the middle of June 1942; through at least five short notice moves, 40 ASP was relocated to LG 100 at Wadi Natrun on 24 July 1942, some seventy miles south west of Alexandria.<sup>29</sup>

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25 Jefford, *Squadrons of the RAF*, pp.222-223.

26 These were 34-38, 40 & 42 ASPs. Sturtivant et al, *Royal Air Force Flying Training and Support Units*, pp. 62-63. Numbers 32 and 33 ASPs re-joined the campaign in North Africa after they had returned from Operation BARBARITY in Greece during April and May 1941.

27 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entries for November 1941 to June 1942 inclusive.

28 Young, *Atlas of the Second World War*, p.63.

29 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entries for June 1942 to July 1942 inclusive.

There are three points of particular note regarding the capability of 40 ASP at this time. First, all of its personnel were subject to continual training by their officers and NCOs in the use of weaponry such as the Lee Enfield rifle, Lewis machine gun, Thompson sub-machine gun and hand grenades; the use of these arms was part of ground defence skills which were more common to the Army's infantry than RAF airmen. Apart from this, these logistics tradesmen received no other battlefield training. In the open desert and operating far from well-defended positions, such ground units had to be self-supporting and able to defend themselves in the not unlikely event that their positions might be overrun by the advancing enemy. The second, and particularly significant point, is that the ASP had quickly developed and refined its mobility. In its early days, the ASP's vehicles were primarily load-carrying in nature with equipment just carried on the floors of trucks and trailers; as such, this was invariably unloaded into tented storage when they arrived at new locations. This proved to be time-consuming when it came to moving site and throughout July and August 1942, the Park's carpenters (wisely included as part of its personnel establishment) fitted many of the vehicles with wooden storage racks and bins, thus enabling the vehicles to remain loaded at all times, greatly reducing the time taken to strike camp. A particular success story for the carpenters was the difference they made to the number of complete aircraft propellers which the park could carry on its vehicles. Prior to this, only three propellers could be carried on a Three Ton truck and proved, through size and shape, to be an extremely awkward load. The carpenters' design and construction of a special storage stand tripled the number of propellers which could be carried. They also later modified the unit's low-loader articulated vehicle trailers to enable the park to carry up to eight fighter aircraft wings. The third point of note concerns camouflage. Throughout July, work was carried out constantly to improve the concealment of vehicles, trailers and tentage by the acquisition of additional camouflage netting and the application of sand coloured paint; this went some way towards reducing the conspicuousness of the park when it was camped in open desert conditions.<sup>30</sup> Such was the difference this work and operating experience made, that the Park was able to record in its ORB '...practice in moving has greatly improved unit's mobility. Unit may now be said to be truly

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30 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entries for July and August 1942.

100% mobile'.<sup>31</sup> By the end of August 1942, 40 ASP was supporting seventeen fighter squadrons and twelve ancillary units operating in the Western Desert. It was estimated (a claim which later proved to be an accurate assessment) that the Park could move at two hours' notice without any dislocation to the service it provided, before moving, or on arrival at a new location.<sup>32</sup>

The critical role which the ASP played in the support of deployed air power is particularly well illustrated by the part it played in the advance of the Eighth Army westwards after the Battle of Alamein, which saw Montgomery's pursuit of the retreating German Africa Corps from El Alamein at the beginning of November 1942, through Libya and back into Tunisia by mid-February 1943.<sup>33</sup> The planning for the ASP's role in this phase of the campaign (Operation BUSTER) began on 5 October 1942 with the Park's commanding officer attending a conference during which it was confirmed that his unit was to support what would be known as "A" Force, comprising 211 Group and its offensive fighter wings, 239 Wing, 244 Wing, 285 Wing and a number of ancillary units; the Park's role was to move with these units in the advance and supply them on route. A new section was also formed within the ASP to supply American fighter types in 239 Wing and to also carry photographic equipment for the aircraft of 285 Wing. A liaison officer from the USAAF was also attached to the park to assist with the American spares' commitment. From this point on, 40 ASP was placed on one hours' notice to move.<sup>34</sup> Just a day later the Park relocated to LG 92 near Amriya on the outskirts of Alexandria and began preparing for the forthcoming offensive which would begin with the Battle of El Alamein; in the period up to the beginning of the battle on 24 October 1942, 40 ASP made in excess of 3,000 issues of equipment and received some 120 tons of equipment from the storage MUs in the Nile Delta area. By 20 October 1942, the Park was fully prepared to support "A" Force for the start of the RAF offensive in Operation BUSTER.<sup>35</sup>

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31 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entry for 24 July 1942.

32 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entry for 31 August 1942.

33 Young, *Atlas of the Second World War*, pp.68-69 and 72-73.

34 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entries for 5 and 8 October 1942.

35 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entries for 17 to 20 October 1942.

The Battle of El Alamein began at 2130 hours on 24 October 1942 and the period up until 4 November 1942, just after the point at which the Eighth Army managed to break out from El Alamein, provides a clear example of just how critical the role of the ASP was in supporting the participating RAF aircraft. Amongst the demands which 40 ASP received in this period, 147 were for Aircraft-on-Ground (AOG) spares – each of which was causing an aircraft to be grounded and unable to operate in the battle. Of these, the Park was able to satisfy 132 (90 per cent) of the AOG demands directly from the stock it was carrying, with the remainder shortly thereafter.<sup>36</sup> After the Eighth Army had broken out from El Alamein in early November 1942, the advance proceeded apace through Libya, eventually driving Rommel's Africa Corps back to the Mareth line in Tunisia on 24 February 1943, having taken Tripoli on 23 January.<sup>37</sup> During this advance, 40 ASP moved progressively westwards supporting its nominated squadrons and units, relocating to new sites on at least fifteen occasions.<sup>38</sup> As the line of communication from the supporting MUs in the Nile Delta area to the east began to lengthen, resupply to the continually advancing ASPs moving to the west became a growing problem and was largely reliant on air transport provided by 216 (Transport) Squadron; by early January 1943, 40 ASP was located at Nofilia in Libya, some 650 miles west of El Alamein.<sup>39</sup> Air re-supply was a challenging task as, to make the best possible use of aircraft carrying space, consignments for 40 ASP often had to be collected from nearby landing grounds, because their freight had been aggregated with another unit's consignment. The reliance on air transport and the growing problems associated with freight space prioritisation came to a head at the end of December 1942 when the Commanding Officer of 40 ASP had to engage with Air Officer Administration (AOA), Air HQ Western Desert due to his quota of air freight being reduced to just AOG spares; the remainder was being transported by road but that was taking fourteen days – by the time these reached the ASP many more of the spares demands had by then become AOG requirements. The AOA was fully sympathetic to the plight of the ASP and agreed for a liaison officer to be appointed who then worked directly with the MU and air movement staff to achieve an increased movement of spares by air,

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<sup>36</sup> TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entries for 24 October to 4 November 1942.

<sup>37</sup> Young, *Atlas of the Second World War*, pp.72-73.

<sup>38</sup> TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entries for 1 November 1942 to 25 February 1943.

<sup>39</sup> TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entry for 2 Jan 1943 and Young, *Atlas of the Second World War*, pp.72-73.

beyond just the AOG requirements.<sup>40</sup> This liaison role was not an easy one and relied on needs being judged by operational experience.

By 8 January 1943, with the lines of communication increasing even further the difficulties of air supply re-surfaced and led to an agreement with Air HQ Western Desert and 216 Squadron that one aircraft per day would be dedicated to 40 ASP freight. The reliance on air transport had become more pronounced due to the fact that the Army would not allocate freight space on the railways for RAF equipment except POL, ammunition, explosives and bombs.<sup>41</sup> Resupply for the RAF eased considerably on 17 April when the ASP started to receive consignments by sea through the port at Tripoli. With the fall of Tunis on 7 May the campaign in North Africa approached its end with the surrender of the Germans and Italians by 12 May. The ASPs played a key part in enabling the fighter and fighter-bomber squadrons to keep pace with the advance of ground forces throughout this time. It was, however, more challenging for the bomber squadrons which were more dependent on elements of the Army's supply system to move their greater munitions and fuel requirements; this, according to the official history saw the Army 'stretched to its utmost limits' and 'came along more slowly'.<sup>42</sup> The advance from the east was complemented by the Allied landings to the west in Morocco and Algeria (Operation TORCH). As part of this operation, six new ASPs had been formed, and landed as part of the amphibious operation.<sup>43</sup> These Parks supported the RAF aircraft which began to operate from captured enemy airfields which participated in operations during the advance towards Tunisia from the west.<sup>44</sup>

This example of 40 ASP's experience throughout the campaign in North Africa highlights how it provided a critical service to deployed air power. There are other instances where specific comment was made by higher command on the ASP's value. In November 1942, for example, the AOA of Air HQ Western Desert commented that '...the unit was to be congratulated on the high standard of serviceability of aircraft in the Western Desert'.<sup>45</sup> Significant

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40 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entry for 31 December 1942.

41 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entry for 31 December 1942 and 2 to 8 January 1943.

42 D. Richards and H. St G Saunders, *Royal Air Force 1939-1945, Volume II, The Fight Avails* (London: HMSO, 1954), p.242.

43 ASP Numbers 131-136. AHB, Narrative – The North African Campaign – November 1942-May 1943 refers.

44 Young, *Atlas of the Second World War*, pp.70-71 and 78-79.

45 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entry for 20 November 1942.

improvements had been made in aircraft serviceability during this part of the campaign (July – October 1942), rising from 67 per cent in the first week to 84.8 per cent by the fifth week.<sup>46</sup> The AOA also commented during a visit to the ASP at Wadi Temet in January 1943 that the squadrons they were supporting were ‘...well satisfied with the service they were receiving from 40 ASP’.<sup>47</sup> The value for future operations was indicated by the AOA when he accompanied Air Vice-Marshal Musgrave-Witham, Head of the Department of War Organisation at the Air Ministry, on a visit to 40 ASP in late February 1943. The Air Marshal was particularly interested in the way the Park had been organised to ensure mobility with continuity of service to the squadrons they were supporting. He went on to comment that he ‘intended making 40 ASP the model for similar units being prepared in England for the invasion of the Continent’.<sup>48</sup> The ability to support expeditionary operations centred, as originally planned, on mobility, a point alluded to by the wartime author Philip Guedalla who observed that ‘Desert life, it seemed, had taught the R.A.F. to be nomadic’.<sup>49</sup>

The ASP concept was also used in India although this was slightly different in that it employed a system of static Universal Equipment Depots, semi-static Equipment Parks (EP) and mobile ASPs. The EPs and ASPs were capable of leapfrog progression in the event of a rapid advance by the air forces. This variation on the original support concept was viewed as providing a more flexible means of meeting the needs of the forward units although it was not adopted elsewhere. Some twenty-one parks operated in this theatre with the majority numbered in the 70, 80 & 90 series.<sup>50</sup> Number 91 ASP, which largely operated in Bengal, moved the furthest east of the ASPs and in March 1946 was sent to Japan as part of the forces of occupation and was the ‘first complete United Kingdom unit of all three Services to arrive on Japanese soil’.<sup>51</sup> In Singapore, 41 ASP provided critical support to the aircraft which remained on the island up until its fall to the Japanese in February 1942, when most of its

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46 R.S. Ehlers, *The Mediterranean Air War – Airpower and Allied Victory in World War II* (Kansas (USA): University Press of Kansas, 2015), p.231.

47 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entry for 13 January 1943.

48 TNA, AIR 29/784, Operational Record Book Number 40 Air Stores Park, entry for 25 February 1943.

49 P. Guedalla, *Middle East 1940 – 1942 – A Study in Air Power* (London: Hodder & Stoughton, 1944), p.167.

50 Sturtivant et al, *Royal Air Force Flying Training and Support Units*, pp. 63-65.

51 Young-James, *Memoirs of an ASP*, pp.70-71 and TNA, AIR 29/785, ORB and Appendices - 91 Air Stores Park 1942-1948.

personnel were taken into captivity as prisoners of war.<sup>52</sup> The operation to invade Sicily (Operation HUSKY) used Numbers 40 and 135 ASPs and the invasion of mainland Italy (Operation AVALANCHE) saw Numbers 135 and 136 ASPs in support, landing in September and October respectively. A further four parks were deployed to Italy in June 1944.<sup>53</sup>

The culmination of the ASPs work during the Second World War was their involvement in the invasion of occupied Europe (Operation OVERLORD) in June 1944. Following D-Day, a series of advanced landing grounds were established on the Continent to enable the maintenance of air superiority for the eventual breakout from the bridgehead; the outline plan for OVERLORD aimed to achieve a minimum construction of twenty seven airfields by D+24.<sup>54</sup> These airfields were initially occupied by the RAF Servicing Commandos, a force formed in January 1942 expressly for this purpose as they had seen active service in this role during the campaigns in North Africa, Sicily and Italy.<sup>55</sup> Once the Servicing Commandos moved on, they left the new airfield HQs to control the location, but supported by an ASP. In total, eight parks took part in the Operation, including a Canadian and a Polish manned ASP.<sup>56</sup>

The ASPs formed for the European theatre trained hard, an important part of which was acclimatizing them for what was to come in Normandy. Number 401 ASP, for example, was housed under canvas from the winter of 1942 right up to the landings in Normandy. One of its officers related how:

This was considered to be good training for the operations which lay ahead and it was not until 18<sup>th</sup> September 1944, at Eindhoven in Holland, that covered accommodation was taken up.<sup>57</sup>

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52 RAF LHCA, History of Supply & Movements in the RAF – Research Material (Personal Accounts), Volume 6, Papers of Group Captain J.H. Nancarrow (under reference D/D Spt Pol (RAF)/112/1/2 dated 17 February 1992) and TNA, AIR 23/4637, Chief Equipment Officer, Air HQ Far East, Personal War Diary 1941-1942.

53 Nos. 31, 36, 37 & 40 ASPs. Air Ministry, *Maintenance*, p.311 refers.

54 Air Ministry, Air Historical Branch (I), RAF Narrative (First Draft), *The Liberation of North West Europe, Volume II – The Administrative Preparations*, p.163.

55 J.P. Kellet, & J.A. Davies, *History of the RAF Servicing Commandos* (Shrewsbury: Airlife, 1989) and Air Ministry, *Maintenance*, Appendix 35, pp.516-517.

56 Nos. 34, 401, 402, 404, 406 (RCAF), 408 (Polish), 414 and 418 ASPs took part and were allocated to Nos. 2, 83, 84 and 85 Groups. Number 408 (Polish) ASP had originally been formed as 206 MU, a mobile equipment park, in June 1943 to support the Polish Spitfire squadrons based at RAF Northolt and RAF Heston near London – TNA, AIR 2/8185, Reorganisation of Maintenance Command, Memoranda E.40/42 – RAF Equipment – Storage and Distribution Organisation in the United Kingdom (S.81906), Maintenance Command Administrative Instruction No. 3/43 dated 18 June 1943 refers.

57 RAF LHCA, History of Supply & Movements in the RAF – Research Material (Personal Accounts) Volume 6, Papers of R.C. Gordard (ex-401 ASP) an officer with No. 401 ASP, dated 29th November 1988.

By this stage of the War, the ASPs had developed into highly effective units, with their procedures well-honed from preceding campaign experience. As such, they had developed a fairly standard organization which usually consisted of a headquarters element, and were made up of about 150 personnel of various trades. Their vehicle fleet consisted of approximately 120 trucks, trailers and utility vehicles, each of which was consecutively numbered with its identity clearly painted on the outside to assist with stock location. Vehicle drivers were required to be storekeepers and stock records were maintained in manuscript ledger form, one per vehicle. All movements were by convoy, with the vehicles kept in their numerical order in case spares were required on the move, when a despatch rider would be sent down the convoy and the appropriate vehicle pulled out of the line so the required spare could be issued.<sup>58</sup>

The first of the eight ASPs assigned to Operation OVERLORD (401 ASP) landed at Arranches in France on 19 June 1944, within a day of the British MULBERRY Harbour outer anchorage first opening for the reception of vehicles and stores.<sup>59</sup> The remaining seven ASPs (34, 402, 404, 406, 408, 414 and 418) landed in France between 21 June 1944 and late October 1944.<sup>60</sup> Following the capture of the first port at Cherbourg on 27 June by the Americans, subsequent action succeeded in securing the entire Cotentin Peninsula down as far as Lessay and then east through St Lo, Caumont to just south of Caen and the far end of the SWORD beach area to the east.<sup>61</sup> The breakout from the Normandy bridgehead came in late July 1944 with the British advancing through Belgium, Holland and then into Germany, with the ASPs keeping pace with the flying squadrons as they moved forward. As experienced in the North African campaign, operations along extended lines of communication became particularly difficult, more so as the distance from the source of supply in the Normandy bridgehead increased.<sup>62</sup> As described in Chapter Seven, air resupply to the forward airfields became essential in order that the ASPs could be restocked as they advanced.

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58 Ibid.

59 War Office, *Notes on Operational Aspects of Mulberry "B"* (London: War Office, 1945), Annex V.

60 TNA, AIR 29/783, Miscellaneous Units – Maintenance Units, ORB for 34 ASP; AIR 29/787, Miscellaneous – Air Stores Parks, ORBs for 401, 402, 404, 406, 408 and 418 ASPs and AIR 29/1065, Miscellaneous Units – Maintenance Units, ORB for 414 ASP.

61 Man, *The Penguin Atlas of D-Day*, pp.88-105.

62 Neillands, *The Battle for the Rhine*, p.70 and 77; Air Ministry, *Maintenance*, p.348.

The ASP concept proved to one of the notable success stories of RAF logistics during the Second World War and the parks played a significant part in the overseas campaigns, from 1940 through until the end of the war in 1945. In total, approximately sixty parks were formed between October 1935 and December 1943.<sup>63</sup>

### **The Beach Units**

The second of the expeditionary organizations, the Beach Units, were not of a pre-war origin, but resulted from the RAF's experiences in the Allied amphibious landings in French North Africa (Operation TORCH) in early November 1942. As highlighted by John Millett:

Amphibious warfare has emphasized the problem of bases, ports, and supply lines immediately behind combat troops. Supplies must be unloaded and strengthened in preparation for an assault upon the enemy. No military operation is possible until adequate build-up has taken place close to the expected scene of conflict.<sup>64</sup>

The RAF's pre-war planning for expeditionary operations was largely based on an assumption that it would land its ground crews and equipment through a secure and established port, prior to moving forward by road and rail, much as it had done when it deployed to France in 1939.<sup>65</sup> The Operation TORCH landings highlighted to the RAF that future disembarkation through secure ports would prove to be the exception rather than the rule, and landings on open beaches, often under enemy fire, would be much more likely. Such landings though, brought very different challenges, not just for the first wave of combat troops, but particularly for the supporting formations which followed on directly after.

The Gallipoli landings in the Dardanelles during the First World War had shown that the planning focus could all too easily be placed on the tactical objectives, with little attention being paid to the nature of the beach or how the activities on it were to be coordinated. In the case of Gallipoli, the coastline was far from ideal and was particularly prone to storms; with the British being

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63 Sturtivant et al, *Royal Air Force Flying Training and Support Units*, pp.62-66.

64 Millett, 'Logistics and Modern War', 204.

65 TNA, AIR 2/1290, Operations, Expeditions (Code A, 40/1): Expeditionary force: organisation of repair work forward of aircraft depot dated 1932.

entirely dependent upon supplies landed from the sea this was fraught with potential difficulty. The beach conditions made the landing of reinforcements difficult and, with this as a priority, few load-carrying animals such as horses and mules could be brought ashore which led to much equipment having to be hand-carried forward to the front lines. The re-supply of ammunition soon became a real problem and, with each soldier having landed with only three hundred rounds of ammunition, this situation rapidly began to cause serious operational problems. Due to the very limited space on the chosen landing area, there was nowhere suitable to establish hospitals and each night was spent having to evacuate the sick and wounded by sea. The supply of drinking water also became a major problem and, due to the lack of sufficient mule transport, many men had to be diverted from their proper place at the front line to return to the beach area for water. The logistics' factor, with a poorly conceived beach maintenance concept at its heart, was a major contributory factor in the failure of the campaign and the British withdrawal from the Gallipoli Peninsula by the end of 1915.<sup>66</sup> The experience though, made it quite clear that the practicalities of logistics on and around beachheads would need to be carefully considered in any future amphibious operations.

Although the Royal Flying Corps had no involvement in the amphibious component of the Dardanelles' campaign, the growing significance of air power in the inter-war period indicated that future operations would most likely call for a combined approach by all three Services. However, apart from the establishment of an Inter-Services Training and Development Centre (ISTDC) at Fort Cumberland near Portsmouth in 1938, little thought had been given to Combined Operations and it was not until mid-1940 that a Directorate of Combined Operations (DCO) was first formed.<sup>67</sup>

The whole concept of beach maintenance was seen as an interim measure only, as it was assumed that any sustained logistical activity would be provided through the early capture of a port. In the early days of Combined Operations, the majority of assaults were intended to be of a 'hit and run' nature rather than substantial amphibious invasions requiring the establishment and

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66 M. Hickey, *Gallipoli – The Constantinople Expeditionary Force, April 1915* in T. Lovering (ed), *Amphibious Assault – Manoeuvre From the Sea* (Woodbridge: Seafarer Books, 2007), pp.7-22.

67 I. Speller, *The Role of Amphibious Warfare in British Defence Policy, 1945-56* (Basingstoke: Palgrave, 2001), pp.19 and 31.

build-up of a bridgehead. As such, there had been little if any need for involvement of the RAF's logistics organization. As Combined Operations planning began to develop in the late summer of 1940, attention began to be focused on developing a more detailed approach to beach maintenance, the term which was by then being used for support activities in the beach area. A key planning assumption which emerged from this work, was that any new beach maintenance organization would need to be able to support a much larger force for a considerable period of time.<sup>68</sup> It was not, however, until early 1942 that this early work began to take shape with the Army Council's announcement that it would form a permanent organization to undertake overseas operations, to be known as the Expeditionary Force.<sup>69</sup> In February 1942 it was agreed that all formal beach training would be carried out at the Combined Training Centre at Dundonald in Scotland where personnel of all three Services would be required to live together so as to foster the team spirit that was so critical to a beach organization. Notwithstanding these developments, the RAF had a limited role in the concept of beach maintenance, with a beach party of just one Beach Liaison Officer and three airmen included in the overall Beach Group organization, to supervise the disembarkation of RAF personnel and the unloading of RAF stores.<sup>70</sup> The growing urgency to develop an improved and formalised beach maintenance organization was brought sharply into focus in August 1942 with the disastrous Dieppe landings where, amongst the many lessons learned, a requirement for well-trained and efficient beach parties was clearly identified.<sup>71</sup>

By September 1942, development work was mature enough for HQ Combined Operations to make a more clearly defined reference in their doctrine stating that 'the units normally working in the Beach Maintenance Area are referred to as the Beach Brick'.<sup>72</sup> Essentially, a 'Beach Brick' consisted of a number of 'Beach Groups' (numbered consecutively), each of which was designed to support the landing of a battalion group. When required, an RAF

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68 The War Office, Amphibious Warfare HQ, *History of the Combined Operations Organization 1940-1945*, (London: War Office, 1956), pp.140-150.

69 Ibid, p.142.

70 M.Fenton, *Royal Air Force Beach Units- Purpose and Organisation* (2015)< [http://www.rafbeachunits.info/Purpose\\_-\\_Organisation/purpose\\_-\\_organisation.html](http://www.rafbeachunits.info/Purpose_-_Organisation/purpose_-_organisation.html)> [accessed 18 January 2016].

71 Speller, *The Role of Amphibious Warfare*, p.29.

72 Ibid. Combined Operations Pamphlet No 2 – Beach Organisation and Maintenance dated Autumn 1942.

beach party would be included, although the main disembarkation of RAF personnel and their equipment would be carried out by the Army. Given this limited involvement, the RAF intended to man its beach party commitment from its existing Embarkation Units (EU). These units had originally only been intended to look after the movement of personnel and stores through ports, and on railways and roads; they were not trained to be used in a front-line capacity and had not undergone wider training to enable them to survive and operate under combat conditions.<sup>73</sup> The first time that the RAF participated in amphibious landings as part of this new concept was as part of the Allied landings in North Africa in November 1942 (Operation TORCH). Due to the size of the operation, the RAF used three of its EUs (Numbers 59-61) in this role, albeit that each was no more than thirty personnel in size. This operation showed that, even with relatively light enemy opposition during the assault phase, the follow-on landing of equipment and combat supplies did not proceed as planned; it was difficult to bring loads ashore at the right place, at the right time and in the right order.<sup>74</sup> The key point which emerged though, was that the EUs were too small to cope with the task and that the RAF needed to expand its commitment to beach maintenance, especially with further, large-scale amphibious operations on the planning agenda.

