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SELECTED ABBREVIATIONS

AFB	Air Force Board
ADP	Automatic Data Processing
AMO	Air Ministry Order
AMP	Air Member for Personnel
AMSO	Air Member for Supply and Organisation
AMWO	Air Ministry Weekly Order
ASMA	Air Staff Management Aid
ASU	Aircraft Storage Unit
BOC	British Oxygen Company
CSDE	Central Servicing Development Establishment
DLO	Defence Logistics Organisation
DTES	Directorate of Tornado Engineering and Supply
EDP	Electronic Data Processing
EOD	Explosive Ordnance Disposal
ESD	Equipment Supply Depot
FAD	Forward Ammunition Depot
FAP	Fly Away Pack
HES	Hardened Equipment Shelter
IT	Information Technology
LITS	Logistics IT Strategy
'Maintex'	Maintenance Executive (Study)
MPO	Master Provision Office/Officer
MRCA	Multi-Role Combat Aircraft
NAMMA	NATO MRCA Management Agency
POL	Petrol, Oil & Lubricants
RAFSADPS	RAF Supply ADP System
SCC	Supply Control Centre
SDR	Strategic Defence Review
SH	Support Helicopter
SSA	Special Storage Areas
STC	Strike Command
TCW	Tactical Communications Wing
TSW	Tactical Supply Wing
UED	Universal Equipment Depot
UKMAMS	UK Mobile Air Movements Squadron
USAS	Unit Supply ADP System
VDU	Visual Display Unit

SUPPLY - AN AIR POWER ENABLER
RAF MUSEUM, HENDON, 30 October 2004

WELCOME ADDRESS BY THE SOCIETY'S CHAIRMAN

Air Vice-Marshal Nigel Baldwin CB CBE FRAeS

Ladies and Gentlemen – good morning and welcome to our first seminar held on a Saturday. Please let me know what you think of the idea.

We have a busy programme so let me just say my usual thank you to Dr Michael Fopp and his colleagues at the RAF Museum for allowing us once again to use their splendid facilities.

Our Chairman today is Air Vice-Marshal Peter Markey. After the usual range of early appointments at places as diverse as Coltishall and Singapore, Peter became involved in the Anglo-French procurement projects – in his case the Puma and Gazelle at Marseilles. This seems to have marked him out as somebody to be involved in collaborative projects because he served subsequently at Carlisle, leading the Anglo-American project to manage the supply support for Phantom and Hercules.

Like many Supply officers, Peter got to know Carlisle very well; indeed he did a tour there as Station Commander and OC 14 MU. He must have liked it because he now lives in Cumbria – thus a long journey for him today (which I much appreciate).

RCDS and a short spell with ACDS (Logistics) during the first Gulf conflict followed and then, as an air commodore, he became Director of AMSO's Implementation Team, charged with setting up Logistics Command and the development of RAF Wyton. He remained as Policy & Plans in the new command, under another of today's speakers, Sir Michael Alcock. His last appointment, from 1995-97, was as Director General Support Management, this post carrying with it responsibility as Head of the RAF's Supply Branch.

On leaving the RAF, Peter became Director of Resources at the NATO Maintenance & Supply Agency in Luxembourg and, two years later, the first and only Brit to be General Manager, a post he held until earlier this summer.

Ladies and Gentleman, there can be no better choice to lead our seminar today. Peter – over to you

INTRODUCTION BY SEMINAR CHAIRMAN

Air Vice-Marshal Peter Markey

During its decade and half the Royal Air Force Historical Society has presented several dozen seminars on the activities of the Service and its Annual General Meeting features a presentation from a learned speaker but, so far we believe, this is the first time the Society has held a seminar which seeks to track the history of a single Branch. A symposium held at Brampton in 1997 did look at logistics in the round and the proceedings are recorded in the Society's Journal No 19 but today we shall focus on the Supply, formerly Equipment and before that the Stores, Branch which, as the oldest non-flying Branch, certainly merits our historical attention. Rather than simply being descriptive today, however, I suggest that our aim should be to trace the dynamics of the development of the Branch in an attempt to explain them and understand why the discipline of Supply is organised and operates as it does today. The Branch today is the product of its history and history is a continuum; if we are to make an informed guess at future trends, then we should try to recall, explain and understand past events.