It was thus that the RAF decided in early 1943 to form specialist RAF Beach Units, although its approach to this was somewhat complicated. Three specific groups were formed, in the United Kingdom, Middle East and North Africa respectively. The six units formed in Britain (Numbers 68 to 70 and 76 to 77) were known as Beach Units; the six units formed in the Middle East were known as Beach Bricks (RAF Component) (Numbers 31 to 36) and for North Africa, three Auxiliary Embarkation Units (AEU) (Numbers 1 to 3). The general concept of operations for these new units was that they would train alongside and be used with the main Beach Group to which they would be assigned.<sup>75</sup> As far as possible, personnel were all volunteers and, due to the arduous nature of

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73M.Fenton, *Royal Air Force Beach Units- Purpose and Organisation* (2015)< [http://www.rafbeachunits.info/Purpose\\_-\\_Organisation/purpose\\_-\\_organisation.html](http://www.rafbeachunits.info/Purpose_-_Organisation/purpose_-_organisation.html)> [accessed 18 January 2016].

74 Air Ministry (AHB) Narrative, The North African Campaign 1942-May 1943, Appendix 9, Air Ministry, *Maintenance*, pp.252-255 and Supplement to the London Gazette of 23 March 1949 (Issue 38569), Despatch Submitted to Commander in Chief Allied Forces on 30 March 1943 by Admiral of the Fleet Sir Andrew Cunningham GCB DSO, Commander in Chief Mediterranean.

75 TNA, AIR 29/438, Air Ministry & Ministry of Defence: Operations Record Books, Miscellaneous Units: Operations Record Book No 1 RAF Beach Squadron and AIR 29/18, Miscellaneous Units – Embarkation Units, Operations Record Book for Auxiliary Embarkation Units.

the work, had to be of a strong physique and meet the fitness standards required for combined operations' training. They were armed with the same type of weapons as the Army, with 70 per cent of the Unit being issued sub-machine guns and the remainder with rifles. They were kitted out with Army khaki battledress, but retained RAF blue headdress when not wearing steel helmets. As far as possible, the officer commanding the RAF Beach Units and their sections were drawn from the RAF Equipment Branch, with Movements experience.<sup>76</sup> Each unit had quite a broad responsibility which included: controlling the landing of RAF personnel, vehicles and stores; their assembly on shore and despatch to forward areas; to establish small dumps of supplies and stores; to provide labour, traffic control and provost services and to salvage and repair 'drowned' vehicles.<sup>77</sup>

Of these new formations, Numbers 68 and 69 Beach Units, 31 to 35 Beach Brick (RAF Component) and 1 to 3 AEU all took part in the invasion of Sicily in July 1943 (Operation HUSKY). Following this, 31 to 35 Beach Brick (RAF Component) took part in the first stage of the invasion of the Italian mainland in September 1943 (Operation BAYTOWN), crossing the Straits of Messina from Sicily to Reggio di Calabria. The final role for these units in the Mediterranean theatre of operations was as part of the landings further north on the Italian mainland at Salerno (Operation AVALANCHE) also in September 1943.<sup>78</sup> With the Italian campaign underway, there was no longer a requirement for so many RAF beach units and by December 1943 all six Beach Bricks (RAF Component) and the three AEUs were disbanded.<sup>79</sup> With the invasion of North West Europe (Operation OVERLORD) now the main planning priority, attention turned to reorganising the remaining beach units into a coherent order of battle to support the planned landings in Normandy. By the beginning of 1944, the six Beach Units (68 to 71 and 76 to 77) had been merged to form Numbers 1, 2 and 4 Beach Units. Additionally a Number 3 and 5 Beach Unit had also been

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76 TNA, AIR 37/99, Allied Expeditionary Air Force: RAF Beach Units: Administration and Organisation.

77 War Office, *History of the Combined Operations Organization 1940-1945*, p.145.

78 Air Ministry, *Maintenance*, p.293 and pp.304-305; M.Fenton, *Royal Air Force Beach Units – List of Units* [http://www.rafbeachunits.info/List\\_of\\_Units/list\\_of\\_units.html](http://www.rafbeachunits.info/List_of_Units/list_of_units.html) [accessed 24 March 2015].

79 M.Fenton, *Royal Air Force Beach Units – List of Units* [http://www.rafbeachunits.info/List\\_of\\_Units/list\\_of\\_units.html](http://www.rafbeachunits.info/List_of_Units/list_of_units.html) [accessed 24 March 2015] and TNA, AIR 29/438, Air Ministry & Ministry of Defence: Operations Record Books, Miscellaneous Units: Operations Record Book No 1 RAF Beach Squadron.

formed. By the end of April 1944 all five of these formations had been renamed from Beach Units to Beach Squadrons, each consisting of two flights.<sup>80</sup>

The need for a comprehensive beach maintenance organization was critical to the success of Operation OVERLORD as the operational plan did not anticipate the capture of the first major port until D+17 at the very earliest. Thus, the beaches were crucial, not only to the landing of men and machines, but also to the re-supply operation.<sup>81</sup> By the beginning of 1944, Numbers 1, 2, 3 and 4 RAF Beach Units were all back in Britain and participated in a series of training exercises in readiness for OVERLORD. The Beach Units had been created under Technical Training Command but came under the operational control of the Director of Movements; these were later transferred to the command of 2<sup>nd</sup> TAF on 1 February 1944 when it was confirmed that all four were likely to be committed to Operation OVERLORD, with Number 3 RAF Beach Squadron held in reserve at RAF Old Sarum.<sup>82</sup>

Their work was critical to the RAF's involvement in the operation with much of it involving the manhandling of supplies from landing craft to beach supply dumps and the marshalling of men and vehicles prior to them moving off the beach area. At the beginning of April 1944 authority was granted for RAF Beach Squadron personnel to wear War Service Dress (Blue) and could fly the RAF Ensign whilst on the Continent.<sup>83</sup> Additionally, authority was granted by HQ Combined Operations in March 1944 for RAF Beach Unit personnel to wear the Combined Operations Badge on the upper sleeve of their battledress.<sup>84</sup>

The seaborne element of Operation OVERLORD was launched on 6 June 1944 and, according to plan, a high degree of air superiority was achieved over the bridgehead. The first RAF personnel to land were those of the three RAF Beach Squadrons, with Number 1 the first ashore at SWORD Beach at

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<sup>80</sup> Ibid.

<sup>81</sup> Air Ministry, Air Historical Branch (I), RAF Narrative (First Draft), *The Liberation of North West Europe, Volume II – The Administrative Preparations*, p.250.

<sup>82</sup> M.Fenton, *Royal Air Force Beach Units – UK Beach Units 1943-44* <[http://www.rafbeachunits.info/List\\_of\\_Units/UK\\_Beach\\_Units\\_1943-44/uk\\_beach\\_units\\_1943-44.html](http://www.rafbeachunits.info/List_of_Units/UK_Beach_Units_1943-44/uk_beach_units_1943-44.html)>[accessed 18 January 2016].

<sup>83</sup> M. Fenton, *Royal Air Force Beach Units – 2nd TAF Beach Squadron* <[http://www.rafbeachunits.info/List\\_of\\_Units/2nd\\_TAF\\_Beach\\_Squadrons/.html](http://www.rafbeachunits.info/List_of_Units/2nd_TAF_Beach_Squadrons/.html)> [accessed 24 March 2015].

<sup>84</sup> TNA, AIR 72/26, Air Ministry Orders, Section A – Standing Orders, Order A.1186/1942, Combined Operations Badge – Introduction for Wear by R.A.F Personnel (A.389213/42/P.1.-29.10.42) dated 29 October 1942 refers.

0720 hrs.<sup>85</sup> Notwithstanding the support role they were to fulfil, the Squadron was landing as part of the assault phase and its personnel were exposed to very similar, if not identical conditions as the combat troops. Number 1 RAF Beach Squadron, for example, landed on SWORD Beach (Queen Roger Sector), between Ouistreham and Lion-Sur-Mer, along with 8 Brigade, 3<sup>rd</sup> British Infantry Division.<sup>86</sup> Even two hours later when the Squadron's 101 Beach Flight came ashore there was still strong enemy opposition with heavy shell and mortar fire as well as a myriad of small arms fire; the arrival of the Flight's commander, Squadron Leader J.N. Dobbin MC, a little later at 1115 hrs was equally hazardous when his landing craft was hit by enemy fire just below the water line, as it touched down on the beach.<sup>87</sup> Number 2 RAF Beach Squadron was assigned to JUNO Beach (Mike and Nan sectors) where the 3<sup>rd</sup> Canadian Division led the assault. This Squadron, like the others, made a significant contribution to the landings; from D-Day through to 6 September 1944 when it was disbanded, No 2 RAF Beach Squadron handled 20,650 tons of RAF stores, 30,728 RAF personnel and 8,644 RAF MT vehicles across its area of responsibility.<sup>88</sup> No 4 RAF Beach Squadron was assigned to GOLD beach where the British 30 Corps came ashore. The Squadron arrived somewhat later as they had been assigned to be part of Force L, the follow-up force on D-Day, but after a short wait offshore, most of the Squadron was ashore just after dark. The four Beach Squadrons were disbanded in August 1944, with many of their number absorbed into the RAF Embarkation Units that were operating in the Mulberry Harbour complex at Arromanches.<sup>89</sup>

Three other Beach Units were formed before the end of the war. Number 5 RAF Beach Unit was formed in November 1943 and took part in the assault landings in the South of France in August 1944 (Operation DRAGOON).<sup>90</sup> A small RAF Beach Unit, No. 6, was formed in South East Asia late in 1944,

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<sup>85</sup> J & D. Rogers, *D-Day Beach Force- The Men Who Turned Chaos into Order* (Stroud: History Press, 2012), p.110.

<sup>86</sup> TNA, AIR 29/438, Air Ministry & Ministry of Defence: Operations Record Books, Miscellaneous Units: Operations Record Book No 1 RAF Beach Squadron.

<sup>87</sup> M. Fenton, *Royal Air Force Beach Units –No.1 01 Beach Flight*

<[http://www.rafbeachunits.info/List\\_of\\_Units/2nd\\_TAF\\_Beach\\_Squadrons/No\\_\\_1\\_Beach\\_Squadron/No\\_\\_101\\_Beach\\_Flight/no\\_\\_101\\_beach\\_flight.html](http://www.rafbeachunits.info/List_of_Units/2nd_TAF_Beach_Squadrons/No__1_Beach_Squadron/No__101_Beach_Flight/no__101_beach_flight.html)> [accessed 18 January 2016].

<sup>88</sup> M. Fenton, *Royal Air Force Beach Units –No.2 Beach Squadron*

<[http://www.rafbeachunits.info/List\\_of\\_Units/2nd\\_TAF\\_Beach\\_Squadrons/No\\_\\_2\\_Beach\\_Squadron/no\\_\\_2\\_beach\\_squadron.html](http://www.rafbeachunits.info/List_of_Units/2nd_TAF_Beach_Squadrons/No__2_Beach_Squadron/no__2_beach_squadron.html)> [accessed 18 January 2016].

<sup>89</sup> TNA, AIR 37/99, Allied Expeditionary Air Force: RAF Beach Units: administration and organisation.

<sup>90</sup> TNA, AIR 29/438, Air Ministry & Ministry of Defence: Operations Record Books, Miscellaneous Units: No 5 RAF Beach Unit.

participating in the landings in Malaya (Operation ZIPPER) in early September 1945.<sup>91</sup> The seventh, and final, RAF Beach Squadron was formed in Bombay on 1st August 1945 as an additional unit for operations in South East Asia. However, it was disbanded after seven weeks due to the surrender of Japan.<sup>92</sup>

## Conclusion

Although the ASPs and the Beach Squadrons (as they eventually became) were amongst a number of specialist RAF logistics units, they were perhaps the two most significant as they made very specific and identifiable contributions to the projection of air power, enabling both mobility and *logistical reach*. The ASPs emerged from a logistics doctrine based on sound operating experience from the First World War where, in the closing stages, mobility proved to be critical to the flying squadrons. The key was to keep them free from having to hold space-consuming stocks of supplies, but being able to provide these as and when required. As campaign experience showed, especially in North Africa, the ASPs enabled the flying squadrons to minimize their stock of spares and maintain mobility, much as their predecessors had back in 1918.

By contrast, the Beach Units were not a product of pre-war vision, but grew out of the need for the RAF to ensure its interests were met in the beach areas of amphibious operations. Their life was significantly shorter than the ASPs and obviously limited to a much smaller geographical area of operation. Their work called for great flexibility (the landing sequence invariably did not proceed according to plan) and was one of significant physical effort as much of the supplies were literally manhandled ashore to the numerous supply dumps in the beachhead area. Unlike the ASPs, the Beach Units invariably went ashore early on the D-Day of operations, often-in landing craft with the assault phase troops, sharing the danger that this brought; the casualties sustained by the RAF Beach Squadrons during OVERLORD bear witness to this.<sup>93</sup> However, it would be quite wrong to assert that the men of the RAF Beach Units were any

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91 TNA, AIR 29/438, Air Ministry & Ministry of Defence: Operations Record Books, Miscellaneous Units: No 6 RAF Beach Unit.

92 M. Fenton, *Royal Air Force Beach Units – List of Units* <[http://www.rafbeachunits.info/List\\_of\\_Units/list\\_of\\_units.html](http://www.rafbeachunits.info/List_of_Units/list_of_units.html)> [accessed 24 March 2015].

93 There were six deaths among RAF Beach Squadron and Beach Balloon Squadron personnel throughout Operation OVERLORD - three are buried in Normandy and three have memorials in the UK.

more courageous or valuable than the ASPs. Their roles were very different, but equally important in providing expeditionary logistics' capability. Although the Beach Squadrons attracted a specific mention in the despatch by Air Chief Marshal Sir Trafford Leigh-Mallory after Operation OVERLORD, the section that includes that reference alludes to a much wider contribution, of which the ASPs must be considered part:

The statistics of the average daily consumption and wastage of P.O.L. and ammunition also reveal something of the achievement of the supply organisation. During July, A.E.A.F. expended daily 750 tons of bombs and more than 200,000 rounds of ammunition. The fuel consumption of A.E.A.F. in July reached approximately 30,000,000 gallons of petrol, almost 1,000,000 gallons per day. A large part of this fuel and ammunition had to be transported into the beach-head and up to forward airfields. In this connection the work of Air Force beach squadrons deserves special mention. These parties went in with the follow-up troops on D-Day and due in no small measure to their efforts, the first airfields were stocked ready for operations in the beach-head on D + 3.<sup>94</sup>

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<sup>94</sup> Air Chief Marshal Sir Trafford Leigh-Mallory, 'Despatch on Air Operations by the Allied Expeditionary Air Force in North West Europe 1943 Nov. 15-1944 Sept. 30', Supplement to the London Gazette, Tuesday 31 December, 1946, Issue 37838, p.80.

## Chapter Nine: Conclusions

### Overview of the Research

Given the RAF's significant contribution to Allied military effort during the Second World War, it would be reasonable to expect that its logistical support would have been considered important and to have attracted academic study as part of the growing interest in air power studies. The introductory chapter of this thesis however, with its review of the historiography in the field, shows that there is a paucity of such scholarship. This paradox strongly supported the need for in-depth research to redress the shortfall.

It was clear from wider reading that the subject was a specialist area which consisted of numerous sub-disciplines; this presented a challenge in terms of determining the best academic approach to ensure that the topic was examined thoroughly. Whilst this is primarily a history thesis, the social/management science discipline to which the contemporary study of logistics belongs, offered a number of models which could enable a structured approach. Of these, Porter's Value Chain Model provided a framework which captures the key components of the supply chain, thereby providing a form of 'road map' to guide research and to shape the chapters in the thesis. Using such a model also enabled a more forensic level of research to be carried out. It was thus that an interdisciplinary approach was taken to the subject, but with the prime aim of producing an historical narrative. Overall, this methodology is believed to be an innovative approach to air power study, a factor which further strengthens its degree of originality. This chapter concludes the research by first drawing out the key points which have emerged under the generic themes of Transformation, Sustainment and Flexibility.

## Transformation

The nature of the first two research questions can be broadly considered as contributing to the collective term *transformation*, examining the origin of RAF logistics and how this developed in the period up to the outbreak of war in 1939. Chapter One considered how the RAF had established a Stores organization at the end of the First World War which supported the fledgling Service during the nineteen twenties and very early nineteen thirties, providing a foundation for further development. From 1934, however, the Expansion Programme (inter alia) transformed and modernized the Stores organization and its infrastructure, to support the very different RAF that had evolved by the outbreak of war. This transformation from 'Biplanes to Monoplanes' was examined in Chapter Two.

Any transformation requires a starting point and it was this that the first research question addressed, aiming to identify what the RAF logistics organization was and how it had come into being. Although the RAF was formed in April 1918, its composition was not totally new and resulted from the merger of the RFC and the RNAS. Given this, it was inevitable that the RAF's logistics organization in 1918 was an amalgam of Army and Naval policy, procedures and infrastructure, albeit these were heavily influenced by Army methods. This was a seminal moment for the new RAF in that it provided a fresh starting point. This thesis has established that, even by late 1918, RAF logistics had not only embraced lessons from the past, but had taken stock of the present by considering and incorporating wider logistics practice from other military and civilian organizations. Whilst much of this experience had resulted from the RFC's careful planning, an element had also resulted from coping with the unexpected, a factor well summed up by the nineteenth-century Prussian general and military theorist Carl von Clausewitz:

The general unreliability of all information presents a special problem in war: all action takes place, so to speak, in a kind of twilight, which like fog or moonlight, often tends to make things seem grotesque and larger than they really are. Whatever is hidden from full view in this feeble light has to be guessed at by talent, or simply left to chance.<sup>1</sup>

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<sup>1</sup> Major-General Carl von Clausewitz, *On War*, 2.2, 1832, tr. M. Howard and P. Paret, 1976, cited in Tsouras, *Military Quotations*, p.186.

The German Field Marshal von Moltke also made the point that:

‘...in war you will generally find that there are three courses open to the enemy – and of these he will almost certainly adopt the fourth.’<sup>2</sup>

The former Director of the Royal Air Force Museum, Peter Dye, has written widely on the RFC during the First World War with particular emphasis on its support organization and capabilities.<sup>3</sup> In Dye’s journal article ‘The Royal Flying Corps Logistic Organisation’, he concludes by suggesting seven key points which might have emerged if the RAF had commissioned a Logistics Lessons Learned Study at the end of the First World War.<sup>4</sup> In doing so, he suggests that air power was an expensive weapon; maintaining aircraft away from the home base demanded considerable resources; attrition on active operations was extremely high; effective support demanded the ready availability of spares; rail and motor transport were critical to the supply pipeline; preserving mobility was a constant battle and the essential “lubricant” was manpower. There are three of Dye’s points, however, which continued to remain significant to RAF logistics following the First World War. First, his point that air power was an expensive weapon, with expenditure running at approximately one million pounds per day by the end of the war, is notable and a fact that remained a feature of defence spending throughout the inter-war years.<sup>5</sup> Even though defence spending was strictly limited by the imposition of the Government’s Ten Year Rule in August 1919, the RAF’s annual expenditure from 1919 up until the beginning of the Expansion Programme in 1934 was already amounting to, on average, 16 per cent of the total annual expenditure for the armed forces. The Expansion Programme saw the RAF’s annual expenditure increase to 26 per cent of total defence spending in 1935 and then rise progressively to 36 per cent in 1939; by the outbreak of war it had exceeded the annual individual expenditure for the Royal Navy and the Army.<sup>6</sup> It must be said, however, that the magnitude of these figures was heavily influenced by the extent of the capital procurement (aircraft and airfield infrastructure) which took place during the Expansion Programme.

2 Cited in: Terraine and Craig, ‘The RAF in World War II: Lessons for Today?’, p.14.

3 See, for example: Dye, ‘The Royal Flying Corps Logistic Organisation’ and Dye, ‘Sustaining Air Power’ Dye, ‘Logistics and the Battle of Britain’.

4 Dye, ‘The Royal Flying Corps Logistic Organization’, 36-37.

5 Ibid, pp.36-37.

6 Figures calculated from: Smith, *British Air Strategy*, Appendices, Table IX, p.336. See also: Edgerton, *England and the Aeroplane*, pp.34-35 and McKercher, ‘Deterrence and the European Balance of Power’, 101, 106, 112-114, 126 and 131.

Secondly, Dye's point regarding the availability of spares was an issue which required constant attention by the logistics organization. As evidenced by Harris' experience whilst commanding 45 Squadron on the North West Frontier of India in 1919/20, the lack of spares (certainly in this theatre of operations) led to serious issues in terms of aircraft airworthiness and safety. Indeed, the serviceability rate of RAF squadrons in India dropped as low as 7 per cent.<sup>7</sup> The management of the resulting inventory had to be incorporated within a well thought out and efficient supply chain, underpinned by a standardized stores accounting and store keeping discipline which provided accountability and visibility of stock. The RFC evolved this rapidly and much work was done to fine tune the construct during the period from 1919 to 1934. It did this, initially through the work of the Establishment Committee under the chairmanship of Bertram Jones. The Committee's terms of reference were underpinned by the tenet that, given the wholesale consumption of resources during the First World War, the management of material in the post-war period needed to be conducted more efficiently and economically.<sup>8</sup> It did indeed, as Air expenditure in the post-war period illustrates. From an annual spend of just under £24 million in 1920, the figure had reduced to £9.4 million by 1922. The annual spend then increased slowly to approximately £16 million in 1928. Air expenditure then remained at an average of £17 million per annum up to, and including, the beginning of the Expansion Programme in 1934. The Committee's findings and the follow-on work of the Air Ministry's Accounting Committee (later renamed as the Committee on Store Accounting and Storekeeping Procedure), set in train the development of a logistics system for peacetime working. Of particular note, is that in developing these procedures, the committee took the opportunity of visiting a number of commercial firms which handled similar stores to the RAF.<sup>9</sup> The composition of the committee and their approach to the task, shows that the Air Ministry was keen to embrace commercial expertise and to incorporate what today would be referred to as best practice.

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<sup>7</sup> Higham, *Armed Forces in Peacetime*, p.159.

<sup>8</sup> TNA, AIR 1/16/15/1/73, Air Ministry File 8055, Equipment Branch – Memorandum on Organisation dated 18 November 1918. Report to The Right Hon the Lord Weir, Secretary of State for the Royal Air Force dated 15 November 1918 and TNA, AIR 72/1, Air Ministry Weekly Orders, Order 670/19 (D.17300).

<sup>9</sup> Promulgated under Air Ministry Office Memorandum Number 123(4). TNA, AIR 29/711 - 17832, Operations Record Book for the School of Store Accounting and Storekeeping, 1929, p.4 refers.

The third point which Dye comments on is that manpower was an essential 'lubricant'. This observation is mostly underpinned by the fact that the size of the RFC grew from 1,200 officers and other ranks in August 1914 to 144,078 in March 1918.<sup>10</sup> From a logistics perspective however, this broader picture requires more detailed comment. It was not just a question of overall numbers, but having a cadre of professionals who were dedicated to that task and trained in the many disciplines which it demanded. In this respect, the RFC's introduction of the Equipment Officer ground branch in early 1915 was significant and this provided clear leadership and management for early logistics, even though such officers were then trained in both stores work and engineering. As described in Chapter Three, the creation of a Stores Branch in 1920 paved the way for an exclusively logistics focused discipline; leadership and management of engineering activity passed back to appropriately qualified General Duties officers until the formation of the RAF's Technical Branch in 1940.<sup>11</sup> It was thus that the RFC's experience during the First World War had helped shape a well-considered logistics organization (with a clearly defined supply chain), which endeavoured to provide operational support to British air power during the 1920s and early 1930s.

Having addressed the first research question, the thesis next considered how and why the logistics organization had developed during the period from the Expansion Programme of the mid-1930s, through to the outbreak of the Second World War; this programme not only re-equipped the Service, but brought significant change to its logistics. By the early 1930s, it had become clear that the political and military aspirations of Mussolini's Fascist Italy and Hitler's Nazi Germany were presenting new threats to the balance of world power which required a significant change to British defence policy. As part of this re-alignment, the RAF embarked upon an Expansion Programme which introduced a whole new era of aircraft technology, replacing the previous wood and canvas biplanes with high performance, stressed, metal skin monoplanes. In the period up until 1945, this saw the introduction of a new generation of aircraft which, as Erik Lund has put it, had been 'profoundly transformed by new

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<sup>10</sup> War Office, *Statistics*, Part II, Section 26, Table u, p.227.

<sup>11</sup> James, *The Paladins*, pp.194-195.

technologies such as retractable undercarriage and jet engine...'<sup>12</sup>, Lund also relates how between 1935 and 1945 '...the RAF's fighter force underwent two major transformations of their electronic environment, the introduction of VHF radio and airborne radar, and one minor, the introduction of ground radar'.<sup>13</sup> The new generation of aircraft also brought with them more powerful aero engines and greater weapon carrying capability; this saw the requirement for an increased range and weight of munitions and much greater volumes of POL.

In simple terms, it was a question of technology and scale. The RAF's logistics operating model of the 1920s and early 1930s, was aligned to support a much smaller Air Force, with fewer, simpler aircraft. Moreover, it was supporting a Service which was predominantly involved in a strategy of air control in India, Iraq, Transjordan and Palestine.<sup>14</sup> The first significant point which emerges from this period is the update which took place to mobilisation planning. The doctrine which had been in place since 1927 was quite rigidly designed and largely aligned with the Army's mobilization programme.<sup>15</sup> Planning for the Abyssinian crisis in 1935 indicated that the RAF would need to provide its own deployment package and one which was not necessarily part of a wider Army deployment. As such, it needed to be self-contained and self-supporting. Air Ministry planning for this was taken forward by the formation of the RAF's Mobilisation Committee in September 1935, with the specific direction from AMSO for them to recommend '...all possible steps (short of mobilisation) to prepare for the prompt despatch of the maximum number of squadrons available'.<sup>16</sup>

The second key point is that the Expansion Programme introduced substantial numbers of new squadrons and aircraft, the extent of which was discussed in Chapter Two. This programme saw an exponential rise in air expenditure which rose from £27.5 million in 1935 to a peak of £133.8 million in 1938.<sup>17</sup> The challenge for logistics was not just the increase in numbers of

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<sup>12</sup> Lund, 'The Industrial History of Strategy', p.82.

<sup>13</sup> Ibid, p.93.

<sup>14</sup> Higham, *Armed Forces in Peacetime*, pp.63-66. See also: Slessor, *The Central Blue*, pp.56-57.

<sup>15</sup> Fearon, 'The Formative Years of the British Aircraft Industry' p.493.

<sup>16</sup> TNA, AIR 20/5792, Formation of Mobilization Committee dated 1935. Summary memorandum 'The Mobilisation Committee dated 1935, p.1.

<sup>17</sup> Higham, *Armed Forces in Peacetime*, Appendix II, pp. 326-327. Figures include civil aviation which was included in the annual Air Estimates for the period in question.

complete aircraft requiring support, but the diversity of extra spares which were required as a result of the technological complexity of modern aircraft. This was but one facet of the problem – the medley of aircraft types and marks were sourced from an ever increasing number of manufacturers. This had been a feature of the RAF's aircraft fleet since the early 1920s (despite the post-First World War run-down) with a growing number of aircraft manufacturers.<sup>18</sup> Indeed, in 1931 the RAF was operating forty-four different aircraft types and thirty-five different types of engines.<sup>19</sup> Little had changed by the beginning of the Expansion Programme and the RAF was operating twenty-eight different aircraft types, with just under 3,000 aircraft on charge, produced by fifteen different manufacturers.<sup>20</sup> As a result of limited funding for new aircraft purchase in the pre-expansion period, the Air Ministry was concerned that a nucleus of an aircraft industry needed to be maintained and established what was known as the 'Ring' of manufacturers in 1934, consisting of some eighteen major manufacturers. This, it hoped, would provide a nucleus of an airframe industry to be available in a national emergency.<sup>21</sup> There was, however, a downside to the 'Ring' concept in that it did lead to an 'unnecessary multiplication of airframe types' a factor which Peter Fearon suggests 'made standardization and servicing difficult'.<sup>22</sup> By 1936, there were more than thirty British firms producing military and civil aircraft, thirteen producing aero engines and approximately 240 companies 'engaged in one branch or another of the multifarious ramifications of the industry generally'.<sup>23</sup> The complexity of the picture is typified by the example of British aero engines where there were some sixty-three types in production, albeit not all of these were or had been fitted to military aircraft.<sup>24</sup>

The third point which emerges is the radical overhaul which took place to the RAF's command structure which, in turn, led to a number of improvements to its logistics organization. Prior to 1935, the RAF's command structure was organised on a geographical basis, divided into Home and Overseas, with sub-

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18 Higham, *Armed Forces in Peacetime*, pp.202-207.

19 Fearon, 'The Formative Years of the British Aircraft Industry', p.493.

20 Thetford, *Aircraft of the Royal Air Force*, Appendix J, p.406 (Totals include the Fleet Air Arm which was still part of the RAF at this time) and Smith, *British Air Strategy*, p.233..

21 P. Fearon, 'The British Airframe Industry and the State, 1918-35', *The Economic History Review*, New Series, 27(2) (May 1974, 236-251 (p.243) and Edgerton, *England and the Aeroplane*, p.38.

22 Fearon, 'The British Airframe Industry and the State', p.244 and Fearon, 'The Formative Years of the British Aircraft Industry', p.493.

23 The British Aircraft Industry, *Flight*, 12 November 1936, p.487.

24 British Aero Engine Data, *Flight*, 12 November 1936, p.504.

divisions in each. The issue with this was that it did not provide a specialist focus for activity type such as collective aircraft roles, training and maintenance. This led, *inter alia*, to the formation of Maintenance Command in April 1938; this included four component Groups, two of which (40 and 42) providing a specialist focus for equipment and fuels/explosives respectively. Between them, both Groups coordinated the development of the vital Maintenance Unit (MU) infrastructure which became a key part of the RAF's supply chain throughout the war. The careful design of the 40 Group MUs, with dispersed sites and protected buildings, enabled stock holdings to be de-centralised. Coupled with the Universal Equipment Depot scheme introduced in May 1939, this did much to reduce the risk of significant loss of stock through enemy bombing. With the exception of Number 1 MU at Kidbrooke which, through its proximity to London, suffered significant damage during the Blitz in 1940/41 and the V1 flying bomb offensive in 1944, this policy provided adequate protection to the various units of the Command throughout the war. Whilst this overhaul was largely organizational, RAF logistics benefited enormously from the recommendations of the Jones Committee in 1938/1939 which examined the RAF's system of administration, with a view to its readiness for war.<sup>25</sup> Of the many areas for improvement which were identified, shortages of equipment (especially spares) and the related provisioning process were significant. It is also noteworthy that the review recommended the creation of equipment sections in each flying squadron, along with a number of sub-recommendations concerning equipment management. This enhancement enabled flying squadrons to have on-hand logistics specialists to ensure their equipment needs were met and was successfully used for the first time in 1939/1940 during the campaign in France, where each of the squadrons deployed with their own Equipment Officers. This concept became ever more significant as the RAF began to operate in overseas theatres, with a greater degree of squadron mobility, throughout the war. It was thus that RAF logistics was transformed from a relatively small-scale 'stores' focussed organization supporting the Imperial defence policy of the nineteen twenties and very early nineteen thirties, to a highly modernized logistics organization which had been overhauled to reflect what the planners then saw as a war which would be considerably more mobile than the conflict of 1914-1918.

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<sup>25</sup> TNA, AIR 2/8788, Report of the Committee on Royal Air Force Administration 1939.

## Sustainment

The third and fourth research questions can be grouped under the collective heading of sustainment. Having thus far examined how the RAF logistics organization originated and was transformed in readiness for war, the third question sought to consider an oft neglected area – the organisation, identity, recruitment and training of its people; this was explored in detail in Chapters Three and Four. The fourth research question addressed the logistical sustainment of air power and considered how the RAF acquired its resources and how these were accumulated, protected and distributed; this relatively broad category was addressed in Chapters Five, Six and Seven.

The first point which needs to be made about sustainment is that it required an organizational infrastructure to enable and regulate it. This thesis has shown that, for logistics, this was to be found in the Air Ministry within the Directorate of Equipment (DofE); notwithstanding a number of name changes and transfers between Air Ministry departments, the DofE remained the professional controlling authority for logistics, from 1918 through to the end of the Second World War. The procurement demands of the Expansion Programme, along with the wider needs of logistics management saw the DofE quadruple in size from just over 200 people in 1935, to 941 by April 1940; as part of the Government's evacuation plans to minimize the effect of enemy air attack on the capital, the majority of staff in the DofE were relocated to Harrogate, North Yorkshire in September 1939.<sup>26</sup> The need for management of logistics at the practical level had been largely met by the formation of Maintenance Command in April 1938 and this too grew to a significant size, though the inadequate detail in the primary data does not enable the numbers of those directly employed on logistics work to be singled-out. From a total strength of 21,750 in February 1941, Maintenance Command doubled in size to just fewer than 45,000 by the end of 1944, of which 56 per cent were civilians.<sup>27</sup> Command and control of logistics, however, was not just exercised through the

<sup>26</sup> TNA, AIR 2/1704, Directorate of Equipment: Proposed Increases of Staff in 1936 (S.37505), Enclosure 17a, S.37505/S.1 dated 19 June 1936 and TNA, AVIA 15/113, Proposed Re-Organization of the Directorate of Equipment 1939 refer.

<sup>27</sup> RAF Narrative: *The Expansion of the Royal Air Force 1934-1939*, p.132. Training Command was further split into Flying Training Command and Technical Training Command in May 1940.

Air Ministry and Maintenance Command, although the former remained the primary authority in this respect throughout the war. Within the United Kingdom, Equipment Officers and airmen/airwomen of related trades were also working within the Headquarters staff and formations within the Home Commands which, by June 1944, had expanded to include Balloon, Bomber, Coastal, Flying Training, Technical Training, Transport, Maintenance, RAF Northern Ireland and the Allied Expeditionary Air Force (both 2<sup>nd</sup> TAF and ADGB).<sup>28</sup> As the war progressed and the extent of the overseas theatres of operation broadened, similar logistics representation was also included within the Headquarters staff and formations of the Middle East Command (up to 1943), the Mediterranean Allied Air Forces (from 1944) and the various formations which developed in the Far East.<sup>29</sup>

Command and control was but one factor. The logistics input to campaign and operational planning was also another important aspect and a number of RAF Equipment Officers were actively involved in the logistics element of operational planning for campaigns such as the invasion of North Africa in November 1942, the invasion of Sicily in July 1943 and the invasion of mainland Europe in 1944.<sup>30</sup> The value of their input is evidenced by the fact that a number of such officers were recognized by the honours and awards system, not just of Britain, but of Allied nations as well. For example, Wing Commander W.J. Maggs was awarded the OBE for distinguished services in the Mediterranean Air Command as part of the planning staff for the invasion of Sicily in 1943 and was also Mentioned in Despatches the same year for distinguished service at HQ North African Tactical Air Force, whilst preparing the outline logistics plan for the redeployment of Allied squadrons to Algeria, in advance of the threatened German breakthrough at Kasserine in North Africa.<sup>31</sup> Group Captain C.W. Gore was awarded the OBE in June 1945 for resolving complicated equipment problems which arose during the expansion and re-arming of Bomber Command.<sup>32</sup> Acting Air Commodore G.L. Worthington was

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28 Delve, *The Source Book of the RAF*, p.107.

29 Delve, *The Source Book of the RAF*, pp.113-124.

30 RAF LHC Archive, History of Supply & Movements in the RAF – Research Material (Personal Accounts) Volume 6, Papers of W.J. Maggs, Notes for a Chronology (1999), pp.10 & 16 and Supplement to The London Gazette, Issue 37,300, 5 October 1945, p.4957.

31 RAF LHC Archive, History of Supply & Movements in the RAF – Research Material (Personal Accounts) Volume 6, Papers of W.J. Maggs, Notes for a Chronology (1999), p.15 and p.19.

32 Recorded in Supplement to The London Gazette, Issue 37,119, 14 June 1945, p.2947.

appointed a Commander of the USA's Legion of Merit in October 1945, following his work for General Eisenhower at Supreme Headquarters Allied Expeditionary Force.<sup>33</sup> This all serves to illustrate that the RAF took logistics seriously and recognized not just its supporting role, but its vital part in operational planning.

The next key point to be made about sustainment is the significance of people, a resource which Peter Dye described as the 'essential lubricant' when writing on RFC logistics.<sup>34</sup> His term remained particularly apt for this asset in the post-war and Second World War period as well. It was not just numbers of people, but numbers of the right people. The RFC had quickly recognized the need for the right people and had created a professional cadre of logisticians in the form of Equipment Officers in January 1915. This role was developed by the formation of a dedicated Stores Branch in 1920 which provided a clear professional focus for RAF logistics and for the management of the various non-commissioned tradesmen who had provided the traditional Army quartermaster function in the RFC and had transferred to the RAF in April 1918. It was at this point that the Stores Branch ceased to have any engineering responsibilities and became purely logistics focussed.

During the inter-war years, the Stores Branch became increasingly dependent on retired officers filling Civilian Stores Officer appointments and by the mid-nineteen thirties, nearly half of officer appointments on RAF stations were filled by this grade. Given the large number of men who had acquired such experience during the First World War and just after, the re-employment of them was a convenient (and cheaper) means of meeting the growing numbers of officers required to manage the increasing number of Stores depots and Equipment Sections on new RAF stations. As the Expansion Scheme progressed and the growing threat of war increased, the Air Ministry realised that such a high reliance on retired officers would not meet the physical needs of modern warfare and concerted efforts were made to replace them with regular officers. Their fears in this respect were confirmed during the Abyssinian crisis of 1935/1936 when the extent of this civilianisation was considered largely

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<sup>33</sup> Recorded in Supplement to The London Gazette, Issue 37,300, 5 October 1945, p.4957.

<sup>34</sup> Dye, 'The Royal Flying Corps Logistic Organization', 36-37.

responsible for why an adequate number of competent stores officers could not be sent to the Middle East Command.<sup>35</sup> This remained an issue even after the outbreak of war, by which time the level of civilian stores officers filling regular officer appointments had risen to not far short of 60 per cent. It is not clear at which point the Air Ministry managed to redress this imbalance, but the extent of the recruiting inflow of direct entrants from civilian life would suggest they did so soon after. The overall requirement for male Equipment Officers (as they became re-titled in 1936) varied throughout the war and there were at least twelve occasions when there was a significant shortfall against the forecast requirement.<sup>36</sup> In many cases these forecasts were best guesses by the manpower planners in advance of specific operations or tasks. The shortfalls, though, appear to be short-lived with a run of no more than two to three months consecutively in any one year of the war. This, coupled with the absence of any amplifying primary or secondary sources regarding performance concerns, suggests the forecasts were probably a miscalculation and were adjusted thereafter. The growth in the number of male Equipment Officers in the RAF throughout the war was substantial and more than quadrupled from 1,021 in September 1939 to a peak of 5,281 in July 1945.<sup>37</sup> A contribution to this increase was made progressively by female (WAAF) Equipment Officers from September 1942 and with the addition of men from the dominions and allied nations from January 1942.

The picture for airmen was quite different. Whilst the statistics regarding officer manning illustrate the numbers involved in the management and leadership of RAF logistics, the evolution of the various airmen's trade groups (and the numbers employed therein), provides a more enlightening view, showing how the nature of logistics changed over time. The stores specialization inherited from the RFC was largely one of storekeeping but, the need for accountability also saw the requirement for stores accountants. By the outbreak of war there were just two trades – the Equipment Assistant carrying out the physical work of logistics and a Clerk (Accounting) carrying out the numerical work of logistics. The Equipment Assistants remained the mainstay of

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<sup>35</sup> TNA, AIR 2/1923, Report on Equipment Aspects of the Middle East Crisis 1935-1936, Notes appended after covering letter to a report submitted from AOC Middle East to The Secretary, Air Ministry, 21 November 1936.

<sup>36</sup> See Appendix 1 to this thesis – Equipment Branch Officer Manning – September 1939 - November 1945.

<sup>37</sup> Ibid.

logistics throughout the war and represented by far the greatest number of logistics 'operatives', followed closely by those engaged in equipment accounting. There were two developments in logistics, however, which added further complexity. First, the growth in the provisioning task following the introduction of the Master Provisioning Scheme in December 1940; the growing size of this task was largely fuelled by the sheer number of different aircraft and aero engine types, along with the accompanying need for munitions and POL – all from different manufacturers and under an immense number of contracts. This was further complicated by the adoption of aircraft sourced from the United States of America which introduced further problems with non-standardization of parts and, in turn, added to the size of the provisioning task. This, of course, was well before the introduction of computerised stock control and required the efforts of large numbers of clerks to carry out the largely paper-based administrative task. Thus, from October 1942, trades for men and women were introduced to assist with the provisioning work. The second development which brought about change was the area of transport and the function of movements. Initially, this came about through the growing number of Embarkation Units which processed personnel and freight for movement by sea, but developed further as a result of the functionality developed by RAF Transport Command from March 1943. This evolution of responsibility saw the total number of airmen employed in logistics rise by 165 per cent, from 15,213 in June 1941 to a peak of 40,446 in January 1945. Of this latter figure, some 76 per cent were engaged in the core function of physical logistics, 12 per cent in stock accounting, 6 per cent in provisioning and 6 per cent in movements-related work.<sup>38</sup>

Women were employed in logistics, as part of the WAAF from the outbreak of war. Their employment, though, was to substitute females for males (up to certain specified limit), to release men for front-line duty. As such, women were not viewed as a source of talent or expertise in their own right. Initially, opportunities were limited to the basic trade of Equipment Assistant (non-commissioned ranks). As the war progressed, opportunities widened, albeit these were limited to areas where heavy, physical work was not involved. In

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<sup>38</sup> Calculated from this thesis, Appendix 2, Non-Commissioned Personnel in Logistics Trades – June 1941-November 1945, data for January 1945.

time they came to be respected by the male workforce and their numbers helped considerably to reduce the significant shortfall in male Equipment Assistant recruiting which became highly problematical from May 1942, largely due to the much wider manpower shortages which were being experienced at that time. The employment of WAAF officers in logistics, however, took much longer to gain acceptance. There was a subtle difference with officers in that commissioned rank brought with it the responsibility of command, a position which could require a WAAF officer to exercise control of both males and females. Such a prospect proved to be unacceptable for some men, especially for male civilians employed in the MUs. This, along with a number of other areas where their employment was limited due to operational requirements, greatly reduced the opportunities to maximize the use of WAAF Equipment Officers throughout the RAF. The contribution of WAAF officers to Equipment Branch officer manning is more difficult to assess, largely due to a lack of completeness in primary data. What can be said is that WAAF officers, along with officers from the dominions and the allies did help redress RAF male officer shortfalls throughout the war, though this import seems to have been quite sporadic and not as marked as for non-commissioned manning in the logistics trades. The substitution rate for both airwomen and officers never officially exceeded 50 per cent (20 per cent at MUs for airwomen due to the increased requirement for heavy lifting) after June 1942. Broadly speaking, there is little doubt that, quantitatively, the employment of WAAFs was important for RAF logistics. Ironically though, the numbers recruited appear to have done more to meet manpower shortages after May 1942 than releasing men for front-line duty as the substitution concept had originally intended.

This thesis has also clearly established that civilians played a key role in the overall logistics manning picture. Non-military personnel had formed part of the formal manpower establishment of logistics on RAF stations as early as 1925. The greatest concentration of civilians though was to be found at the stores depots where most units were manned almost entirely by non-uniformed personnel. Wider planning during the Expansion Programme gave rise to concerns regarding the future reliability of such a dependency, largely centred around the fears of disaffection, sabotage or industrial action and was subject to high-level review in 1937/1938. Options for mitigation considered a wide range

of alternative manning strategies from the complete manning of the depots by military personnel, to the option of inviting civilians so employed to take on a military reserve commitment. The outcome of these deliberations was a more pragmatic approach and saw civilians at the depots added to the Schedule of Reserved Occupations in 1939. Notwithstanding the reservations regarding the reliability and loyalty of civilians which troubled the RAF's higher command, this research has not found any evidence, in primary or secondary sources, to support these views. These people were not divorced from the war – the Battle of Britain (with its very real threat of German invasion at the time), the Blitz and the later onslaught by Hitler's *Vengeance* weapons on the UK population in 1944, brought the war to the home front. The war was not someone else's problem and the civilians in logistics, along with thousands of other civilians who participated in vital war work such as Air Raid Precautions and the emergency services, were keen to contribute to the war effort. Moreover, many of them had close relatives or friends who were serving in the armed services at home and overseas. If anything, this probably strengthened their resolve and motivated them to try and do their very best.

The sourcing of recruits from the dominions, colonies and European allied nations was largely in response to the general shortage of UK manpower which developed from the autumn of 1941. This initiative though, proved to be of limited value to logistics and the numerical contribution was small when viewed as a percentage of the size of the RAF's Equipment Branch and trades; in any area this never exceeded 1.5 per cent throughout the war. A lack of any credible, qualitative evidence makes it difficult to draw any conclusions regarding this limited contribution. It is perhaps not wide of the mark to suggest that the inclusion of manpower from overseas sources was more of a political gesture. Indeed, for those who had escaped from countries over-run and then occupied by Germany, it was an opportunity for them to fight back.

The final components of the people dimension are recruitment and training; these activities between them were responsible for providing the required quantity and quality of people for logistics. The high unemployment within the UK throughout the 1920s and 1930s and the availability of an attractive way of life in the military provided fertile conditions for recruiting and

this, on the whole was not a period of difficulty for RAF logistics in sourcing its required manpower. The needs of the Expansion Programme dramatically increased the numbers of people required and the National Service Act (and later variants) introduced on the outbreak of war, became the prime means of obtaining manpower for the armed forces; a detailed schedule of reserved occupations had also been drawn up to safeguard manpower required for essential industries.<sup>39</sup> Notwithstanding this, the legal commitment for military service which the Act brought could not guarantee that overall numbers and quality could be achieved. The manning levels for Equipment Officers throughout the war varied and, as commented on earlier, there were shortages but the occurrences are quite sporadic and the incompleteness of primary data makes it quite difficult to identify any trends. The inclusion of WAAF Equipment Officers and a limited number from overseas countries made a contribution, albeit not in any sizeable numbers. The lack of any archival sources which comment on Equipment Branch shortages suggests that this was regarded as a fact of life and did not lead to any detrimental effect on operational output. The situation for airmen, however, was quite different and more pronounced from early 1942 when the trained strength of those in logistics trades started to fall considerably short of the requirement, most likely as a result of the national manpower shortages which were beginning to become more pronounced by this stage of the war.<sup>40</sup> It was here that the availability of WAAFs and contributions from the dominions and allied nations did make a significant contribution; by March 1945 these additional sources were able to reduce the shortfall by as much as 70 per cent. By early 1945, planning with regards to the war in the Far East, sought to rebalance overall manpower distribution to meet a forecast requirement. This identified a requirement for a significant number of additional Equipment Assistants and much of this shortfall was met by surplus aircrew who were no longer required in the European theatre following the imminent surrender of Germany. Broadly speaking, recruiting for logistics (as with most other specialisations in the RAF) was very much a hand-to-mouth affair throughout the war and required constant attention to ensure that the right numbers were available in the right places. In this respect, operational uncertainties such as the overall duration of the war and where and for how

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39 M. Gowing, 'The Organisation of Manpower in Britain during the Second World War', *Journal of Contemporary History*, 7(1/2), 147-167 (p.148).

40 Ibid, pp.153-154.

long the RAF's supply chain was required made forecasting highly problematical. As far as training was concerned, considerable investment had been made in this area during the inter-war years and was in good shape by the outbreak of war. The only notable change which the training schools experienced, aside from a need to continually update the syllabus largely as a result of procedural changes, was almost a continual relocation to new locations throughout the country as the demands and relative priorities for accommodation from other organisations grew during the war. The operational record books for the various training schools provide little qualitative data for any broad conclusions to be drawn on effectiveness, although a comparison of the success rate for men and women from 1941 to 1944 does show that the training wastage rate for men was roughly twice that as for women. There is little, if anything, in primary sources to explain this difference but comments in secondary sources strongly suggest that women did perhaps have a greater aptitude for the largely administrative nature of much of the logistics task.