The idea for this seminar came from Gp Capt David Packman, who is here today, and we thank him very much. We have a galaxy of speakers to explore our theme, starting with Wg Cdr Larry O'Hara who will examine the period from the First World War to the 1930s. Larry is, incidentally, one of our three organisers today and I offer him our particular thanks for helping to put this seminar together. Larry, over to you.

THE EARLY DAYS

Wg Cdr Larry O'Hara

Larry O'Hara joined the Service in 1955 as a fighter controller, he left to seek his fortune in the gold fields of South Africa and then returned to join the Equipment Branch. He held a wide variety of appointments in the UK and Germany and concluded his service on the DS at Bracknell. He is a member of the Western Front Association and of the Centre for World War One Studies.

The constitution of the RAF Equipment Branch was published as an AMO in 1930.[1] Before that date there had been an RAF Stores Branch, the Royal Flying Corps Equipment Organisation and the Royal Engineers Balloon Depot. In this presentation I will trace the antecedents of the Supply Branch from the Balloon Section to the 1930s. We start in 1878 when £150 was included in the Army Estimates for the construction of observation balloons. This led to the establishment of a Balloon Depot which eventually found a permanent home at Farnborough. The exotic supplies needed by the balloon units such as coal gas, hydrogen cylinders and goldbeaters skin were procured, stored and issued by the Balloon Depot.

The next step was the formation of the Royal Flying Corps on 13 April 1912. When the Committee for Imperial Defence recommended the establishment of the RFC it had intended that 'The British Aeronautical Service should be regarded as one.' The corps itself, which was intended to embrace all aspects of military and naval aviation, comprised a Military and a Naval Wing, and the Central Flying School at Upavon; there were, in addition to these, the Royal Aircraft Factory, which had evolved from the Balloon Depot, and the Aeronautical Inspection Department. Almost inevitably, the Admiralty wished to dissociate itself from the War Office and to this end it created its own breakaway air arm, the Royal Naval Air Service, which was established as a separate organisation on 1 July 1914 by order of the Admiralty – and without Parliamentary sanction.

Cpl Frank Kirby VC, who, having first become the RFC's original quartermaster, would subsequently be influential in the creation and management of the wartime system for the provision of supplies within the air service.

The RFC was represented at the War Office by the Directorate of Military Aeronautics under Brig-Gen Sir David Henderson. The directorate had three branches:

MA1 – responsible for Policy, Administration and Personnel;

MA2 – responsible for the supply and inspection of equipment, including the administration of the Royal Aircraft Factory and the Aeronautical Inspection Department;

MA3 – the Contracts Branch, which, unusually, was under military control.

It was a farsighted piece of organisation. By contrast, at the Admiralty the RNAS was treated as any other branch of the Royal Navy. The Director of the Air Department (an appointment which had existed since May 1912), Capt Murray Sueter, was responsible for advising the First Sea Lord on operational matters, the Second Sea Lord on personnel and training and the Third Sea Lord on design and construction. All questions relating to the provision of Naval stores and other supplies were to be referred to the appropriate Professional Departments. It was a complicated organisation which would not survive the pressures of war.

In the main, the groundcrew of the original RFC were transferred from the Royal Engineers. One of these men, Lt Frank Kirby, a quartermaster, was, as far as I can determine, the only holder of a Victoria Cross to serve in the RAF Stores Branch. Kirby, then a corporal, had gained his VC during the Boer War on what would now be described as a commando raid. On 2 June 1900, as part of a group of mounted sappers under the command of Maj Hunter-Weston, he was involved in blowing up a culvert on the Delagoa Bay railway line. As the party retired they came under heavy fire from the Boers and one of the sappers was unhorsed and left behind. Kirby returned and took the man up onto his own horse. The citation makes it clear that this was no flash in the pan as he had been noted for displaying

gallantry in the face of the enemy on no fewer than three previous occasions. He was promoted to sergeant in the field, became a warrant officer in 1906 and was commissioned as an honorary lieutenant and quartermaster in the Balloon Battalion in April 1911, transferring to the RFC on its formation. He retired as a group captain in 1926 by which time he had added a CBE to his VC and DCM.

The supply organisation in the RFC was complex. As an Army unit, the corps conformed to standard military practice, which is to say that Q Stores, eg domestic equipment, clothing and non-specialist tools, were provided by the Army Service Corps with ammunition, pyrotechnics and lubricating oil being provided by the Army Ordnance Corps. The Quartermaster and his staff were responsible for the storage, accounting and issue of these items which were delivered on an 'as required' basis so there was little need for holding large stocks at squadron level. The RFC was itself responsible for the provision, storage and supply of aeronautical equipment. Such was the growing complexity of the aeronautical stores task that as early as June 1913 Capt W D Beatty was appointed to command the Aeronautical Ordnance Depot at Farnborough.

The common belief among military planners was that the war which started in August 1914 would be of short duration. When the RFC set off for France, the force consisted of four squadrons and the Aircraft Park. It had a strength of 105 Officers, 755 ORs, sixty-three aeroplanes and ninety-five vehicles – roughly the size of an infantry battalion. This deployment had required the mobilisation of practically all of the RFC's reserves of personnel, aircraft and logistic support. It was a clean sweep which almost paralysed development of the training base in the early stages, Lt-Col Hugh Trenchard being left behind to attempt to build for the future using the much depleted remnant as the foundation.

The RFC arrived in time to join the retreat from Mons. Over the following days the squadrons moved frequently and ended the retreat at Melun, south-east of Paris. The problems of maintaining operations, with squadrons constantly on the move, with poor communications and few maps, were considerable but even at this stage the professionalism of the RFC was evident. Through its reconnaissance flights the BEF was kept aware of the position of the enemy while the German Army was repeatedly surprised when confronted by the

British rearguard. For its safety, however, the Aircraft Park had been ordered to Le Havre on 25 August after the two serviceable aircraft it still held had been flown to St Quentin. During the retreat makeshift supply arrangements were the order of the day and commanders in France purchased aircraft and spares directly from French manufacturers to replace losses. HQ RFC's Deputy Assistant Quartermaster-General often paid for these using gold coins carried under the seat of his car; he was Maj Robert Brook-Popham who was clearly regarded as having a safe pair of hands.

Faced with a situation which it had not envisaged, the War Office was obliged to concentrate on supporting the RFC in the Field. To this end, the RNAS, which had gained control of all aspects of lighter-than-air aviation before the war, now assumed responsibility for home defence as well. As the prospect of a short sharp war faded the RFC and RNAS both began to appreciate that their existing supply arrangements were inadequate to sustain the task in hand. There was an urgent need to develop a well-founded training organisation in order to meet the demand for the additional squadrons that would be needed in France and elsewhere. The build up of the RFC in France proceeded at a very slow pace. There were some ninety operational aircraft serving with the BEF in March 1915, 106 in June and 153 by September. At home the training organisation was also competing for resources. In May 1915 there were 234 officers under instruction at eleven air stations.

The problems of managing scarce sources of supply often resulted in filling gaps with whatever could be produced. This is shown by the aircraft establishment of No 1 Sqn which in May 1915 comprised four Morane Parasols, four Caudrons, three Avros, and single examples of the BE8 and of Bristol, Martinsyde and Morane single-seat scouts. The number of engine types was equally varied. The result was a nightmare for the supply organisation. There was an urgent need to provide for the management of supply, technical stores and movements. This led to the establishment of an Assistant Equipment Officer on each squadron. This individual, often a grounded aircrew officer, was given specialist training in the technical aspects of his duties, which were far more broadly based than the mere handling of supplies. I should perhaps stress that the generic term 'Equipment Officer' was slightly misleading; it was an employment grade not a

job description.

So the RFC now had two kinds of people handling its stores: its own brand of Equipment Officer, looking after specialist aviation materiel, and Quartermasters, many of them NCOs, who handled less exotic supplies furnished via the Ordnance Corps. The Army List of June 1915 shows a strength of fifteen Equipment Officers (who worked at wing level), thirty-seven Assistant Equipment Officers and thirteen commissioned Quartermasters. It is some measure of the rate at which the RFC began to expand that by April 1916 there were almost 1,200 Equipment Officers and Quartermasters on the list, although I should, perhaps, stress that many of these men actually functioned as what we would regard as mechanical engineers or signals (and later armament and photographic) specialists. Although some of them did have 'supply' responsibilities we should not confuse them with the, perhaps more familiar, Equipment Officers of the RAF of the 1930s-60s. It is also interesting to note that of the 1,200 only forty-five were serving in France at squadron level, and twenty-one of those were specifically established to look after the provision, maintenance and operation of wireless equipment.