Turning to the heart of the sustainment concept – the physical resources which the RAF required to conduct air operations. John Lynn in his edited work on logistics expressed this in metaphorical terms as 'Mars [the Roman god of war] must be fed...No one can doubt the importance of feeding Mars in modern warfare, and it takes no great effort to recognize that it has always been a major aspect of large-scale armed struggle'.<sup>41</sup> The scope of this thesis does not permit an examination of all the resources required to support operations and has therefore focussed on the three key commodities of spares, POL and explosives. All three saw exponential increases in the quantity procured and consumed throughout the war but the most complex and challenging in terms of supply chain management was the spares inventory. Although complexity had become a feature of the RAF's inventory during the 1930s, largely due to the number of different manufacturers the Service was procuring from, the Expansion Programme increased this mix considerably. It was not just the diversity of aircraft, but the wide range of technological developments such as gun turrets, machine guns, hydraulic systems and variable pitch propellers which also added to the burgeoning pool of spares. The urgency of technical development also reduced the time available for extensive testing and this led

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<sup>41</sup> Lynn, *Feeding Mars*, p.vii.

to a wide range of modifications having to be incorporated to resolve problems with defects or inadequacies in design. This is well illustrated by the position in 1938 where, of the fifteen new aircraft types introduced to service at that time (with most having been in service for an average of just one year, 1,355 defect reports had been raised on these aircraft resulting in 924 approved modifications.<sup>42</sup>

The need for spares seldom attracts comment in secondary sources and therefore warrants brief comment in order that their significance to supporting air power is appreciated. More often than not, wear and tear was a key contributory factor, but maintenance (both planned and unplanned), battle damage repair, modifications and the repair of damage sustained through accidents also had a part to play.<sup>43</sup> A less obvious cause was the need to replace equipment which had been jettisoned from aircraft during operations such as the external long-range fuel tanks which were fitted to fighter aircraft such as the Supermarine Spitfire and were often jettisoned to reduce weight and increase speed in the event of an air-to-air combat engagement with the enemy. Occasionally, equipment such as guns was thrown overboard from badly damaged bomber aircraft (often with an engine or engines out of action) returning to home bases in an attempt to reduce weight and thereby gain valuable and much needed height in order to reach the runway.

Of all the factors which complicated spares procurement, the lack of standardization stands out as one of the most troublesome. It had been an issue for the RAF since the end of the First World War and was further complicated by the adoption of American produced aircraft, where the problem was even more pronounced; despite attempts by the Air Ministry to address this problem, little progress was made so it remained a challenge throughout the war. The actual provisioning of spares was a complex process in itself and required a mix of forecasting, in the case of new acquisitions and trend analysis using actual consumption data, for items which had been in service for a period of time. Following the ordering of these requirements through standing contracts

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<sup>42</sup> Source: Data calculated from this thesis, Table 14, p.150.

<sup>43</sup> A number of secondary sources include accounts by bomber aircrew, for example, whose aircraft sustained battle damage on operations but returned to their home airfields and required extensive repair. See for example: K. Wilson, *Journey's End – Bomber Command's Battle from Arnhem to Dresden and Beyond* (London: Weidenfield & Nicolson, 2010); A. Cooper, *Air Battle of the Ruhr – RAF Offensive March to July 1943* (Shrewsbury: Airlife Publishing, 1992) and M. R. Ford-Jones, *Bomber Squadron – Men Who Flew with XV* (London: William Kimber, 1987).

with manufacturers, the resulting consignments were delivered to the extensive range of equipment MUs. These stocks could then be drawn upon by user-units to meet their needs as required. The RAF's inventory grew substantially and in a relatively short period of time; from a size of 40,000 different items in 1918<sup>44</sup>, the inventory had expanded to 500,000 in June 1940<sup>45</sup>, before reaching its peak of 813,000 in April 1945.<sup>46</sup> A lack of surviving detailed data in primary sources precludes deeper analysis of these figures but the breakdown in April 1945 indicates that airframe spares represented the greatest proportion of items in the inventory (30 per cent), closely followed by American spares and equipment (22 per cent) and MT spares (20 per cent).<sup>47</sup> It should be noted that these figures represent different types of item and do not reflect the total quantities held for that particular item. The inventory figures also exclude POL items and explosives – separate comment is made on these later in this chapter. The size of the inventory and its dispersal across the equipment depots soon began to present significant issues for stock control, not least of which was the need to know what the overall stock position was for any one item; this was key in that orders for fresh stock were usually only placed when the total stock position dropped to a pre-defined level. This, inter alia, led to the introduction of the Master Provisioning Scheme in October 1939 which established what were effectively stock control offices at the UK depots and a limited number overseas. One innovative scheme which the Air Ministry implemented which made a direct contribution to getting aircraft back to flying condition quickly was the Aircraft on Ground concept which, with visible physical marking appended, afforded urgently required spares which were effectively grounding an aircraft, to be treated with priority throughout the supply chain. Such was the success of this concept that it has remained in use by the United Kingdom's Ministry of Defence into the twenty-first century.<sup>48</sup>

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44 P. Dye, Royal Flying Corps Logistics, Evening Seminar Series, University of Birmingham, Department of History, 21 February 2012.

45 TNA, AIR 20/1832, Ministry of Aircraft production – Suggested Absorption of DDGE, Memorandum by DDGE - Relationship of Directorate of Equipment with Ministry of Aircraft Production dated 28 June 1940, p.2.

46 Air Ministry, *Maintenance*, p.160.

47 Source: Data calculated from this thesis, Table 16, p.162.

48 MOD, Joint Service Publication 886, The Defence Logistic Support Chain Manual, Volume 3 – Supply Chain Management, Part 1 – Standard Priority System, Figure 4: Military Aviation Defect State Codes (UK Government: 2013), p 16.< <https://www.gov.uk/government/collections/jsp-886-the-defence-logistics-support-chain>>[accessed 21 July 2015].

Notwithstanding the conceptual logic of the Master Provisioning Scheme, the whole process (especially for aircraft related spares) required the balancing of complete aircraft production with spares production. Although it had been agreed in December 1939 that a target of 15 per cent of manufacturing capacity should be reserved for manufacturing spares, a significant shortage began to develop by the first half of 1940 – this became an issue which would see high-level intervention until late 1943.<sup>49</sup> The spares shortage problem was exacerbated by Beaverbrook when he took up his post as the first Minister of Aircraft Production in May 1940. Very quickly, he became wholly pre-occupied with the production of complete aircraft. Whilst this was undoubtedly important to Fighter Command during the Battle of Britain, Beaverbrook's lack of understanding regarding the importance of spares production left a legacy which took until late 1943 for a noticeable reduction in the percentage of aircraft grounded within the RAF's home commands to be achieved; much of this improvement was due to Beaverbrook's replacement by Moore-Brabazon as Minister in charge, although Portal's continued efforts to emphasise the importance of spares production to Beaverbrook also played a significant part. The proportion of aircraft grounded through lack of spares reached a peak of 8.7 per cent for all commands in June 1941 and dropped slowly to 3.1 per cent in December 1943.<sup>50</sup> Clearly, spares availability had a direct effect on operational performance as the lack of key spares could very quickly ground aircraft, thereby reducing the numbers available for operational tasking. The dialogue between Beaverbrook and the Air Ministry throughout the former's tenure in post shows an acrimonious relationship, a feature which was not helped by Churchill who seemed to believe that the fostering of an adversarial relationship between the two ministries was a healthy and productive way to conduct business.

The complexity of the RAF inventory increased markedly by the acquisition of aircraft from the United States of America which had already started in 1938 but increased significantly with the signing of the Lend-Lease Act in March 1941. This source too experienced problems with the provision of spares, a position not helped by the fact that American manufacturers had to

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49 TNA, AIR 8/459, Unservicability due to Shortage of Spares – Correspondence with M.A.P, Memorandum by D.G.E, Air Ministry to the Air Supply Board: Supply of Airframe and Engine Spares for Repair. Reference S.B.M. 456/40 dated 22 August 1940, Paragraph 3.

50 Postan, *British War Production*, p.321.

satisfy the orders for both British and American customers for the same aircraft type. The gradual introduction of American aircraft to the RAF's overall fleet increased the proportion of these types to some 28 per cent by May 1945.<sup>51</sup>

The provisioning of POL and explosives was less problematical than aircraft spares and was largely a matter of supply keeping up with increasing demand as the war progressed. The availability of fuel to the wider war effort had been recognized as part of national planning in the late 1930s and the far-sighted formation of the Petroleum Board and the introduction of the pooling scheme did much to balance out and prioritize operational demands. Explosives were quite a different commodity and there was not of course the wider national interest. As such, the provisioning of RAF explosives was a more direct affair between the Master Provisioning Office at Fauld, the Air Ministry and the ordnance factories. Overall, there are few conclusions to draw on the provisioning of POL and explosives although it is clear from archival sources that a close working relationship between the Air Ministry and industry was vital in order that future changes in requirements could be catered for in production planning.

The final part of the sustainment perspective which requires a concluding comment is how the RAF accumulated, protected and distributed the stocks of equipment which the procurement process had sourced. At the heart of this responsibility were two of the groups within Maintenance Command – numbers 40 and 42. The former operated the lion's share of the equipment depots and was essentially the conduit for the majority of the RAF's inventory, excluding POL and explosives; the latter two were more specialist in nature and were the responsibility of 42 Group. The provision and management of POL was a notable success story and the Petroleum Board's *partnered* approach with the Air Ministry and Maintenance Command was a key factor in the successful control of this critical commodity. Although a similar relationship was not to be found in the provisioning of explosives, 42 Group was dependant on the output of the Ministry of Aircraft Production's factories for ever increasing stock requirements, especially during the peak of the bomber offensive in 1944.

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<sup>51</sup> Data calculated from figures in: Thetford, *Aircraft of the Royal Air Force*, Appendix J.

There are two significant points which are particularly worthy of note relating to size and security. First, is the problem which arose from the sheer size of the stockholding task in terms of required space. Deliveries of equipment from Air Ministry contracts placed during the Expansion Programme saw vast quantities of stock literally pour into the 40 Group depots and by the middle of 1940 the existing storage space had already become congested. With the need for further expansion already becoming quite clear, 40 Group pressed ahead with acquiring additional storage space; this included a number of initiatives, ranging from complete new build sites, to the extensive and widespread use of buildings which were hired for the duration of the war only. Overall, this saw the size of 40 Group's real estate grow from just ten units in February 1939, to forty-two in December 1944.<sup>52</sup> This enlargement directly equated to a substantial increase in actual storage space, resulting in just over a 75 per cent increase from 12,796,000 cubic feet in November 1941, to 22,484,794 cubic feet in March 1944.<sup>53</sup> Number 42 Group experienced similar storage problems, although the storage of explosives required locations remote from centres of population for safety reasons, with POL having similar requirements, but also the need for large bulk storage tankage. The location of explosive storage sites in the UK was largely influenced by the needs of Bomber Command and 42 Group introduced a tailored supply chain which, through a network of forward depots situated in close proximity to flying units, was able to accumulate stock at the main ammunition depots and then hold stock further forward; this reduced the supply risk to units in the event of disruptions to the road and rail transport network. This too saw a sizeable increase in the number of ammunition related units which more than doubled, from eleven in December 1939, to twenty-four in July 1945.<sup>54</sup> The storage of POL was the most dramatic in terms of expansion. By September 1943, the quantity of aviation fuel stored in the UK had increased by just over 260 times, from 8,000 tons in 1936 to 2,090,700 tons.<sup>55</sup> The second point of note is physical security. The concept of stock dispersal had been incorporated in to the design of the new depots with dispersed sites which permitted the same type of stock to be distributed across a number of physical locations, thereby minimizing complete loss in the event of

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<sup>52</sup> Data from: Air Ministry, *Maintenance*, Diagram 18, p.152.

<sup>53</sup> Data from: Air Ministry, *Maintenance*, Appendix 14, pp.442-448.

<sup>54</sup> Data from: Sturtivant *et al*, *Royal Air Force Flying Training and Support Units*, pp.204-215.

<sup>55</sup> Air Ministry, *Works*, p.272. These figures exclude packed stocks in fuel dumps, tinning factory stocks, the contents of cross-country pipelines and stocks at RAF stations.

enemy action or sabotage. Vulnerability was also reduced by the new depots being constructed to the west of the United Kingdom, along with the application of a range of camouflage and concealment measures. Notwithstanding this, there is clear evidence that the Luftwaffe amassed detailed intelligence on virtually all of the RAF's logistics sites. Given that Luftwaffe aircraft had the range to attack most of these and had sufficient intelligence and electronic aids to enable relatively accurate navigation to targets, the question emerges as to why the enemy failed to exploit what could have been a significant advantage during the Battle of Britain? Part of the answer, it is suggested, lies with the fact that the Luftwaffe failed to recognize the inter-dependence of the various links in the RAF's supply chain. Whilst it endeavoured to target the UK's industrial manufacturing base during the Blitz of 1940/1941, German intelligence did not appear to have recognized the fact that much of the output from factories (especially aircraft spare parts) was being directed to just eight of the RAF equipment depots; it is likely that sizeable bombing missions to target these could have had a serious impact on the ability of the RAF to sustain defensive operations, particularly at the critical stages of the Battle of Britain. Credit for the Luftwaffe's failure can also be attributed to the dysfunctional decision making of the German high command.

The final part of the sustainment perspective is the distribution element. Transport, as it had been during the First World War, was critical to logistics. It was not just a question of moving supplies from depots to units, but it also enabled mobility of air power and the achievement of *logistical reach*; the latter was particularly significant following the D-Day landings in 1944 and the requirement to support aircraft operating on the continent as the Allies advanced through the Low Countries and into Germany itself. Overall, the RAF used five main methods of transport: surface means which included road, rail, water and pipeline with the fifth being air. Road transport during the inter-war years was established on a unit-by-unit basis, with the type and numbers of vehicles so established reflecting the role of the units concerned. The later part of the Expansion Programme, through and in to early 1940 with the threat of enemy invasion, saw the growing requirement for a pan-RAF MT capability and this led to the formation of the specialist MT companies, most of which were established with a heavy lift capability. Aside from their routine movement

activities between RAF units, industrial sites and the MUs, the MT Companies had a key role to play in relocating the ground elements of flying squadrons to new operating locations. Although the MOD AHB (RAF) short narrative on movements during the Second World War states that the first three MT companies were ‘...very busily employed conveying the ground personnel and equipment of operational fighter squadrons from airfield to airfield’ during the period of the Battle of Britain, there is little supporting evidence in the ORBs of these units to support this task as a particularly sizeable undertaking.<sup>56</sup> There is, however, more extensive evidence for the significance and value of the MT companies in the North African theatre.

In a similar vein, the railways were an important means of transport although this came into its own for the movement of bulky and heavy consignments such as aviation fuel and aircraft bombs. Despite the extent of enemy air attacks on the UK, the rail network proved to be remarkably resilient, especially throughout 1940 with the enemy’s intensive efforts to pave the way for possible invasion. The third means of surface transport used by logistics was by water. Ocean going cargo ships were the only means of moving sizeable numbers of personnel and freight to overseas theatre of war and RAF logistics had a key part to play in this through the staffing of a significant number of troopships. The formation and extensive numerical development of RAF Embarkation Units had a key part to play in these activities at home and overseas, with perhaps their most notable contribution in the closing months of the war being their employment on the Mulberry Harbour in Normandy. Experiments were also conducted with the use of inland waterways in the UK but these were not particularly successful, mainly due to the relative slow speed of the barges and their use was therefore discontinued in November 1944. The movement of fuel in bulk (as opposed to stock in containers) posed one of the more significant challenges in terms of movement, mainly due to the need for large volumes, particularly to meet the insatiable appetite of the heavy, four engined aircraft of Bomber Command. In the inter-war and early years of the war itself, such movements were by road tanker from the refineries to the flying units. The construction of the UK Pipeline system in 1941 made a significant

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<sup>56</sup> Ministry of Defence, Air Historical Branch (RAF) Monograph, ‘Royal Air Force Movements during the Second World War’ (unreferenced & undated), p.2. See also Brown, ‘RAF Movements’, p.449.

difference to the distribution of fuel and enabled large volumes to be pumped from the refineries to user units.

Of all the means of transport used by the RAF throughout the war, the use of air transport as part of logistics is less well understood and is under-represented in the literature. The inter-war years saw a somewhat polarized development, with its use largely confined to operations in Afghanistan, India and the Middle East, although mainly for the movement of passengers; this was a reflection of geographical needs and foreign policy at the time, rather than the development of a wider operational capability. The RAF's approach was quite different from the German Luftwaffe which attached two JU52 transport aircraft to each of its staffels and saw this as enabling highly mobile flying units. For the first part of the war, much of the RAF's transport fleet was a diverse range of largely impressed civilian aircraft, although their availability proved to be highly significant in supporting the British Air Forces in France in 1939 and 1940. It was not until the introduction of the American Douglas Dakota aircraft as part of the Lend-Lease scheme in March 1943 and the formation of RAF Transport Command at about the same time, that a significant transformation began to occur in air transport capability.<sup>57</sup> The RAF had made good use of its available air transport resources during the ebb and flow of battle in North Africa during 1942/1943, but the Dakota-dominated transport force (especially the squadrons of 46 Group) made a critical input to the support of the Allied Tactical Air Force and the British 21<sup>st</sup> Army in the breakout from Normandy in 1944, and the subsequent advance into Germany. The failure of the Allies to acknowledge the strategic significance of the port of Antwerp in Operation OVERLORD led to supply lines being seriously overstretched during the British advance through France, Belgium and Holland. RAF air transport became the key to the British Army maintaining combat effectiveness until re-supply by land could be improved following the eventual capture of Antwerp and its opening to Allied shipping at the end of November 1944.<sup>58</sup>

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<sup>57</sup> Thetford, *Aircraft of the Royal Air Force*, p.151.

<sup>58</sup> J.Buckley, *Monty's Men – The British Army and the Liberation of Europe* (Totton: Yale University Press, 2013), p.250.

## **Flexibility**

The final theme in this thesis can be broadly viewed as flexibility and embraces the fifth and final research question: how the RAF adjusted its logistics organization to meet the evolving needs of RAF air power throughout the war; this was analyzed in Chapter Eight. For established RAF units in the United Kingdom, logistical support was provided through the RAF's basic supply chain which comprised the source of supply in industry at one end, the equipment depots (MUs) as an intermediary link, with the end of the chain being the Equipment Sections on RAF units which, in contemporary parlance, served as a consumer outlet. With the addition of port units for receiving and dispatching consignments of stores and supplies by sea, the basic supply chain also met the requirements of established units overseas. The basic supply chain, however, had a significant limitation when it came to expeditionary operations in that the Equipment Sections on bases were not mobile formations and operated from purpose-built complexes. Moreover, they also held relatively large accumulations of stores and supplies. Planning at this time though, was in no doubt that any future war would be very different in nature from the First World War and was likely to be considerably more global and mobile. The largely static environment of trench warfare had enabled the RFC to establish more permanent operating locations and a supply chain from the United Kingdom which remained very much the same during the period from 1914 to 1917, albeit its scale and intensity of operation increased markedly during this time. The German offensive in the spring of 1918, however, brought these locations under more direct threat from the enemy and saw the RFC having to relocate its flying squadrons in response to the advance. This often required moves to temporary locations at very short notice and many of these were without on-site logistic facilities. This saw the need for a mobile logistics capability which could provide the required munitions, fuel and spares for flying squadrons as they relocated to the new airfields and resulted in the creation of mobile resupply convoys. It should be noted though, that these established in response to an urgent need and were not a standard part of the RFC's logistics order of battle at the time.

Post-war planning acknowledged the requirement for a mobile component and embraced this idea as part of a wider maintenance support concept within the plans for the dispatch of a future expeditionary force overseas. Essentially, this built on the key logistic elements which the RFC had used throughout the war for operations on the Continent: a port detachment; a forward aircraft depot and Air Stores Parks which would act as a mobile distributing and collecting service to forward units; this latter capability was a direct descendant of the 1918 resupply convoys.<sup>59</sup> This concept, based on tried and tested wartime conditions, was embodied in the RAF's *War Manual* of 1928 and was designed to enable RAF logistics to achieve a much greater reach than the basic supply chain which served its established bases.<sup>60</sup> This operational doctrine, though, was a contingency plan and the units required to operate the maintenance element were to be formed as and when required. It was thus that RAF logistics planned flexibility into its operating procedures. The first four ASPs were formed in the Middle East during the Abyssinian crisis of 1935, although in the event they were not required for long and were disbanded shortly thereafter. These early parks were reformed for the campaign in France during 1939/1940, a period which was to provide valuable operating experience. In due course, further parks were formed and played a valuable part in the campaigns in North Africa, Sicily, Italy and the invasion of the Continent with the following advance into Germany in 1945. Their efficacy was perhaps best demonstrated in the ebb and flow of the North African Campaign 1941-1943 and in the breakout from the Normandy Bridgehead in July 1944; in both cases the ASPs played a critical role in providing logistical support over ever extending lines of communications as airfields were established forward from base areas.

The third type of unit formed was the Beach Squadrons. This concept had not formed part of the RAF's original 1928 War Organization as planning had assumed that movement to an overseas theatre of operations would be through an established port. Although the Gallipoli landings during the First World War had given a foretaste of the challenges faced with landings on open

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59 TNA, AIR 1/8/15/1/7, RAF in France – notes on system of supply for (extracts from AM file 290308/20) notes by Air Commodore R. Brooke-Popham dated 20 September 1920 and Jones, *The War in the Air*, Volume 4, p.355 refers.

60 TNA, AIR 10/2312, Royal Air Force War Manual Organization and Administration (Provisional), AP 1301, Royal Air Force War Manual, Part II: Organization and Administration (Provisional), Chapter IX, Paragraphs 4-7.

beaches, it was not until the Dieppe landings in August 1942 that a growing need for a more developed combined services approach to what was referred to as beach maintenance would be required. By this stage of the war it had become quite clear that the RAF would need to participate in this work as its ground support organization would need to deploy into the field to support air power participating in future amphibious landings and the following campaign once a beach head had been established. For the RAF, this first took place with the landings in North Africa in November 1942, albeit the Equipment Organization used personnel from its existing Embarkation Units to support this. By early 1943 the need for a more formalized arrangement had developed and the first RAF Beach Units were formed; these took part in the invasion of Sicily in July 1943, the invasion of mainland Italy in September 1943 and the invasion of mainland Europe in June 1944, by which time these units had been renamed Beach Squadrons. The Beach Squadrons ensured that RAF stores and supplies could be clearly segregated into supply 'dumps' as they were landed and then moved forward to become part of the supply chain once that was established.

It was thus that the RAF logistics organization was able to build flexibility into its order of battle and to achieve *logistical reach*. This enabled the essential ground support elements to be deployed to the field and for them to receive the vital stores and supplies required to maintain air power away from the shores of the United Kingdom.

## **Overall Assessment**

The research for this thesis, through five research questions, has provided a detailed analysis of RAF logistics. This has enabled its origins to be defined, its development to be understood and for its specialist components to be explored. The point which must be made about the individual elements, however, is that they all contributed towards the single aim of sustaining air power. This unity of purpose was well summed up by Wesley Craven and James Cate in their official history of the United States Army Air Force. In considering what they term as men and planes (a generic term which includes logistics) they observed that '...combat operations...were their constant guide

and indeed their very *raison d'être*'.<sup>61</sup> As such, the strands of research need to be drawn together and for an overall assessment to be made on RAF logistics during the Second World War.

Four key points stand out from this research. First, the RAF valued the importance of lessons from the past, especially from the First World War which enabled it to develop effective operating methods and a robust supply chain structure during the inter-war period. With the advent of the pre-Second World War Expansion Programme in 1934, this attention to detail enabled the RAF to manage effectively the vast quantities of inbound stores and supplies, even though the footprint of the supply chain had to expand considerably to meet the resulting storage requirements.

The second point is inventory management, which was key to ensuring stores and supplies were maintained in adequate numbers. The Master Provisioning Scheme enabled a methodical approach to be taken to stock control, even if the limited availability of automatic data processing aids made this a manually intensive task. There were problems with spares availability, but this largely resulted from the inevitable difference of priorities (and opinions) between the Air Ministry and the Ministry of Aircraft Production, following Churchill's creation of the latter in May 1940. It is clear that the shortage of spares did have a direct effect on aircraft availability but this was not the only reason and other maintenance issues were also responsible for grounding aircraft. The position improved, but required constant attention by the Air Ministry's Directorate of Equipment for the rest of the war.

The third point is the significance of people. This component of logistics was complex in itself with different requirements such as provisioning and movements leading to increased numbers of personnel with specialist skills and qualifications. Air forces, when compared with naval and land forces, are renowned for having a significantly larger ratio of support staff to fighting staff, a concept often referred to as the teeth to tail ratio.<sup>62</sup> For the RAF, the ratio of air crew to ground crew at the beginning and end of the war was approximately

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61 Craven and Cate, *The Army Air Forces in World War II*, Volume Six, p.v.

62 M. Suman, 'Teeth to Tail Ratio – An Archaic Concept', *Indian Defence Review*, Volume 21, Number 4 (Oct – Dec 2006), 71-75.

1:9.<sup>63</sup> As far as logistics personnel were concerned, the war's end saw a population of 5,209 Equipment Officers and 35,373 logistic trades other ranks; this represented approximately 11 per cent of total ground branch officers and 5 per cent of total ground tradesmen in September 1945.<sup>64</sup> Whether these percentages could be viewed as low or high is difficult to judge and would be a matter of opinion rather than an informed view. To use Dye's expression though, they were indeed an essential lubricant.

The fourth and perhaps most significant point is the RAF's ability to achieve *logistical reach*. The use of the embarkation units, Beach Squadrons, forward depots and Air Stores Parks, enabled the RAF to stretch its supply chain well into overseas operational theatres (often as part of amphibious operations) and to support flying squadrons as they moved from airfield to airfield. This far-sighted concept had been included in the RAF's war organization as early as 1928 and proved critical in ensuring that RAF air power could play its part effectively in the allied effort during the Second World War.

One theme which has been commented on at various points in this thesis is the question of the effectiveness of the British Aviation industry during the Expansion Programme and the war itself. This topic was first explored through the work of the historian Correlli Barnett, with later views expressed by the historians Erik Lund and David Edgerton. Barnett's overall view was that the British aviation industry failed what he termed as the 'audit of war', largely through low production caused by the excessive numbers of aircraft types. Whilst this thesis had not specifically set out to explore this first part of the RAF's supply chain in detail, its underpinning research supports the view that the large numbers of aircraft types and marks in RAF service at any one time did make logistics difficult. The reluctance to prioritise spares' production by both the Ministry of Aircraft Production and the British aircraft industry compounded the challenge. In this respect, the evidence from this research supports Barnett's view. It must be said, however, that the Air Ministry and RAF also had a significant part to play in that they were largely responsible

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63 Figures calculated from Air Ministry, Royal Air Force Personnel Statistics, Section II, Table VI, pp.39-42. Figures include all ranks.

64 Figures calculated from Air Ministry, Royal Air Force Personnel Statistics, Section II, Table VI, pp.39-42 and this thesis, Appendix 1 and 2.

for generating the Air Staff operational requirements which led to the complexity of aircraft types and marks in service.

The Service did not always get it right and, for example, the RAF's logistics performance during the Normandy campaign of 1944 was a considerable improvement on its experience in the first of the major amphibious landings in North Africa some eighteen months earlier. Much of the success can be attributed to the fact that RAF logisticians were, by and large, included in operational planning teams.

Drawing a conclusion on the overall effectiveness of RAF logistics during the Second World War is difficult as the discipline is multi-faceted, each of which affected different aspects of operational output. Broad brush observations can be made, however, which go some way towards forming a general view. It is clear that the Air Ministry did much before the war to develop and strengthen its logistics' infrastructure which did much to facilitate the more rapid growth of the RAF after the outbreak of war. This was particularly challenging given the uncertainty of the duration and extent of the war itself. Whilst RAF logistics was supporting military operations, the Air Ministry also recognized that much of the logistics' task was not too dissimilar from commercial operations and embraced good practice from the civilian sector wherever it could; this was particularly evident in the fields of warehousing, procurement and stock control. The RAF's overseas supply chains were perhaps its greatest challenge where the difficulties of maintaining physical security and being able to achieve *logistical reach* did prove problematical. Learning from experience was a critical requirement and RAF logisticians became particularly adept at this as the war progressed.

Achieving effective logistics took great effort and was a complex business. Taking into account the chapter conclusions in this thesis, the overall performance can be judged to have been highly effective. This, in no small part, can be attributed to the fact that from the outset, the RAF knew that logistics would be vital to the achievement of operational success and made sure that it was given due attention.

## Appendices

## Appendix 1- Equipment Branch Officer Manning: September 1939 – November 1945<sup>1</sup>

Month & Year	Branch Requirement	Actual Manning				Total	Shortfall
		RAF	WAAF	Dominion	Allied/ Foreign		
Sep 1939	Not Known (N/K)	1021	Nil	Nil	Nil	1021	
Oct 1939	N/K	958	Nil	Nil	Nil	958	
Nov 1939	N/K	1019	Nil	Nil	Nil	1019	
Dec 1939	N/K	1016	Nil	Nil	Nil	1016	
Jan 1940	N/K	1016	Nil	Nil	Nil	1016	
Feb 1940	N/K	1269	Nil	Nil	Nil	1269	
Mar 1940	N/K	1347	Nil	Nil	Nil	1347	
Apr 1940	N/K	1353	Nil	Nil	Nil	1353	
May 1940	N/K	1308	Nil	Nil	Nil	1308	
Jun 1940	N/K	1430	Nil	Nil	Nil	1430	
Jul 1940	N/K	1430	Nil	Nil	Nil	1430	
Aug 1940	N/K	1700	Nil	Nil	Nil	1700	
Sep 1940	N/K	1848	Nil	Nil	Nil	1848	
Oct 1940	2500	1981	Nil	Nil	Nil	1981	- 519
Nov 1940	N/K	1960	Nil	Nil	Nil	1960	
Dec 1940	N/K	2022	Nil	Nil	Nil	2022	
Jan 1941	N/K	2097	Nil	Nil	Nil	2097	
Feb 1941	N/K	2152	Nil	Nil	Nil	2152	
Mar 1941	N/K	2179	Nil	Nil	Nil	2179	
Apr 1941	N/K	2237	Nil	Nil	Nil	2237	
May 1941	N/K	2290	Nil	Nil	Nil	2290	
Jun 1941	N/K	2392	Nil	Nil	Nil	2392	
Jul 1941	3750	2525	Nil	Nil	Nil	2525	- 1225
Aug 1941	3790	2646	Nil	Nil	Nil	2646	- 1144
Sep 1941	3747	2943	Nil	Nil	Nil	2943	- 804
Oct 1941	N/K	2981	Nil	Nil	Nil	2981	
Nov 1941	N/K	3126	Nil	Nil	Nil	3126	
Dec 1941	N/K	3207	Nil	Nil	Nil	3207	
Jan 1942	N/K	3267	N/K	11	3	3281	
Feb 1942	N/K	3276	N/K	9	2	3287	
Mar 1942	3715	3263	N/K	8	2	3273	- 442
Apr 1942	N/K	3298	N/K	7	3	3308	
May 1942	N/K	3303	N/K	7	5	3315	
Jun 1942	N/K	3339	N/K	8	5	3352	
Jul 1942	N/K	3452	N/K	11	6	3469	
Aug 1942	N/K	3527	N/K	12	7	3546	
Sep 1942	4568	3518	59	22	7	3607	- 961
Oct 1942	4524	3547	N/K	26	7	3580	- 944
Nov 1942	N/K	3544	N/K	32	7	3583	
Dec 1942	N/K	3571	N/K	42	10	3623	
Jan 1943	N/K	3700	N/K	38	13	3751	
Feb 1943	N/K	3805	N/K	41	13	3859	
Mar 1943	4870	3848	N/K	46	14	3908	- 962
Apr 1943	N/K	3918	N/K	43	15	3976	
May 1943	N/K	3974	N/K	45	14	4033	
Jun 1943	N/K	4117	N/K	45	14	4176	
Jul 1943	4747	4260	280	47	15	4602	- 145
Aug 1943	N/K	4361	N/K	50	17	4428	
Sep 1943	4781	4375	289	54	17	4735	- 46

<sup>1</sup> Source: TNA, AIR 20/1015, AIR 20/1016, AIR 20/2025, AIR 22/296; RAFM, RAF Personnel Statistics, Table XI, p.99; RAFM, The Women's Auxiliary Air Force (1953), p.95, Air Ministry, Manning Plans & Policy, Appendix 8 and RAFC Library, Air Force Lists September 1939 to September 1940.

Month & Year	Branch Requirement	Actual Manning					Shortfall
		RAF	WAAF	Dominion	Allied/ Foreign	Total	
Oct 1943	N/K	4400	N/K	55	19	4424	
Nov 1943	N/K	4552	N/K	N/K	N/K	4552	
Dec 1943	N/K	4398	N/K	54	18	4470	
Jan 1944	4700	4400	N/K	64	20	4484	- 216
Feb 1944	N/K	4381	N/K	66	20	4467	
Mar 1944	N/K	4398	N/K	66	20	4484	
Apr 1944	N/K	4412	N/K	63	23	4498	
May 1944	N/K	4428	366	65	25	4884	
Jun 1944	N/K	4519	N/K	65	24	4608	
Jul 1944	N/K	4566	379	65	24	5034	
Aug 1944	5178	4535	N/K	68	25	4628	- 550
Sep 1944	N/K	4726	413	65	25	5229	
Oct 1944	N/K	4811	408	72	25	5316	
Nov 1944	N/K	4479	N/K	55	25	4559	
Dec 1944	N/K	4884	N/K	63	25	4972	
Jan 1945	N/K	4866	453	60	27	5406	
Feb 1945	N/K	4896	N/K	60	30	4986	
Mar 1945	N/K	4933	N/K	70	35	5038	
Apr 1945	N/K	4922	381	66	33	5402	
May 1945	N/K	4817	424	67	35	5331	
Jun 1945	N/K	4806	N/K	74	36	4916	
Jul 1945	N/K	4761	417	68	35	5281	
Aug 1945	N/K	4748	N/K	63	40	4851	
Sep 1945	N/K	4733	475	62	39	5209	
Oct 1945	N/K	4586	375	57	40	5058	
Nov 1945	N/K	4318	N/K	54	12	4384	

## Appendix 2 - Non-Commissioned Personnel in Logistic Trades: June 1941- November 1945<sup>1</sup>

Month & Year: June 1941

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	1677	1669	0	0	0	0	- 8
Clerk, Equipment Accounting (WAAF)	525	583	0	0	0	0	+58
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) RAF	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	11104	10836	0	0	0	0	-268
Equip Assistant (WAAF)	1907	859	0	0	0	0	-1048
Total / Net	15213	13947	0	0	0	0	-1266

<sup>1</sup> Source: TNA, AIR 22/315: Comparative Statements of Establishments and Strength R.A.F. Personnel June 1941 – January 1944 and AIR 22/316 – Comparative Statements of Establishments and Strength R.A.F. Personnel June 1944 – January 1946.

Month &amp; Year: July 1941

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	1922	1998	0	0	0	0	+76
Clerk, Equipment Accounting (WAAF)	557	382	0	0	0	0	-175
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	11938	11396	0	0	0	0	-542
Equip Assistant (WAAF)	2029	989	0	0	0	0	-1040
Total / Net	16446	14765	0	0	0	0	-1681

Month &amp; Year: August 1941

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	1752	2167	0	0	0	0	+415
Clerk, Equipment Accounting (WAAF)	989	480	0	0	0	0	-509
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	11525	11810	0	0	0	0	+285
Equip Assistant (WAAF)	3396	953	0	0	0	0	-2443
Total / Net	17662	15410	0	0	0	0	-2252

Month &amp; Year: September 1941

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	1790	2239	0	0	0	0	+449
Clerk, Equipment Accounting (WAAF)	1230	586	0	0	0	0	-644
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	11746	12045	0	0	0	0	+299
Equip Assistant (WAAF)	3923	1381	0	0	0	0	-2542
Total / Net	18689	16251	0	0	0	0	-2438

Month &amp; Year: October 1941

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	1869	2321	0	0	0	0	+452
Clerk, Equipment Accounting (WAAF)	1421	804	0	0	0	0	-617
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	11889	12222	0	0	0	0	+333
Equip Assistant (WAAF)	4288	2142	0	0	0	0	-2146
Total / Net	19467	17489	0	0	0	0	-1978

Month &amp; Year: November 1941

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	1879	2378	0	0	0	0	+499
Clerk, Equipment Accounting (WAAF)	1616	903	0	0	0	0	-713
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	12577	12478	149	1	0	0	+51
Equip Assistant (WAAF)	4634	2640	0	0	0	0	-1994
Total / Net	20706	18399	149	1	0	0	-2157

Month &amp; Year: December 1941

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	1919	2416	0	0	0	0	+497
Clerk, Equipment Accounting (WAAF)	1692	1039	0	0	0	0	-653
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	12923	12807	145	1	0	0	+30
Equip Assistant (WAAF)	4729	3434	0	0	0	0	-1295
Total / Net	21263	19696	145	1	0	0	-1421

Month &amp; Year: January 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2036	2505	0	1	0	0	+470
Clerk, Equipment Accounting (WAAF)	1692	1147	0	0	0	0	-545
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	13552	12909	170	0	0	0	-473
Equip Assistant (WAAF)	4877	4097	0	0	0	0	-780
Total / Net	22157	20658	170	1	0	0	-1328

Month &amp; Year: February 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2107	2568	0	0	0	0	+461
Clerk, Equipment Accounting (WAAF)	1720	1337	0	0	0	0	-383
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	13791	13122	148	1	0	0	-520
Equip Assistant (WAAF)	5078	4890	0	0	0	0	-188
Total / Net	22696	21917	148	1	0	0	-630

Month &amp; Year: March 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2139	2631	0	1	0	0	+493
Clerk, Equipment Accounting (WAAF)	1737	1424	0	0	0	0	-313
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	14185	13275	130	0	0	0	-780
Equip Assistant (WAAF)	5154	5501	0	0	0	0	+347
Total / Net	23215	22831	130	1	0	0	-253

Month &amp; Year: April 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2226	2693	0	1	0	0	+468
Clerk, Equipment Accounting (WAAF)	1758	1449	0	0	0	0	-309
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	14435	13433	123	0	0	0	-879
Equip Assistant (WAAF)	5318	5901	0	0	0	0	+583
Total / Net	23737	23476	123	1	0	0	-137

Month &amp; Year: May 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2365	2687	0	1	0	0	+322
Clerk, Equipment Accounting (WAAF)	1995	1474	0	0	0	0	-521
Clerk, Provisioning (RAF)	0	0	0	0	0	0	0
Clerk, Provisioning (WAAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	15226	13415	110	1	0	0	-1701
Equip Assistant (WAAF)	5753	6154	0	0	0	0	+401
Total / Net	25339	23730	110	1	0	0	-1498

Month &amp; Year: June 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2429	2683	0	0	0	0	+253
Clerk, Equipment Accounting (WAAF)	2068	1512	0	0	0	0	-556
Clerk, Provisioning (RAF)	262	0	0	0	0	0	-262
Clerk, Provisioning (WAAF)	466	80	0	0	0	0	-386
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	15448	13531	120	1	0	0	-1797
Equip Assistant (WAAF)	6330	6414	0	0	0	0	+84
Total / Net	27003	24220	120	1	0	0	-2662

Month &amp; Year: July 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2583	2660	0	1	0	0	+78
Clerk, Equipment Accounting (WAAF)	2125	1613	0	0	0	0	-512
Clerk, Provisioning (RAF)	262	-	0	0	0	0	-262
Clerk, Provisioning (WAAF)	466	-	0	0	0	0	-466
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	16538	13581	137	1	0	0	-2819
Equip Assistant (WAAF)	6472	6659	0	0	0	0	+187
Total / Net	28446	24513	137	2	0	0	-3794

Month &amp; Year: August 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2661	2627	0	0	0	0	-34
Clerk, Equipment Accounting (WAAF)	2118	1695	0	0	0	0	-423
Clerk, Provisioning (RAF)	280	-	0	0	0	0	-280
Clerk, Provisioning (WAAF)	478	-	0	0	0	0	-478
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	17618	13660	125	1	0	0	-3832
Equip Assistant (WAAF)	6340	6861	0	0	0	0	+521
Total / Net	29495	24843	125	1	0	0	-4526

Month &amp; Year: September 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2690	2605	0	1	0	0	-84
Clerk, Equipment Accounting (WAAF)	2153	1798	0	0	0	0	-355
Clerk, Provisioning (RAF)	361	-	0	0	0	0	-361
Clerk, Provisioning (WAAF)	922	-	0	0	0	0	-922
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	17821	13690	165	1	0	0	-3966
Equip Assistant (WAAF)	6071	7256	0	0	0	0	+1185
Total / Net	30018	25349	165	1	0	0	4503

Month &amp; Year: October 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	1977	2578	0	0	0	0	+601
Clerk, Equipment Accounting (WAAF)	1618	1884	0	0	0	0	+266
Clerk, Provisioning (RAF)	193	0	0	0	0	0	-193
Clerk, Provisioning (WAAF)	184	0	0	0	0	0	-184
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	17561	13874	185	2	0	0	-3500
Equip Assistant (WAAF)	5751	7405	0	0	0	0	+1654
Total / Net	27284	25741	185	2	0	0	-1356

Month &amp; Year: November 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2094	2560	0	0	0	0	+466
Clerk, Equipment Accounting (WAAF)	1703	2025	0	0	0	0	+322
Clerk, Provisioning (RAF)	232	111	0	0	0	0	-121
Clerk, Provisioning (WAAF)	222	318	0	0	0	0	+96
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	18203	14172	183	2	0	0	-3846
Equip Assistant (WAAF)	6096	7463	0	0	0	0	+1367
Total / Net	28550	26649	183	2	0	0	-1716

Month &amp; Year: December 1942

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2027	2475	0	0	0	0	+448
Clerk, Equipment Accounting (WAAF)	1654	2079	0	0	0	0	+425
Clerk, Provisioning (RAF)	193	268	0	0	0	0	+75
Clerk, Provisioning (WAAF)	184	510	0	0	0	0	+326
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	17777	14196	196	2	0	0	-3383
Equip Assistant (WAAF)	5889	7425	0	0	0	0	+1536
Total / Net	27724	26953	196	2	0	0	-573

Month &amp; Year: January 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2052	2464	0	0	0	0	+412
Clerk, Equipment Accounting (WAAF)	1672	2185	0	0	0	0	+513
Clerk, Provisioning (RAF)	193	290	0	0	0	0	+97
Clerk, Provisioning (WAAF)	184	664	0	0	0	0	+480
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	17885	14678	170	2	0	0	-3035
Equip Assistant (WAAF)	5957	7539	0	0	0	0	+1582
Total / Net	27943	27820	170	2	0	0	-49

Month &amp; Year: February 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2470	2430	0	0	0	0	-40
Clerk, Equipment Accounting (WAAF)	2278	2242	0	0	0	0	-36
Clerk, Provisioning (RAF)	315	320	0	0	0	0	+5
Clerk, Provisioning (WAAF)	419	724	0	0	0	0	+305
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	19162	14971	135	2	0	0	-4054
Equip Assistant (WAAF)	6487	7745	0	0	0	0	+1258
Total / Net	31131	28432	135	2	0	0	-2562

Month &amp; Year: March 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2513	2416	0	0	0	0	-97
Clerk, Equipment Accounting (WAAF)	2137	2327	0	0	0	0	+190
Clerk, Provisioning (RAF)	662	319	0	0	0	0	-343
Clerk, Provisioning (WAAF)	981	744	0	0	0	0	-237
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	19580	15283	163	2	0	0	-4132
Equip Assistant (WAAF)	6097	7715	0	0	0	0	+1618
Total / Net	31970	28804	163	2	0	0	-3001

Month &amp; Year: April 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2645	2519	0	0	0	0	-126
Clerk, Equipment Accounting (WAAF)	2292	2307	0	0	0	0	+15
Clerk, Provisioning (RAF)	546	323	0	0	0	0	-223
Clerk, Provisioning (WAAF)	871	747	0	0	0	0	-124
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	20383	15655	163	2	0	0	-4563
Equip Assistant (WAAF)	6159	7597	0	0	0	0	+1438
Total / Net	32896	29148	163	2	0	0	-3583

Month &amp; Year: May 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2581	2663	0	0	0	0	+82
Clerk, Equipment Accounting (WAAF)	2293	2283	0	0	0	0	-10
Clerk, Provisioning (RAF)	777	340	0	0	0	0	-437
Clerk, Provisioning (WAAF)	871	760	0	0	0	0	-111
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	19755	15994	165	1	0	0	-3595
Equip Assistant (WAAF)	6180	7495	0	0	0	0	+1315
Total / Net	32457	29535	165	1	0	0	-2756

Month &amp; Year: June 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2634	2692	0	0	0	0	+58
Clerk, Equipment Accounting (WAAF)	2399	2257	0	0	0	0	-142
Clerk, Provisioning (RAF)	802	376	0	0	0	0	-426
Clerk, Provisioning (WAAF)	1036	775	0	0	0	0	-261
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	20312	16422	165	1	0	0	-3724
Equip Assistant (WAAF)	6243	7358	0	0	0	0	+1115
Total / Net	33426	29880	165	1	0	0	-3380

Month &amp; Year: July 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2647	2687	0	0	0	0	+40
Clerk, Equipment Accounting (WAAF)	2412	2273	0	0	0	0	-139
Clerk, Provisioning (RAF)	961	372	0	0	0	0	-589
Clerk, Provisioning (WAAF)	1036	772	0	0	0	0	-264
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	20615	16815	213	5	0	0	-3582
Equip Assistant (WAAF)	6471	7317	0	0	0	0	+846
Total / Net	34142	30236	213	5	0	0	-3688

Month &amp; Year: August 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2606	2678	0	0	0	0	+72
Clerk, Equipment Accounting (WAAF)	2429	2336	0	0	0	0	-93
Clerk, Provisioning (RAF)	972	372	0	0	0	0	-600
Clerk, Provisioning (WAAF)	1036	922	0	0	0	0	-114
Clerk GD (Movements Control) (RAF)	0	0	0	0	0	0	0
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	21283	17051	178	1	0	0	-4053
Equip Assistant (WAAF)	6509	7258	0	0	0	0	+749
Total / Net	34835	30617	178	1	0	0	-4039

Month &amp; Year: September 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2650	2659	0	0	0	0	+9
Clerk, Equipment Accounting (WAAF)	2443	2419	0	0	0	0	-24
Clerk, Provisioning (RAF)	965	410	0	0	0	0	-555
Clerk, Provisioning (WAAF)	1043	923	0	0	0	0	-120
Clerk GD (Movements Control) (RAF)	Nil	249	0	0	0	0	+249
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	20788	17270	176	1	0	0	-3341
Equip Assistant (WAAF)	6592	7366	0	0	0	0	+774
Total / Net	34481	31296	176	1	0	0	-3008

Month &amp; Year: October 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2610	2659	0	0	0	0	+49
Clerk, Equipment Accounting (WAAF)	2445	2457	0	0	0	0	+12
Clerk, Provisioning (RAF)	958	450	0	0	0	0	-508
Clerk, Provisioning (WAAF)	1072	901	0	0	0	0	-171
Clerk GD (Movements Control) (RAF)	Nil	261	0	0	0	0	+261
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	20916	17470	162	1	0	0	-3283
Equip Assistant (WAAF)	6607	778	0	0	0	0	-5829
Total / Net	34608	24976	162	1	0	0	-9469

Month &amp; Year: November 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2584	2645	0	0	0	0	+61
Clerk, Equipment Accounting (WAAF)	2374	2509	0	0	0	0	+135
Clerk, Provisioning (RAF)	1020	449	0	0	0	0	-571
Clerk, Provisioning (WAAF)	1072	876	0	0	0	0	-196
Clerk GD (Movements Control) (RAF)	Nil	264	0	0	0	0	+264
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	20917	17509	185	1	0	0	-3222
Equip Assistant (WAAF)	6682	8038	0	0	0	0	+1356
Total / Net	34649	32290	185	1	0	0	-2173

Month &amp; Year: December 1943

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2590	2638	0	0	0	0	+48
Clerk, Equipment Accounting (WAAF)	2398	2536	0	0	0	0	+138
Clerk, Provisioning (RAF)	1069	441	0	0	0	0	-628
Clerk, Provisioning (WAAF)	1121	989	0	0	0	0	-132
Clerk GD (Movements Control) (RAF)	Nil	291	0	0	0	0	+291
Clerk GD (Movements Control) (WAAF)	0	0	0	0	0	0	0
Embarkation Assistant (RAF)	0	0	0	0	0	0	0
Equipment Assistant (RAF)	21350	17667	218	1	0	0	-3464
Equip Assistant (WAAF)	6489	8266	0	0	0	0	+1777
Total / Net	35017	32828	218	1	0	0	-1970

Month &amp; Year: January 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2627	2628	0	0	0	0	+1
Clerk, Equipment Accounting (WAAF)	2334	2543	0	0	0	0	+209
Clerk, Provisioning (RAF)	1289	448	0	0	0	0	-841
Clerk, Provisioning (WAAF)	1227	974	0	0	0	0	-253
Clerk GD (Movements Control) (RAF)	Nil	299	0	0	0	0	+299
Clerk GD (Movements Control) (WAAF)	Nil	Nil	0	0	0	0	Nil
Embarkation Assistant (RAF)	1124	16	0	0	0	0	-1108
Equipment Assistant (RAF)	22018	18029	177	1	0	0	-3811
Equip Assistant (WAAF)	6431	8556	0	0	0	0	+2125
Total / Net	37050	33493	177	1	0	0	-3379

Month &amp; Year: February 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2661	2624	0	0	0	0	-37
Clerk, Equipment Accounting (WAAF)	2319	2539	0	0	0	0	+220
Clerk, Provisioning (RAF)	1252	454	0	0	0	0	-798
Clerk, Provisioning (WAAF)	1215	872	0	0	0	0	-343
Clerk GD (Movements Control) (RAF)	Nil	301	0	0	0	0	+301
Clerk GD (Movements Control) (WAAF)	Nil	Nil	0	0	0	0	0
Embarkation Assistant (RAF)	1212	125	0	0	0	0	-1087
Equipment Assistant (RAF)	22444	18118	161	1	0	0	-4164
Equip Assistant (WAAF)	6443	8775	0	0	0	0	+2332
Total / Net	37546	33808	161	1	0	0	-3576

Month &amp; Year: March 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2663	2612	0	0	0	0	-51
Clerk, Equipment Accounting (WAAF)	2336	2530	0	0	0	0	+194
Clerk, Provisioning (RAF)	1285	477	0	0	0	0	-808
Clerk, Provisioning (WAAF)	1164	842	0	0	0	0	-322
Clerk GD (Movements Control) (RAF)	Nil	305	0	0	0	0	+305
Clerk GD (Movements Control) (WAAF)	Nil	Nil	0	0	0	0	0
Embarkation Assistant (RAF)	1189	231	0	0	0	0	-958
Equipment Assistant (RAF)	23441	18363	134	1	0	0	-4943
Equip Assistant (WAAF)	6501	8855	0	0	0	0	+2354
Total / Net	38579	34215	134	1	0	0	-4229

Month &amp; Year: April 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2525	2558	0	0	0	0	+33
Clerk, Equipment Accounting (WAAF)	2354	2502	0	0	0	0	+148
Clerk, Provisioning (RAF)	1344	502	191	0	0	0	-651
Clerk, Provisioning (WAAF)	1116	848	0	0	0	0	-268
Clerk GD (Movements Control) (RAF)	Nil	303	0	0	0	0	+303
Clerk GD (Movements Control) (WAAF)	Nil	Nil	0	0	0	0	0
Embarkation Assistant (RAF)	1353	420	0	0	0	0	-933
Equipment Assistant (RAF)	23657	18458	130	1	0	0	-5068
Equip Assistant (WAAF)	6582	8777	0	0	0	0	+2195
Total / Net	38931	34368	321	1	0	0	-4241

Month &amp; Year: May 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2543	2528	0	0	0	0	-15
Clerk, Equipment Accounting (WAAF)	2332	2470	0	0	0	0	+138
Clerk, Provisioning (RAF)	1052	549	191	0	0	0	-312
Clerk, Provisioning (WAAF)	1371	908	0	0	0	0	-463
Clerk GD (Movements Control) (RAF)	Nil	305	0	0	0	0	+305
Clerk GD (Movements Control) (WAAF)	Nil	Nil	0	0	0	0	0
Embarkation Assistant (RAF)	1397	555	0	0	0	0	-842
Equipment Assistant (RAF)	23152	18581	144	1	0	0	-4426
Equip Assistant (WAAF)	6591	8664	0	0	0	0	+2073
Total / Net	38438	34560	335	1	0	0	-3542

Month &amp; Year: June 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2588	2496	0	0	0	0	-92
Clerk, Equipment Accounting (WAAF)	2361	2439	0	0	0	0	+78
Clerk, Provisioning (RAF)	1231	596	191	0	0	0	-444
Clerk, Provisioning (WAAF)	1378	960	0	0	0	0	-418
Clerk GD (Movements Control) (RAF)	Nil	315	0	0	0	0	+315
Clerk GD (Movements Control) (WAAF)	Nil	Nil	0	0	0	0	0
Embarkation Assistant (RAF)	1461	699	0	0	0	0	-762
Equipment Assistant (RAF)	23386	18728	162	1	0	0	-4495
Equip Assistant (WAAF)	6658	8567	Nil	0	0	0	+1909
Total / Net	39063	34800	353	1	0	0	-3909

Month &amp; Year: July 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2668	2487	0	0	0	0	-181
Clerk, Equipment Accounting (WAAF)	2386	2418	0	0	0	0	+32
Clerk, Provisioning (RAF)	1381	629	0	0	0	0	-752
Clerk, Provisioning (WAAF)	1332	1044	0	0	0	0	-288
Clerk GD (Movements Control) (RAF)	Nil	315	0	0	0	0	+315
Clerk GD (Movements Control) (WAAF)	8	Nil	0	0	0	0	-8
Embarkation Assistant (RAF)	1807	817	0	0	0	0	-990
Equipment Assistant (RAF)	23448	18814	122	1	0	0	-4511
Equip Assistant (WAAF)	6676	8487	0	0	0	0	+1811
Total / Net	39706	35011	122	1	0	0	-4572

Month &amp; Year: August 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2642	2461	0	0	0	0	-181
Clerk, Equipment Accounting (WAAF)	2305	2399	0	0	0	0	+94
Clerk, Provisioning (RAF)	1392	685	0	0	0	0	-707
Clerk, Provisioning (WAAF)	1323	1103	0	0	0	0	-220
Clerk GD (Movements Control) (RAF)	Nil	315	0	0	0	0	+315
Clerk GD (Movements Control) (WAAF)	Nil	8	0	0	0	0	+8
Embarkation Assistant (RAF)	1786	918	0	0	0	0	-868
Equipment Assistant (RAF)	23275	18878	130	1	0	0	-4266
Equip Assistant (WAAF)	6738	8412	0	0	0	0	+1674
Total / Net	39461	35179	130	1	0	0	-4151

Month &amp; Year: September 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2633	2441	0	0	0	0	-192
Clerk, Equipment Accounting (WAAF)	2384	2374	0	0	0	0	-10
Clerk, Provisioning (RAF)	1486	732	0	0	0	0	-754
Clerk, Provisioning (WAAF)	1343	1147	0	0	0	0	-196
Clerk GD (Movements Control) (RAF)	Nil	418	0	0	0	0	+418
Clerk GD (Movements Control) (WAAF)	Nil	10	0	0	0	0	+10
Embarkation Assistant (RAF)	1848	1066	0	0	0	0	-782
Equipment Assistant (RAF)	23279	18979	135	1	0	0	-4164
Equip Assistant (WAAF)	6617	8306	0	0	0	0	+1689
Total / Net	39590	35473	135	1	0	0	-3981

Month &amp; Year: October 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2707	2426	1	0	0	0	-280
Clerk, Equipment Accounting (WAAF)	2396	2357	0	0	0	0	-39
Clerk, Provisioning (RAF)	1405	778	0	0	0	0	-627
Clerk, Provisioning (WAAF)	1343	1193	0	0	0	0	-150
Clerk GD (Movements Control) (RAF)	Nil	428	0	0	0	0	+428
Clerk GD (Movements Control) (WAAF)	Nil	11	0	0	0	0	+11
Embarkation Assistant (RAF)	1908	1169	0	0	0	0	-739
Equipment Assistant (RAF)	23664	19062	72	1	0	0	-4529
Equip Assistant (WAAF)	6531	8221	0	0	0	0	+1690
Total / Net	39954	35645	73	1	0	0	-4235

Month &amp; Year: November 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2647	2415	0	2	0	0	-230
Clerk, Equipment Accounting (WAAF)	2392	2341	0	0	0	0	-51
Clerk, Provisioning (RAF)	1269	807	0	0	0	0	-462
Clerk, Provisioning (WAAF)	1343	1223	0	0	0	0	-120
Clerk GD (Movements Control) (RAF)	Nil	429	0	0	0	0	+429
Clerk GD (Movements Control) (WAAF)	Nil	26	0	0	0	0	+26
Embarkation Assistant (RAF)	2140	1234	0	0	0	+151	-906
Equipment Assistant (RAF)	23782	19241	205	0	0	+329	-4336
Equip Assistant (WAAF)	6525	8150	0	0	0	0	+1625
Total / Net	40098	35866	205	2	0	+480	-4025

Month &amp; Year: December 1944

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2498	2396	0	2	0	0	-100
Clerk, Equipment Accounting (WAAF)	2407	2325	0	0	0	0	-82
Clerk, Provisioning (RAF)	1269	833	0	0	0	0	-436
Clerk, Provisioning (WAAF)	1343	1210	0	0	0	0	-133
Clerk GD (Movements Control) (RAF)	Nil	437	0	0	0	0	+437
Clerk GD (Movements Control) (WAAF)	Nil	32	0	0	0	0	+32
Embarkation Assistant (RAF)	2140	1419	0	0	0	+134	-721
Equipment Assistant (RAF)	23577	19436	205	0	0	+1019	-3936
Equip Assistant (WAAF)	6677	8076	0	0	0	0	+1399
Total / Net	39911	36164	205	2	0	+1153	-3540

## Month &amp; Year: January 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians <sup>2</sup>	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2450	2386	0	0	0	0	-64
Clerk, Equipment Accounting (WAAF)	2513	2287	0	0	0	0	-226
Clerk, Provisioning (RAF)	1124	876	0	0	0	0	-248
Clerk, Provisioning (WAAF)	1493	1217	0	0	0	0	-276
Clerk GD (Movements Control) (RAF)	Nil	437	0	0	0	0	+437
Clerk GD (Movements Control) (WAAF)	Nil	32	0	0	0	0	-32
Embarkation Assistant (RAF)	2220	1565	0	0	0	+150	-655
Equipment Assistant (RAF)	23583	19521	0	0	203	+1306	-3859
Equip Assistant (WAAF)	7063	7985	0	0	0	0	+922
Total / Net	40446	36306	0	0	203	+1456	-2545

## Month &amp; Year: February 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2430	2367	0	0	0	0	-63
Clerk, Equipment Accounting (WAAF)	2446	2271	0	0	0	0	-175
Clerk, Provisioning (RAF)	1110	895	0	0	0	0	-215
Clerk, Provisioning (WAAF)	1494	1204	0	0	0	0	-290
Clerk GD (Movements Control) (RAF)	Nil	438	0	0	0	0	+438
Clerk GD (Movements Control) (WAAF)	Nil	34	0	0	0	0	+34
Embarkation Assistant (RAF)	2161	1673	0	0	0	+130	-488
Equipment Assistant (RAF)	23374	19616	0	0	205	+1333	-3553
Equip Assistant (WAAF)	7074	7892	0	0	0	0	+818
Total / Net	40089	36390	0	0	205	+1463	-3494

<sup>2</sup> Used to include civilians borne against military establishment and Civilian Technical Corps as one figure from January to September 1945 only.

Month &amp; Year: March 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2426	2357	0	0	0	0	-69
Clerk, Equipment Accounting (WAAF)	2264	2255	0	0	0	0	-9
Clerk, Provisioning (RAF)	1172	920	0	0	0	0	-252
Clerk, Provisioning (WAAF)	1457	1203	0	0	0	0	-254
Clerk GD (Movements Control) (RAF)	Nil	439	0	0	0	0	+439
Clerk GD (Movements Control) (WAAF)	Nil	35	0	0	0	0	+35
Embarkation Assistant (RAF)	2265	1766	0	0	0	+121	-499
Equipment Assistant (RAF)	23258	19558	0	0	186	+1562	-3514
Equip Assistant (WAAF)	6996	7784	0	0	0	+7	+788
Total / Net	39838	36317	0	0	186	+1690	-3335

Month &amp; Year: April 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2538	2340	0	0	6	0	-192
Clerk, Equipment Accounting (WAAF)	2251	2229	0	0	0	0	-22
Clerk, Provisioning (RAF)	1047	991	0	0	0	0	-56
Clerk, Provisioning (WAAF)	1495	1201	0	0	0	0	-294
Clerk GD (Movements Control) (RAF)	Nil	442	0	0	0	0	+442
Clerk GD (Movements Control) (WAAF)	Nil	34	0	0	0	0	+34
Embarkation Assistant (RAF)	2279	1990	0	0	0	+46	-289
Equipment Assistant (RAF)	22725	19709	0	0	90	+1398	-2926
Equip Assistant (WAAF)	7078	7667	0	0	0	+8	+589
Total / Net	39413	36603	0	0	96	+1452	2714

Month &amp; Year: May 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2481	2323	0	0	5	0	-153
Clerk, Equipment Accounting (WAAF)	2181	2195	0	0	0	0	+14
Clerk, Provisioning (RAF)	1095	1020	0	0	0	+1	-75
Clerk, Provisioning (WAAF)	1526	1194	0	0	0	0	-332
Clerk GD (Movements Control) (RAF)	Nil	446	0	0	0	0	+446
Clerk GD (Movements Control) (WAAF)	Nil	34	0	0	0	0	+34
Embarkation Assistant (RAF)	2165	2083	0	0	1	+79	-81
Equipment Assistant (RAF)	22856	19828	0	0	228	+1291	-2800
Equip Assistant (WAAF)	7050	7555	0	0	0	+6	+505
Total / Net	39354	36678	0	0	234	+1377	2442

Month &amp; Year: June 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2447	2304	0	0	0	0	-143
Clerk, Equipment Accounting (WAAF)	2173	2181	0	0	0	0	+8
Clerk, Provisioning (RAF)	1101	1068	0	0	0	+2	-33
Clerk, Provisioning (WAAF)	1570	1183	0	0	0	0	-387
Clerk GD (Movements Control) (RAF)	Nil	443	0	0	0	+1	+443
Clerk GD (Movements Control) (WAAF)	Nil	34	0	0	0	0	+34
Embarkation Assistant (RAF)	2184	2181	0	0	1	+86	-2
Equipment Assistant (RAF)	22915	19941	0	0	200	+1070	-2774
Equip Assistant (WAAF)	7112	7469	0	0	0	+5	+357
Total / Net	39502	36804	0	0	201	+1164	-2497

Month &amp; Year: July 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2415	2282	0	0	1	0	-132
Clerk, Equipment Accounting (WAAF)	2137	2152	0	0	0	0	+15
Clerk, Provisioning (RAF)	1120	1075	0	0	0	+4	-45
Clerk, Provisioning (WAAF)	1687	1167	0	0	0	0	-520
Clerk GD (Movements Control) (RAF)	Nil	429	0	0	0	+1	+429
Clerk GD (Movements Control) (WAAF)	Nil	34	0	0	0	0	+34
Embarkation Assistant (RAF)	2259	2240	0	0	1	+81	+18
Equipment Assistant (RAF)	24053	19814	0	0	209	+1118	-4030
Equip Assistant (WAAF)	6993	7339	0	0	0	+2	+346
Total / Net	40664	36532	0	0	211	+1206	-3921

Month &amp; Year: August 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2485	2253	0	0	0	0	-232
Clerk, Equipment Accounting (WAAF)	2124	2109	0	0	0	0	-15
Clerk, Provisioning (RAF)	1148	1177	0	0	0	+11	+29
Clerk, Provisioning (WAAF)	1867	1156	0	0	0	0	-711
Clerk GD (Movements Control) (RAF)	Nil	422	0	0	0	0	+422
Clerk GD (Movements Control) (WAAF)	Nil	34	0	0	0	0	+34
Embarkation Assistant (RAF)	2197	2300	0	0	0	+82	+103
Equipment Assistant (RAF)	24098	19789	0	0	203	+1284	-4106
Equip Assistant (WAAF)	6970	7106	0	0	0	+2	+136
Total / Net	40889	36346	0	0	203	+1379	-4340

Month &amp; Year: September 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2431	2285	0	0	0	0	-146
Clerk, Equipment Accounting (WAAF)	2095	2080	0	0	0	0	-15
Clerk, Provisioning (RAF)	1095	1209	0	0	1	+62	+115
Clerk, Provisioning (WAAF)	1930	1047	0	0	0	+102	-883
Clerk GD (Movements Control) (RAF)	Nil	371	0	0	0	0	+371
Clerk GD (Movements Control) (WAAF)	Nil	28	0	0	0	0	+28
Embarkation Assistant (RAF)	2206	2302	0	0	0	+91	+96
Equipment Assistant (RAF)	24008	19688	0	0	0	+1365	-4320
Equip Assistant (WAAF)	6855	6363	0	0	177	0	-315
Total / Net	40620	35373	0	0	178	+1620	-5069

Month &amp; Year: October 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2308	2378	0	0	2	0	+72
Clerk, Equipment Accounting (WAAF)	2088	2012	0	0	0	0	-76
Clerk, Provisioning (RAF)	974	1269	0	0	0	+65	+295
Clerk, Provisioning (WAAF)	1817	976	0	0	0	+55	-841
Clerk GD (Movements Control) (RAF)	2	353	0	0	0	0	+351
Clerk GD (Movements Control) (WAAF)	Nil	31	0	0	0	0	+31
Embarkation Assistant (RAF)	2166	2227	0	0	0	+83	+61
Equipment Assistant (RAF)	23350	20191	0	0	181	+1190	-2978
Equip Assistant (WAAF)	6750	5621	0	0	0	+15	-1129
Total / Net	39455	35058	0	0	183	+1408	-4214

Month &amp; Year: November 1945

Trade	Requirement	Trained Strength	Civilians Borne Against Military Establishment	Civilian Technical Corps	Civilians	Transfers In From Other Trades	Surplus/Deficiency (before transfers in)
Clerk, Equipment Accounting (RAF)	2214	2531	0	0	0	0	+317
Clerk, Equipment Accounting (WAAF)	1997	1867	0	0	0	0	-130
Clerk, Provisioning (RAF)	953	1233	0	0	0	+64	+280
Clerk, Provisioning (WAAF)	1743	932	0	0	0	+69	-811
Clerk GD (Movements Control) (RAF)	2	338	0	0	0	0	+336
Clerk GD (Movements Control) (WAAF)	Nil	29	0	0	0	0	+29
Embarkation Assistant (RAF)	2166	2052	0	0	0	+67	-114
Embarkation Assistant (WAAF)	0	4	0	0	0	0	+4
Equipment Assistant (RAF)	22786	20702	0	0	224	+1359	-1860
Equip Assistant (WAAF)	6585	5353	0	0	0	+37	-1232
Total / Net	38446	35041	0	0	224	+1596	-3181

### Appendix 3 - Non-Commissioned Dominion and Allied/Foreign Personnel in RAF Logistics Trades: November 1941- November 1945<sup>1</sup>

Month & Year: November 1941

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	201	34	-167
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	33	3	-30
Allied - Equipment Assistant (Male)	80	49	-31
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	14	1	-13
Total/Net	328	87	-241

Month & Year: December 1941

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	112	58	-54
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	20	12	-8
Allied - Equipment Assistant (Male)	69	50	-19
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	8	3	-5
Total/Net	209	123	-86

Month & Year: January 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	121	68	-53
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	22	14	8
Allied - Equipment Assistant (Male)	71	50	-21
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	7	2	-5
Total/Net	221	134	-87

Month & Year: February 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	121	68	-53
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	22	14	-8
Allied - Equipment Assistant (Male)	71	50	-21
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	7	2	-5
Total/Net	221	134	-87

<sup>1</sup> Source: TNA, AIR 22/315: Comparative Statements of Establishments and Strength R.A.F. Personnel June 1941 – January 1944 and AIR 22/316 – Comparative Statements of Establishments and Strength R.A.F Personnel June 1944 – January 1946.

Month &amp; Year: March 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	124	69	-55
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	22	14	-8
Allied - Equipment Assistant (Male)	70	39	-31
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	7	2	-5
Total/Net	223	124	-99

Month &amp; Year: April 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	134	171	+37
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	39	14	-25
Allied - Equipment Assistant (Male)	80	49	-31
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	7	2	-5
Total/Net	260	236	-24

Month &amp; Year: May 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	132	168	+36
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	22	14	-8
Allied - Equipment Assistant (Male)	64	48	-16
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	33	5	-28
Total/Net	251	235	-16

Month &amp; Year: June 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	129	168	+39
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	23	14	-9
Allied - Equipment Assistant (Male)	89	44	-45
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	7	3	-4
Total/Net	248	229	-19

Month &amp; Year: July 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	154	168	+14
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	23	14	-9
Allied - Equipment Assistant (Male)	94	36	-58
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	9	1	-8
Total/Net	280	219	-61

Month &amp; Year: August 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	165	165	0
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	27	14	-13
Allied - Equipment Assistant (Male)	100	38	-62
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	12	1	-11
Total/Net	304	218	-86

Month &amp; Year: September 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	166	157	-9
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	27	14	-13
Allied - Equipment Assistant (Male)	105	66	-39
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	20	1	-19
Total/Net	318	238	-80

Month &amp; Year: October 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	172	159	-13
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	28	14	-14
Allied - Equipment Assistant (Male)	100	65	-35
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	12	1	-11
Total/Net	312	239	-73

Month &amp; Year: November 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	173	154	-19
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	25	84	+59
Allied - Equipment Assistant (Male)	86	64	-22
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	11	1	-10
Total/Net	295	303	+8

Month &amp; Year: December 1942

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	177	179	+2
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	16	12	-4
Allied - Equipment Assistant (Male)	77	56	-21
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	5	1	-4
Total/Net	275	248	-27

Month &amp; Year: January 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	213	246	+33
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	17	12	-5
Allied - Equipment Assistant (Male)	85	58	-27
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	7	1	-6
Total/Net	322	317	-5

Month &amp; Year: February 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	222	258	+36
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	18	12	-6
Allied - Equipment Assistant (Male)	76	73	-3
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	7	1	-6
Total/Net	323	344	+21

Month & Year: March 1943 (figures not recorded)

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	-	-	-
Dominion - Equipment Assistant (Female)	-	-	-
Dominion - Clerk, Equipment Accounting (Male)	-	-	-
Allied - Equipment Assistant (Male)	-	-	-
Allied - Equipment Assistant (Female)	-	-	-
Allied - Clerk, Equipment Accounting (Male)	-	-	-
Total/Net	-	-	-

Month & Year: April 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	261	283	+22
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	20	12	-8
Allied - Equipment Assistant (Male)	137	91	-46
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	7	1	-6
Total/Net	425	387	-38

Month & Year: May 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	409	309	-100
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	17	12	-5
Allied - Equipment Assistant (Male)	132	93	-39
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	6	1	-5
Total/Net	564	415	-149

Month & Year: June 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	487	310	-177
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	20	12	-8
Allied - Equipment Assistant (Male)	141	112	-29
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	6	1	-5
Total/Net	654	435	-219

Month &amp; Year: July 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	483	306	-177
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	24	13	-11
Allied - Equipment Assistant (Male)	163	109	-54
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	11	14	+3
Total/Net	681	442	239

Month &amp; Year: August 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	517	302	-215
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	17	13	-4
Allied - Equipment Assistant (Male)	194	132	-62
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	14	3	-11
Total/Net	742	450	-292

Month &amp; Year: September 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	540	307	-233
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	24	13	-11
Allied - Equipment Assistant (Male)	177	111	-66
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	13	3	-10
Total/Net	754	434	-320

Month &amp; Year: October 1943 (figures not recorded)

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	-	-	-
Dominion - Equipment Assistant (Female)	-	-	-
Dominion - Clerk, Equipment Accounting (Male)	-	-	-
Allied - Equipment Assistant (Male)	-	-	-
Allied - Equipment Assistant (Female)	-	-	-
Allied - Clerk, Equipment Accounting (Male)	-	-	-
Total/Net	-	-	-

Month &amp; Year: November 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	790	314	-476
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	42	13	-29
Allied - Equipment Assistant (Male)	343	137	-206
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting	35	6	-29
Total/Net	1210	470	-740

Month &amp; Year: December 1943

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	860	314	-546
Dominion - Equipment Assistant (Female)	0	0	0
Dominion - Clerk, Equipment Accounting (Male)	46	13	-33
Allied - Equipment Assistant (Male)	320	144	-176
Allied - Equipment Assistant (Female)	0	0	0
Allied - Clerk, Equipment Accounting (Male)	25	5	-20
Total/Net	1251	476	-775

Month &amp; Year: January 1944 (Allied becomes shown as Foreign from Jan 1944 onwards)

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	1101	332	-769
Dominion - Equipment Assistant (Female)	184	5	-179
Dominion - Clerk, Equipment Accounting (Male)	46	13	-33
Dominion - Clerk, Equipment Accounting (Female)	60	0	-60
Foreign - Equipment Assistant (Male)	320	141	-179
Foreign - Equipment Assistant (Female)	10	0	-10
Foreign - Clerk, Equipment Accounting (Male)	25	4	-21
Foreign - Clerk, Equipment Accounting (Female)	0	0	0
Total/Net	1746	495	-1251

Month &amp; Year: February 1944 (Majority of figures missing for February)

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	-	-	-
Dominion - Equipment Assistant (Female)	-	-	-
Dominion - Clerk, Equipment Accounting (Male)	-	13	-
Dominion - Clerk, Equipment Accounting (Female)	-	0	-
Foreign - Equipment Assistant (Male)	-	-	-
Foreign - Equipment Assistant (Female)	-	-	-
Foreign - Clerk, Equipment Accounting (Male)	-	1	-
Foreign - Clerk, Equipment Accounting (Female)	-	0	-
Total/Net	-	14	-

Month &amp; Year: March 1944

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	1013	436	-577
Dominion - Equipment Assistant (Female)	189	14	-175
Dominion - Clerk, Equipment Accounting (Male)	53	13	-40
Dominion - Clerk, Equipment Accounting (Female)	64	0	-64
Foreign - Equipment Assistant (Male)	-	-	-
Foreign - Equipment Assistant (Female)	-	-	-
Foreign - Clerk, Equipment Accounting (Male)	-	-	-
Foreign - Clerk, Equipment Accounting (Female)	-	-	-
<b>Total/Net</b>	<b>1319</b>	<b>463</b>	<b>-856</b>

Month &amp; Year: April 1944

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	292	187	-105
Dominion - Equipment Assistant (Female)	3	0	-3
Dominion - Clerk, Equipment Accounting (Male)	11	2	-9
Dominion - Clerk, Equipment Accounting (Female)	1	0	-1
Foreign - Equipment Assistant (Male)	-	-	-
Foreign - Equipment Assistant (Female)	-	-	-
Foreign - Clerk, Equipment Accounting (Male)	-	-	-
Foreign - Clerk, Equipment Accounting (Female)	-	-	-
<b>Total/Net</b>	<b>307</b>	<b>189</b>	<b>-118</b>

Month &amp; Year: May 1944

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	1008	440	-568
Dominion - Equipment Assistant (Female)	187	16	-171
Dominion - Clerk, Equipment Accounting (Male)	51	13	-38
Dominion - Clerk, Equipment Accounting (Female)	63	0	-63
Foreign - Equipment Assistant (Male)	288	186	-102
Foreign - Equipment Assistant (Female)	3	0	-3
Foreign - Clerk, Equipment Accounting (Male)	30	50	+20
Foreign - Clerk, Equipment Accounting (Female)	0	0	0
<b>Total/Net</b>	<b>1630</b>	<b>705</b>	<b>-925</b>

Month &amp; Year: June 1944

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	-	-	-
Dominion - Equipment Assistant (Female)	-	-	-
Dominion - Clerk, Equipment Accounting (Male)	60	12	-48
Dominion - Clerk, Equipment Accounting (Female)	63	0	-63
Foreign - Equipment Assistant (Male)	281	182	-99
Foreign - Equipment Assistant (Female)	12	0	-12
Foreign - Clerk, Equipment Accounting (Male)	10	3	-7
Foreign - Clerk, Equipment Accounting (Female)	3	0	-3
<b>Total/Net</b>	<b>429</b>	<b>197</b>	<b>-232</b>

Month &amp; Year: July 1944

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	1080	450	-630
Dominion - Equipment Assistant (Female)	187	14	-173
Dominion - Clerk, Equipment Accounting (Male)	84	11	-73
Dominion - Clerk, Equipment Accounting (Female)	63	0	-63
Foreign - Equipment Assistant (Male)	281	200	-81
Foreign - Equipment Assistant (Female)	12	5	-7
Foreign - Clerk, Equipment Accounting (Male)	10	3	-7
Foreign - Clerk, Equipment Accounting (Female)	3	0	-3
<b>Total/Net</b>	<b>1720</b>	<b>683</b>	<b>1037</b>

Month &amp; Year: August 1944

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	939	448	-491
Dominion - Equipment Assistant (Female)	204	14	-190
Dominion - Clerk, Equipment Accounting (Male)	63	11	-52
Dominion - Clerk, Equipment Accounting (Female)	60	0	-60
Foreign - Equipment Assistant (Male)	292	203	-89
Foreign - Equipment Assistant (Female)	22	18	-4
Foreign - Clerk, Equipment Accounting (Male)	16	3	-13
Foreign - Clerk, Equipment Accounting (Female)	4	0	-4
<b>Total/Net</b>	<b>1600</b>	<b>697</b>	<b>903</b>

Month &amp; Year: September 1944

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	1048	454	-594
Dominion - Equipment Assistant (Female)	207	18	-189
Dominion - Clerk, Equipment Accounting (Male)	63	11	-52
Dominion - Clerk, Equipment Accounting (Female)	64	0	-64
Foreign - Equipment Assistant (Male)	300	204	-96
Foreign - Equipment Assistant (Female)	24	18	-6
Foreign - Clerk, Equipment Accounting (Male)	19	3	-16
Foreign - Clerk, Equipment Accounting (Female)	4	0	-4
Total/Net	1729	708	1021

Month &amp; Year: October 1944

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	-	205	-
Dominion - Equipment Assistant (Female)	-	18	-
Dominion - Clerk, Equipment Accounting (Male)	-	3	-
Dominion - Clerk, Equipment Accounting (Female)	-	-	-
Foreign - Equipment Assistant (Male)	-	462	-
Foreign - Equipment Assistant (Female)	-	17	-
Foreign - Clerk, Equipment Accounting (Male)	-	11	-
Foreign - Clerk, Equipment Accounting (Female)	-	-	-
Total/Net		716	

Month &amp; Year: November 1944

Trade	Establishment	Trained Strength	Surplus/ Deficiency
Dominion - Equipment Assistant (Male)	427	494	+67
Dominion - Equipment Assistant (Female)	130	17	-113
Dominion - Clerk, Equipment Accounting (Male)	41	10	-31
Dominion - Clerk, Equipment Accounting (Female)	50	0	-50
Foreign - Equipment Assistant (Male)	272	202	-70
Foreign - Equipment Assistant (Female)	25	18	-7
Foreign - Clerk, Equipment Accounting (Male)	17	3	-14
Foreign - Clerk, Equipment Accounting (Female)	4	0	-4
Total/Net	966	744	-222

Month &amp; Year: December 1944

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	441	499	+58
Dominion - Equipment Assistant (Female)	135	16	-119
Dominion - Clerk, Equipment Accounting (Male)	41	10	-31
Dominion - Clerk, Equipment Accounting (Female)	49	0	-49
Foreign - Equipment Assistant (Male)	265	200	-65
Foreign - Equipment Assistant (Female)	33	18	-15
Foreign - Clerk, Equipment Accounting (Male)	17	3	-14
Foreign - Clerk, Equipment Accounting (Female)	4	0	-4
<b>Total/Net</b>	<b>985</b>	<b>746</b>	<b>-239</b>

Month &amp; Year: January 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	426	487	+61
Dominion - Equipment Assistant (Female)	135	25	-110
Dominion - Clerk, Equipment Accounting (Male)	42	10	-32
Dominion - Clerk, Equipment Accounting (Female)	49	0	-49
Foreign - Equipment Assistant (Male)	319	201	-118
Foreign - Equipment Assistant (Female)	38	18	-20
Foreign - Clerk, Equipment Accounting (Male)	17	3	-14
Foreign - Clerk, Equipment Accounting (Female)	6	0	-6
<b>Total/Net</b>	<b>1032</b>	<b>744</b>	<b>-288</b>

Month &amp; Year: February 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	426	472	+46
Dominion - Equipment Assistant (Female)	135	25	-110
Dominion - Clerk, Equipment Accounting (Male)	42	10	-32
Dominion - Clerk, Equipment Accounting (Female)	49	0	-49
Foreign - Equipment Assistant (Male)	330	206	-124
Foreign - Equipment Assistant (Female)	38	18	-20
Foreign - Clerk, Equipment Accounting (Male)	17	3	-14
Foreign - Clerk, Equipment Accounting (Female)	6	0	-6
<b>Total/Net</b>	<b>1043</b>	<b>734</b>	<b>-309</b>

Month &amp; Year: March 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	-	483	-
Dominion - Equipment Assistant (Female)	-	25	-
Dominion - Clerk, Equipment Accounting (Male)	-	10	-
Dominion - Clerk, Equipment Accounting (Female)	-	0	-
Foreign - Equipment Assistant (Male)	-	213	-
Foreign - Equipment Assistant (Female)	-	15	-
Foreign - Clerk, Equipment Accounting (Male)	-	4	-
Foreign - Clerk, Equipment Accounting (Female)	-	0	-
Total/Net		750	

Month &amp; Year: April 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	455	480	+25
Dominion - Equipment Assistant (Female)	143	22	-121
Dominion - Clerk, Equipment Accounting (Male)	48	10	-38
Dominion - Clerk, Equipment Accounting (Female)	56	0	-56
Foreign - Equipment Assistant (Male)	329	211	-118
Foreign - Equipment Assistant (Female)	40	15	-25
Foreign - Clerk, Equipment Accounting (Male)	21	3	-18
Foreign - Clerk, Equipment Accounting (Female)	6	1	-5
Total/Net	1098	742	-356

Month &amp; Year: May 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	452	537	+85
Dominion - Equipment Assistant (Female)	140	20	-120
Dominion - Clerk, Equipment Accounting (Male)	45	10	-35
Dominion - Clerk, Equipment Accounting (Female)	56	0	-56
Foreign - Equipment Assistant (Male)	335	212	-123
Foreign - Equipment Assistant (Female)	39	17	-22
Foreign - Clerk, Equipment Accounting (Male)	21	3	-18
Foreign - Clerk, Equipment Accounting (Female)	6	0	-6
Total/Net	1094	799	-295

Month &amp; Year: June 1945 (no figures shown)

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	-	-	-
Dominion - Equipment Assistant (Female)	-	-	-
Dominion - Clerk, Equipment Accounting (Male)	-	-	-
Dominion - Clerk, Equipment Accounting (Female)	-	-	-
Foreign - Equipment Assistant (Male)	-	-	-
Foreign - Equipment Assistant (Female)	-	-	-
Foreign - Clerk, Equipment Accounting (Male)	-	-	-
Foreign - Clerk, Equipment Accounting (Female)	-	-	-
Total/Net	-	-	-

Month &amp; Year: July 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	498	586	+88
Dominion - Equipment Assistant (Female)	110	16	-94
Dominion - Clerk, Equipment Accounting (Male)	56	22	-34
Dominion - Clerk, Equipment Accounting (Female)	46	0	-46
Foreign - Equipment Assistant (Male)	346	207	-139
Foreign - Equipment Assistant (Female)	48	18	-30
Foreign - Clerk, Equipment Accounting (Male)	32	1	-31
Foreign - Clerk, Equipment Accounting (Female)	8	0	-8
Total/Net	1144	850	-294

Month &amp; Year: August 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	446	524	+78
Dominion - Equipment Assistant (Female)	85	16	-69
Dominion - Clerk, Equipment Accounting (Male)	50	9	-41
Dominion - Clerk, Equipment Accounting (Female)	38	0	-38
Foreign - Equipment Assistant (Male)	345	205	-140
Foreign - Equipment Assistant (Female)	48	23	-25
Foreign - Clerk, Equipment Accounting (Male)	31	1	-30
Foreign - Clerk, Equipment Accounting (Female)	8	0	-8
Total/Net	1051	778	-273

Month &amp; Year: September 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	438	474	+36
Dominion - Equipment Assistant (Female)	80	15	-65
Dominion - Clerk, Equipment Accounting (Male)	49	9	-40
Dominion - Clerk, Equipment Accounting (Female)	37	0	-37
Foreign - Equipment Assistant (Male)	364	205	-159
Foreign - Equipment Assistant (Female)	53	24	-29
Foreign - Clerk, Equipment Accounting (Male)	32	1	-31
Foreign - Clerk, Equipment Accounting (Female)	11	0	-11
<b>Total/Net</b>	<b>1064</b>	<b>728</b>	<b>-336</b>

Month &amp; Year: October 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	367	467	+100
Dominion - Equipment Assistant (Female)	66	15	-51
Dominion - Clerk, Equipment Accounting (Male)	38	9	-29
Dominion - Clerk, Equipment Accounting (Female)	37	0	-37
Foreign - Equipment Assistant (Male)	361	208	-153
Foreign - Equipment Assistant (Female)	53	24	-29
Foreign - Clerk, Equipment Accounting (Male)	32	1	-31
Foreign - Clerk, Equipment Accounting (Female)	11	0	-11
<b>Total/Net</b>	<b>965</b>	<b>724</b>	<b>-241</b>

Month &amp; Year: November 1945

<b>Trade</b>	<b>Establishment</b>	<b>Trained Strength</b>	<b>Surplus/ Deficiency</b>
Dominion - Equipment Assistant (Male)	313	460	+147
Dominion - Equipment Assistant (Female)	47	13	-34
Dominion - Clerk, Equipment Accounting (Male)	38	9	-29
Dominion - Clerk, Equipment Accounting (Female)	26	0	-26
Foreign - Equipment Assistant (Male)	341	197	-144
Foreign - Equipment Assistant (Female)	54	35	-19
Foreign - Clerk, Equipment Accounting (Male)	30	0	-30
Foreign - Clerk, Equipment Accounting (Female)	10	0	-10
<b>Total/Net</b>	<b>859</b>	<b>714</b>	<b>-145</b>

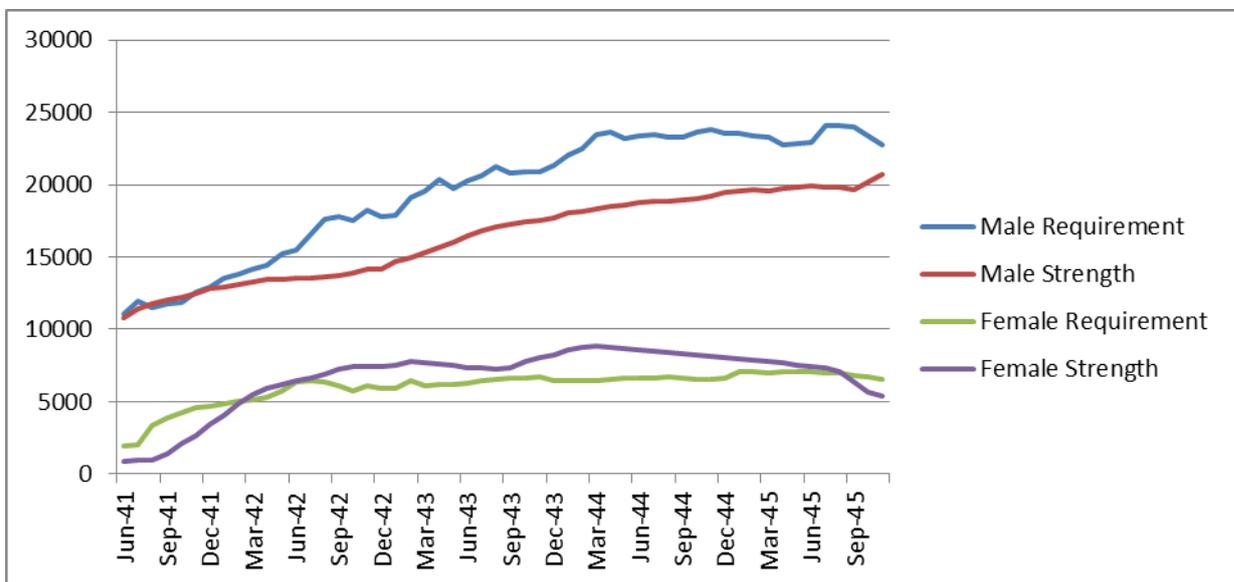
## Appendix 4 - RAF Equipment Assistant Trade Shortfall Resolution: June 1941 to November 1945<sup>2</sup>

Date	Male Shortfall	Female Surplus	Dominion	Allied	Transfers	Net Result	% Reduction
Jun-41	268	0	0	0	0	268	0
Jul-41	542	0	0	0	0	542	0
Nov-41	0	0	34	49	0	-83	0
Dec-41	0	0	58	50	0	-108	0
Jan-42	473	0	68	50	0	355	25
Feb-42	520	0	68	50	0	402	23
Mar-42	780	347	69	39	0	325	58
Apr-42	879	583	171	49	0	76	91
May-42	1701	401	0	0	0	1300	24
Jun-42	1797	84	0	0	0	1713	5
Jul-42	2819	187	0	0	0	2632	7
Aug-42	3832	521	0	0	0	3311	14
Sep-42	3966	1185	0	0	0	2781	30
Oct-42	3500	1654	0	0	0	1846	47
Nov-42	3846	1367	34	49	0	2396	38
Dec-42	3383	1536	58	50	0	1739	49
Jan-43	3035	1582	68	50	0	1335	56
Feb-43	4054	1258	68	50	0	2678	34
Mar-43	4132	1618	69	39	0	2406	42
Apr-43	4563	1438	171	49	0	2905	36
May-43	3595	1315	34	49	0	2197	39
Jun-43	3724	1115	58	50	0	2501	33
Jul-43	3582	846	68	50	0	2618	27
Aug-43	4053	749	68	50	0	3186	21
Sep-43	3341	774	69	39	0	2459	26
Oct-43	3283	1065	171	49	0	1998	39
Nov-43	3222	1356	34	49	0	1783	45
Dec-43	3464	1777	58	50	0	1579	54
Jan-44	3811	2125	68	50	0	1568	59
Feb-44	4164	2332	68	50	0	1714	59
Mar-44	4943	2354	69	39	0	2481	50
Apr-44	5068	2195	171	49	0	2653	48
May-44	4426	2073	34	49	0	2270	49
Jun-44	4495	1909	58	50	0	2478	45
Jul-44	4511	1811	68	50	0	2582	43
Aug-44	4266	1674	68	50	0	2474	42
Sep-44	4164	1689	69	39	0	2367	43
Oct-44	4529	1690	171	49	0	2619	42
Nov-44	4336	1625	34	49	329	2299	47
Dec-44	3936	1399	58	50	1019	1410	64
Jan-45	3859	922	68	50	1306	1513	61
Feb-45	3553	818	68	50	1333	1284	64
Mar-45	3514	788	69	39	1562	1056	70
Apr-45	2926	589	171	49	1398	719	75
May-45	2800	505	34	49	1291	921	67

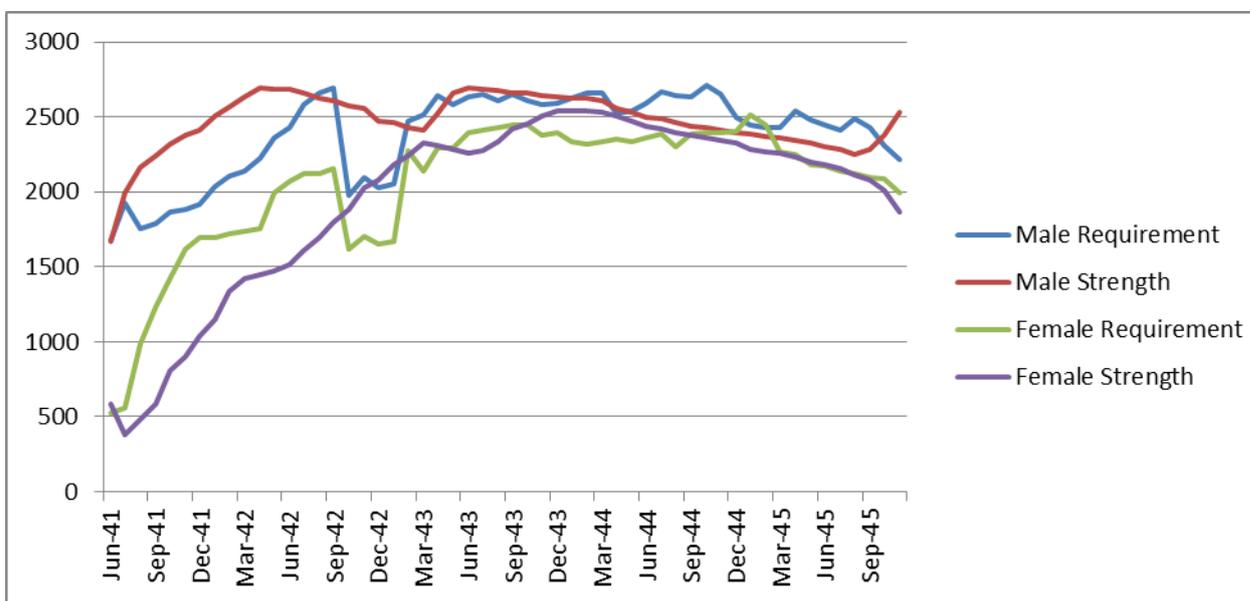
<sup>2</sup> Source: Data taken from Appendix 2 and 3.

<b>Date</b>	<b>Male Shortfall</b>	<b>Female Surplus</b>	<b>Dominion</b>	<b>Allied</b>	<b>Transfers</b>	<b>Net Result</b>	<b>% Reduction</b>
Jun-45	2774	357	58	50	1070	1239	55
Jul-45	4030	346	68	50	1118	2448	39
Aug-45	4106	136	68	50	1284	2568	37
Sep-45	4320	0	69	39	1365	2847	34
Oct-45	2978	0	171	49	1190	1568	47
Nov-45	1860	0	171	49	1359	281	85

### Appendix 5 - Trained Strength and Requirement Comparisons for the Five Logistics Trades (Male and Female): June 1941 to October 1945<sup>1</sup>

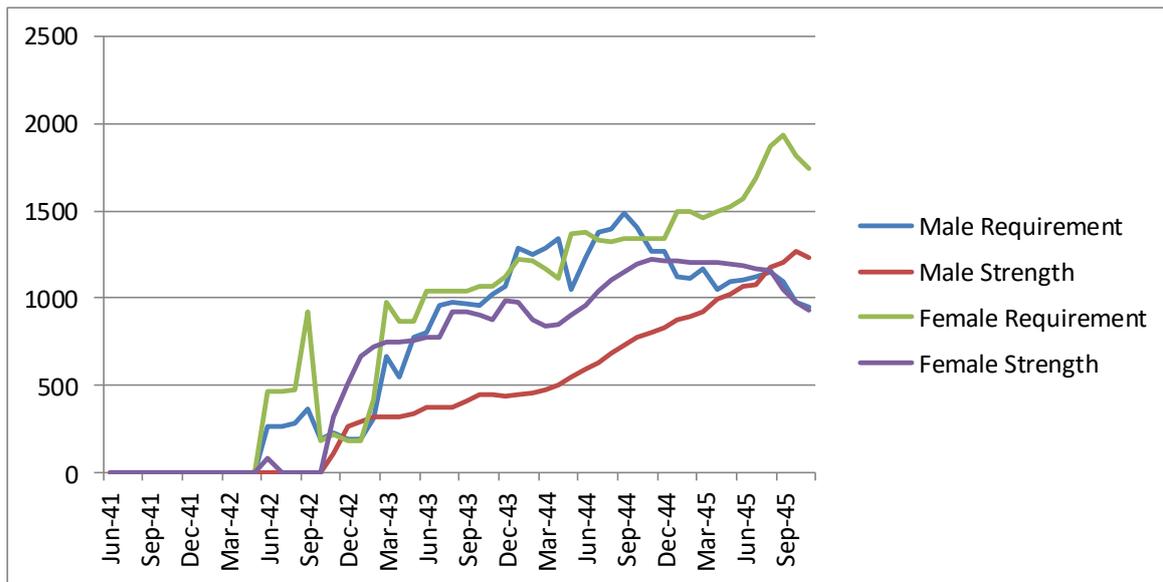


Equipment Assistant

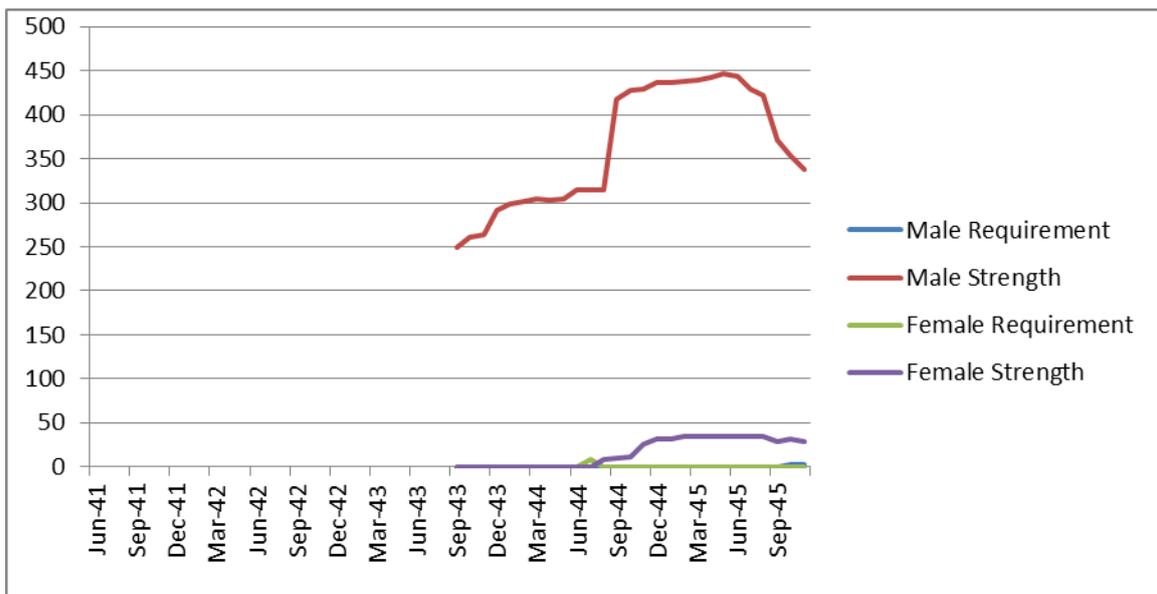


Clerk (Equipment Accounting)

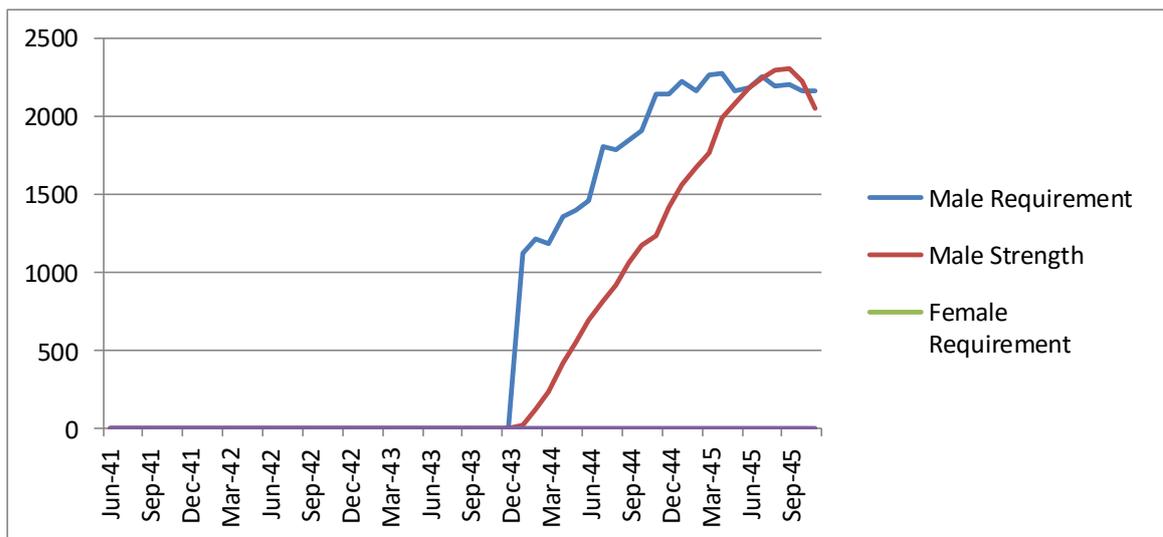
<sup>1</sup> Source: Data taken from Appendix 2 and 3.



Clerk (Provisioning)



Clerk (General Duties) (Movements Control)



Embarkation Assistant

Appendix 6 - Operational (Op) Expired Aircrew and Aircrew Cadets Serving in Equipment Trades:  
January 1945 – September 1945<sup>1</sup>

Trade	January 1945		February 1945		March 1945		April 1945		May 1945		June 1945	
	Op Expired Aircrew	Aircrew Cadets										
Clerk GD Mov Control	1	0	1	0	1	0	1	0	1	0	1	0
Clerk, Provisioning	1	0	2	0	8	0	9	0	13	0	21	0
Embarkation Assistant	19	0	42	0	49	0	83	0	90	0	89	0
Equipment Assistant	10	625	85	413	130	668	140	418	154	301	164	83
<b>Totals</b>	<b>31</b>	<b>625</b>	<b>130</b>	<b>413</b>	<b>188</b>	<b>668</b>	<b>233</b>	<b>418</b>	<b>258</b>	<b>301</b>	<b>275</b>	<b>83</b>

Trade	July 1945		August 1945		September 1945	
	Op Expired Aircrew	Aircrew Cadets	Op Expired Aircrew	Aircrew Cadets	Op Expired Aircrew	Aircrew Cadets
Clerk GD Mov Control	1	0	1	0	0	0
Clerk, Provisioning	21	0	22	0	22	0
Embarkation Assistant	84	0	86	0	86	0
Equipment Assistant	166	82	163	73	230	0
<b>Totals</b>	<b>272</b>	<b>82</b>	<b>272</b>	<b>73</b>	<b>338</b>	<b>0</b>

Note: Figures include personnel under training and those actually employed in the trade shown.

<sup>1</sup> TNA, AIR 22/316: Comparative Statements of Establishments and Strength R.A.F. Personnel June 1944 – January 1946.

### Appendix 7 - Equipment Training School (Airmen) – RAF Equipment Assistant Training Course Data: 1941 to 1942<sup>1</sup>

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
251/252	13.3.41	1.5.41	185	47	25	138	121	17	88
253/254	24.3.41	8.5.41	146	29	20	117	104	13	89
255/256	31.3.41	15.5.41	161	21	13	140	114	26	81
257/258	4.4.41	22.5.41	173	36	21	137	112	25	82
259/260	11.4.41	29.5.41	120	0	0	120	113	7	94
261/262	Not Known	6.41	150	25	17	113	101	12	89
263/264	Not Known	6.41	150	26	17	106	94	12	89
265/266	Not Known	6.41	161	31	19	114	108	6	95
267/268	Not Known	6.41	157	31	20	105	104	11	99
269/270	16.5.41	3.7.41	159	0	0	147	90	57	61
271/272	23.5.41	10.7.41	142	0	0	138	103	35	75
273/274	30.5.41	17.7.41	81	0	0	80	55	25	69
275/276	6.6.41	24.7.41	169	0	0	146	99	47	68
277/278	13.6.41	31.7.41	139	0	0	131	96	35	73
279/280	20.6.41	7.8.41	36	0	0	34	20	14	59
281/282	27.6.41	14.8.41	86	12	14	74	61	13	82
283/284	4.7.41	21.8.41	101	14	14	80	68	12	85
285/286	11.7.41	28.8.41	92	17	18	64	64	0	100
287/288	18.7.41	4.9.41	150	30	20	117	95	22	81
289/290	25.7.41	11.9.41	112	19	17	91	76	15	84

<sup>1</sup> Source: TNA, AIR 29/711, Equipment Training School (Airmen) formerly School of Store Accounting and Store-keeping: Operations Record Book (RAF Form 540).

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
291/292	2.8.41	18.9.41	134	12	9	110	103	7	94
293/294	9.8.41	25.9.41	78	14	18	52	47	5	90
295/296	16.8.41	2.10.41	91	15	16	76	67	9	88
297/298	23.8.41	9.10.41	96	15	16	83	78	5	94
299/300	30.8.41	16.10.41	90	14	16	75	62	13	83
301/302	5.9.41	23.10.41	95	9	9	88	73	15	83
303/304	12.9.41	30.10.41	91	11	12	88	86	2	98
305/306	19.9.41	6.11.41	90	8	9	65	54	11	83
307/308	26.9.41	13.11.41	179	21	12	153	147	6	96
311/312	10.10.41	20.11.41	101	11	11	99	80	19	81
313	17.10.41	27.11.41	24	4	17	27	26	1	96
314	24.10.41	5.12.41	31	2	6	32	27	5	84
315	31.10.41	12.12.41	25	1	4	23	20	3	87
316	7.11.41	19.12.41	24	2	8	28	27	1	96
317	14.11.41	22.12.41	58	3	5	55	52	3	95
318/319	21.11.41	29.12.41	73	8	11	65	65	0	100
320/321	28.11.41	5.1.42	80	1	1	83	66	17	80
322/323	5.12.41	12.1.42	77	3	4	71	61	10	86
324	12.12.41	19.1.42	42	1	2	39	37	2	95
325	19.12.41	26.1.42	43	3	7	46	37	9	80
326/327	1.1.42	9.2.42	68	3	4	75	59	16	79
328/329	8.1.42	16.2.42	88	2	2	83	65	18	78
330/331	15.1.42	25.2.42	67	3	4	57	52	5	91
332	22.1.42	2.3.42	32	1	3	34	33	1	97
333	29.1.42	9.3.42	42	8	19	41	35	6	85
334	5.2.42	16.3.42	23	3	13	18	13	5	72

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
335	12.2.42	23.3.42	28	4	14	31	30	1	97
336	19.2.42	30.3.42	10	0	0	17	15	2	88
337	26.2.42	6.4.42	18	4	22	14	14	0	100
338	5.3.42	20.4.42	13	1	8	20	12	8	60
339	12.3.42	27.4.42	36	4	11	26	26	0	100
340	19.3.42	4.5.42	32	7	22	28	28	0	100
341	26.3.42	11.5.42	55	6	11	54	51	3	94
342/343	1.4.42	18.5.42	87	7	8	64	64	0	100
344	9.4.42	25.5.42	25	1	4	30	29	1	97
345	16.4.42	2.6.42	11	3	27	24	21	3	88
346	23.4.42	8.6.42	38	1	3	42	40	2	95
347	30.4.42	15.6.42	25	2	8	25	24	1	96
348	7.5.42	22.6.42	20	2	10	18	18	0	100
349	14.5.42	29.6.42	21	1	5	24	24	0	100
350	21.5.42	6.7.42	22	2	9	18	14	4	78
351	28.5.42	6.7.42	25	1	4	26	24	2	92
352	4.6.42	13.7.42	21	1	5	12	10	2	83
353B	11.6.42	27.7.42	18	0	0	21	20	1	95
353A(Polish)	11.6.42	3.8.42	26	0	0	26	26	0	100
354	18.6.42	3.8.42	14	0	0	23	23	0	100
355	25.6.42	10.8.42	38	1	3	37	34	3	92
356	2.7.42	17.8.42	17	1	6	12	12	0	100
357	9.7.42	24.8.42	21	0	0	23	23	0	100
358	16.7.42	7.9.42	89	0	0	85	82	3	96
359	23.7.42	14.9.42	86	4	5	79	77	2	97
360	30.7.42	21.9.42	91	2	2	87	80	7	92

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
362	13.8.42	5.10.42	84	4	5	84	81	3	96
363	20.8.42	12.10.42	90	5	6	79	74	5	94
364	23.8.42	19.10.42	86	14	16	71	68	3	96
365	10.9.42	5.11.42	86	1	1	83	80	3	96
366	17.9.42	12.11.42	100	6	6	85	81	4	95
367	24.9.42	19.11.42	74	7	9	73	71	2	97
368	1.10.42	26.11.42	90	10	11	82	77	5	94
369	8.10.42	23.12.42	97	12	12	88	85	3	97
370	15.10.42	10.12.42	96	11	11	79	77	2	97
371	22.10.42	7.12.42	92	22	24	72	71	1	99
372	29.10.42	17.12.42	75	4	5	74	72	2	97
373	5.11.42	23.12.42	87	6	7	83	79	4	95
374	12.11.42	31.12.42	85	4	5	85	77	8	91
375	19.11.42	7.1.43	89	1	1	85	74	11	87
376	26.11.42	14.1.43	89	6	7	83	73	10	88
377	3.12.42	21.1.43	89	10	11	79	67	12	85
378	10.12.42	28.1.43	112	14	13	94	87	7	93
379	17.12.42	4.2.43	95	5	5	96	83	13	86
380	24.12.42	11.2.43	96	7	7	89	78	11	88
381	31.12.42	18.2.43	147	9	6	136	123	13	90
382	7.1.43	25.2.43	96	7	7	85	73	8	86
383(Polish)	14.1.43	22.2.43	20	1	5	19	19	0	100
383	14.1.43	4.3.43	88	14	16	72	65	7	90
384	21.1.43	8.3.43	144	14	10	130	107	23	82
385	28.1.43	11.3.43	128	19	15	101	96	5	95
386	4.2.43	25.3.43	133	11	8	118	106	12	90

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
387	11.2.43	1.4.43	125	13	10	108	92	16	85
388	18.2.43	8.4.43	147	9	6	132	102	30	77
389	25.2.43	15.4.43	149	24	16	122	107	15	88
390	4.3.43	21.4.43	122	9	7	144	132	12	92
391	11.3.43	29.4.43	149	16	11	131	108	23	82
392	18.3.43	6.5.43	142	26	18	115	112	3	97
393	25.3.43	13.5.43	150	27	18	122	109	13	89
394	1.4.43	20.5.43	145	27	19	108	88	20	81
395	8.4.43	27.5.43	150	26	17	117	105	12	90
396	15.4.43	3.6.43	177	31	18	143	143	0	100
397	22.4.43	10.6.43	146	39	27	103	103	0	100
398	29.4.43	17.6.43	140	54	39	87	83	4	95
399	6.5.43	24.6.43	137	33	24	86	84	2	98
400	13.5.43	1.7.43	138	29	21	105	100	5	95
401	20.5.43	15.7.43	132	28	21	101	98	3	97
402	27.5.43	22.7.43	67	20	30	67	65	2	97
402	12.7.43	22.7.43	21	0	0	18	18	0	100
403	3.6.43	29.7.43	91	26	29	64	61	3	95
404	10.6.43	5.8.43	97	40	41	58	55	3	95
405	17.6.43	12.8.43	111	35	32	96	78	18	81
406	8.7.43	26.8.43	97	4	4	95	61	34	64
407	15.7.43	2.9.43	55	1	2	45	38	7	84
408	22.7.43	9.9.43	72	3	4	80	64	16	80
409	29.7.43	16.9.43	54	9	17	44	39	5	89
410	5.8.43	23.9.43	54	4	7	57	50	7	88
411	12.8.43	30.9.43	49	12	24	40	38	2	95

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
412	19.8.43	7.10.43	55	10	18	33	33	0	100
413	26.8.43	14.10.43	59	6	10	59	57	2	97
414	2.9.43	21.10.43	50	7	14	44	43	1	98
415	9.9.43	28.10.43	60	8	13	53	53	0	100
416	16.9.43	4.11.43	55	8	15	50	49	1	98
417	23.9.43	11.11.43	47	4	9	47	39	8	83
418	30.9.43	18.11.43	47	8	17	45	45	0	100
419	7.10.43	25.11.43	50	15	30	39	38	1	97
420	14.10.43	2.12.43	69	9	13	51	51	0	100
421	21.10.43	9.12.43	66	12	18	54	49	5	91
422	28.10.43	16.12.43	78	6	8	58	50	8	86
423	4.11.43	22.12.43	73	11	15	74	75	9	101
424	11.11.43	30.12.43	6	8	133	21	21	0	100
425	18.11.43	6.1.44	0	0	0	5	5	0	100
426	25.11.43	13.1.44	0	2	0	3	2	1	67
428	16.12.43	3.2.44	59	6	10	29	28	1	97
429	23.12.43	10.2.44	77	5	6	82	82	0	100
430	30.12.43	17.2.44	54	13	24	44	43	1	98
431	6.1.44	24.2.44	62	7	11	54	54	0	100
432	13.1.44	2.3.44	59	10	17	49	47	2	96
433	20.1.44	9.3.44	27	10	37	29	25	4	86
434	27.1.44	16.3.44	62	4	6	49	47	2	96
435	3.2.44	23.3.44	65	6	9	58	55	3	95
436	10.2.44	30.3.44	42	3	7	42	42	0	100
437	17.2.44	6.4.44	58	8	14	45	43	2	96
438	24.2.44	13.4.44	75	7	9	69	67	2	97

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
439	2.3.44	20.4.44	67	9	13	43	43	0	100
440	9.3.44	27.4.44	54	8	15	52	44	8	85
Totals			12260	1550	13	10618	9498	1136	89

## Appendix 8 - Equipment Training School (Airmen) – WAAF Equipment Assistant Training Course Data: 1941 to 1942<sup>1</sup>

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
16	14.6.41	Not Known	21	0	0	19	18	1	95
17	20.6.41	Not Known	23	0	0	23	23	0	100
19/20	4.7.41	8.8.41	125	1	1	119	113	6	95
21/22	11.7.41	15.8.41	63	4	6	59	48	11	81
23/24	18.7.41	22.8.41	124	10	8	105	84	21	80
25/26	25.7.41	29.8.41	157	10	6	145	135	10	93
27/28	2.8.41	5.9.41	183	13	7	166	150	16	90
29/30	9.8.41	12.9.41	170	10	6	154	145	9	94
31/32	16.8.41	19.9.41	233	16	7	190	165	25	87
33/34	23.8.41	26.9.41	207	3	1	193	148	45	77
35/36	30.8.41	3.10.41	194	23	12	169	144	25	85
37/38	6.9.41	10.10.41	160	1	1	183	144	39	79
39/40	13.9.41	17.10.41	138	10	7	156	142	14	91
41/42	20.9.41	24.10.41	151	9	6	156	137	19	88
43/44	27.9.41	31.10.41	182	7	4	204	163	41	80
45/46	3.10.41	7.11.41	157	11	7	149	142	7	95
47/48	10.10.41	14.11.41	150	6	4	140	134	6	96
49/50	17.10.41	20.11.41	190	10	5	192	172	20	90
51/52	24.10.41	27.11.41	108	1	1	120	117	3	98
53/54	31.10.41	5.12.41	195	9	5	192	166	26	86

<sup>1</sup> Source: TNA, AIR 29/711, Equipment Training School (Airmen) formerly School of Store Accounting and Store-keeping: Operations Record Book (RAF Form 540).

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
55/56	7.11.41	12.12.41	240	18	8	232	188	44	81
57/58	14.11.41	19.12.41	211	6	3	203	166	37	82
59/60	21.11.41	22.12.41	219	11	5	188	147	41	78
61/62	28.11.41	29.12.41	206	14	7	250	227	23	91
63/64	5.12.41	5.1.42	194	9	5	207	187	20	90
65/66	12.12.41	12.1.42	295	13	4	295	242	53	82
67/68	19.12.41	19.1.42	207	12	6	219	183	36	84
69/70	1.1.42	2.2.42	180	7	4	173	139	34	80
71/72	1.1.42	2.2.42	176	20	11	187	147	40	79
73/74	8.1.42	16.2.42	181	15	8	149	146	3	98
75/76	8.1.42	16.2.42	165	9	5	143	136	7	95
77/78	15.1.42	23.2.42	81	6	7	149	143	6	96
79/80	22.1.42	2.3.42	88	8	9	104	98	6	94
81/82	29.1.42	9.3.42	61	5	8	82	81	1	99
83/84	5.2.42	16.3.42	127	4	3	121	99	22	82
85/86	12.2.42	23.3.42	144	6	4	141	117	24	83
87/88	19.2.42	30.3.42	123	2	2	128	118	10	92
89/90	26.2.42	6.4.42	136	4	3	143	139	4	97
91/92	5.3.42	13.4.42	98	6	6	110	100	10	91
93/94	12.3.42	20.4.42	139	3	2	135	120	15	89
95/96	19.3.42	27.4.42	183	5	3	181	167	14	92
97	26.3.42	4.5.42	28	2	7	39	38	1	97
98	1.4.42	11.5.42	21	2	10	41	41	0	100
99	9.4.42	18.5.42	24	4	17	39	34	5	87
100	16.4.42	25.5.42	27	0	0	35	0	0	0
101	23.4.42	1.6.42	22	1	5	26	22	4	85

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
102	30.4.42	8.6.42	31	1	3	34	34	0	100
103	7.5.42	15.6.42	52	3	6	46	45	1	98
104/105	14.5.42	29.6.42	63	3	5	59	58	1	98
106/107	21.5.42	2.7.42	66	2	3	61	51	10	84
108/109	28.5.42	6.7.42	62	4	6	58	51	7	88
110/111	4.6.42	13.7.42	60	1	2	61	59	2	97
112	11.6.42	20.7.42	64	6	9	67	64	3	96
113	18.6.42	27.7.42	124	6	5	117	107	10	91
114/115	25.6.42	3.8.42	128	6	5	108	106	2	98
116	2.7.42	10.8.42	121	4	3	116	116	0	100
117	9.7.42	17.8.42	92	6	7	103	100	3	97
118	16.7.42	24.8.42	72	4	6	71	68	3	96
119	23.7.42	7.9.42	65	1	2	65	63	2	97
120	30.7.42	14.9.42	67	3	4	64	63	1	98
121	6.8.42	21.9.42	66	0	0	63	61	2	97
122	13.8.42	28.9.42	63	1	2	76	71	5	93
123	20.8.42	5.10.42	65	0	0	74	73	1	99
124	3.9.42	12.10.42	63	5	8	58	52	6	90
125	10.9.42	19.10.42	65	1	2	65	63	2	97
126	17.9.42	26.10.42	66	2	3	69	69	0	100
127	24.9.42	5.11.42	68	2	3	65	60	5	92
128	1.10.42	12.11.42	65	4	6	64	54	10	84
129	8.10.42	19.11.42	59	3	5	59	56	3	95
130	15.10.42	26.11.42	66	1	2	67	64	3	96
131	22.10.42	3.12.42	66	0	0	72	65	7	90
132	29.10.42	10.12.42	51	0	0	49	47	2	96

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
133	5.11.42	17.12.42	64	2	3	57	56	1	98
134	12.11.42	23.12.42	63	4	6	61	61	0	100
135	19.11.42	31.12.42	66	5	8	61	59	2	97
136	26.11.42	7.1.43	66	0	0	68	68	0	100
137	3.12.42	14.1.43	69	1	1	68	68	0	100
138	10.12.42	21.1.43	69	2	3	66	57	9	86
139	17.12.42	28.1.43	57	1	2	56	53	3	95
407	15.7.43	26.8.43	38	4	11	28	27	1	96
408	22.7.43	2.9.43	43	5	12	29	29	0	100
409	29.7.43	9.9.43	43	5	12	33	28	5	85
410	5.8.43	16.9.43	44	2	5	46	45	1	98
411	12.8.43	23.9.43	45	13	29	38	35	3	92
412	19.8.43	30.9.43	40	7	18	25	25	0	100
413	26.8.43	7.10.43	33	1	3	39	39	0	100
414	2.9.43	14.10.43	38	4	11	37	36	1	97
415	9.9.43	21.10.43	40	5	13	33	32	1	97
416	16.9.43	28.10.43	43	8	19	34	34	0	100
417	23.9.43	4.11.43	43	2	5	36	36	0	100
418	30.9.43	11.11.43	44	6	14	40	40	0	100
419	7.10.43	18.11.43	42	3	7	41	41	0	100
420	14.10.43	25.11.43	42	5	12	40	40	0	100
421	21.10.43	2.12.43	42	2	5	32	32	0	100
422	28.10.43	9.12.43	38	1	3	45	43	2	96
423	4.11.43	16.12.43	36	2	6	31	31	0	100
424	11.11.43	22.12.43	96	4	4	89	88	1	99
425	18.11.43	30.12.43	94	9	10	82	80	2	98

Course No	Date of Intake	Date of Output	Original Intake	Wastage	Wastage as % of Intake	No Taking Exam	Passed	Failed	Pass Rate (%)
426	25.11.43	6.1.44	101	5	5	96	89	7	93
427	2.12.43	15.1.44	11	3	27	20	13	7	65
428	9&16.12.43	20&27.1.44	2	4	200	44	43	1	98
429	23.12.43	3.2.44	24	4	17	14	14	0	100
430	30.12.43	10.2.44	29	7	24	20	20	0	100
431	6.1.44	17.2.44	32	2	6	29	29	0	100
432	13.1.44	24.2.44	29	5	17	20	18	2	90
433	20.1.44	2.3.44	32	7	22	27	24	3	89
434	27.1.44	9.3.44	7	1	14	12	12	0	100
435	3.2.44	16.3.44	0	0	0	18	17	1	94
436	10.2.44	23.3.44	0	3	0	4	4	0	100
437	17.2.44	30.3.44	0	0	0	1	0	1	0
Totals			9942	559	6	9885	8901	949	90

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