From an early date it was obvious that the buildings at South Farnborough were not going to be large enough to meet the needs of the expanding service. This led, in late 1915, to the requisitioning of the Thames Iron Works at Greenwich and the Charlton Rope Works as sub-depots for aeronautical stores. The RFC then became partners in the establishment of a new depot being built at Didcot. In France, two aircraft depots were established at St Omer and Candas.

The conflict between the RFC and the RNAS surfaced again at the Committee for Imperial Defence in January 1916. Both services complained that the other interfered with its supply sources. Maj-Gen Henderson pleaded for an end to this wasteful competition. This resulted in a Joint War Air Committee (JWAC) being created in February. The Committee highlighted the fact that the two air services had yet to resolve their differences, even extending to the roles they should undertake, but, because the JWAC had been given no teeth, the initiative failed within six weeks. A separate Judicial Inquiry proposed that there should be one Equipment Department for both naval and military air services. But again little transpired, except that the Air Board was expanded in December 1916 to include a newly created

Fifth Sea Lord responsible for aviation matters. The Board also included a representative from the newly formed Ministry of Munitions which had assumed responsibility for aircraft design and supply. The urgent need to manage supply is illustrated by the fact that in December the two services had on order more than 9,000 aircraft of seventy-six types and 20,000 aircraft engines of fifty-seven types. The Ministries worked assiduously at standardisation to the point that by March 1918 there were only eighteen types of aircraft and twenty-five of engines.

As the RFC grew and developed there was a need for change in the supply organisation. It was eventually accepted that, as aeronautical supplies were so peculiar in themselves and of such a technical nature, the RFC should have its own integral technical stores department. The Ordnance Aircraft Department transferred, lock, stock and barrel to the RFC on 6 January 1917. This was a major step in the evolution of the Stores Branch. Later in 1917 a War Office Department was set up under (by now Lt-Col) Frank Kirby which had the task of introducing system and uniformity into the RFC's Stores Accounting arrangements. Members of the branch visited all home units and began to issue the first standard instructions on accounting. A year later, with the imminent establishment of the RAF, the problem of integrating the RFC system with that used by the RNAS was also tackled by the branch. The problem of merging the separate accounting systems which were operating for Q stores and technical stores was also addressed but not solved. This work led to the development of a standardised nomenclature and the first RAF Vocabulary.

The much expanded BEF was eventually organised as five Armies, each with its RFC Brigade. By February 1918 the BEF was responsible for 123 miles of the front line. Each RFC Brigade comprised two Aircraft Wings and a Balloon Wing supported by an Army Air Park. The RFC had also assumed responsibility for the air defence of the UK in February 1916. In addition, the training organisation had expanded at a remarkable pace, initially comprising four geographical Groups which were later amalgamated as the Training Division. By November 1917 the Division comprised sixty-eight squadrons. The UK base was supported by six Stores Depots, five Aircraft Repair Depots and thirteen Aircraft Acceptance Parks. During 1917 4,227 aircraft were delivered to the BEF and a further

Accounts
Responsibilities
Surveys of Property
Inspections and Inventory Reports
Property Returns
Supply Service Installation
Quartermaster Manual
Paymaster Manual
Manual No 7
Quartermaster Forms
Guard Duties
Mess Organisation
Hygiene and Sanitation
Engines
MT
Oils, Gases and Tyres
Aeroplanes
Gunnery
Bombing
Radio
Photography

Fig 1. *Topics covered by the basic Equipment Officers Training Course – 1918.*

5,770 aircraft to home units. By then the RFC had more than 9,000 vehicles and motorcycles on charge.

In the evolving RFC, its Equipment Officers had originally attended a variety of courses to gain qualifications in such specialist areas as, for instance, aircraft and vehicle engineering, wireless communications, armaments and photography. This disparate activity was eventually rationalised when the Equipment Officers School of Instruction was established near Reading in August 1917. It moved to Henley in October where, on the creation of the RAF, it was restyled the Technical Officers School of Instruction. This change of name, which mirrored the RAF's redesignation of the Equipment Officers it had inherited from the RFC as Technical Officers, better reflected the broad range of responsibilities covered by officers of this Branch. The school offered a comprehensive eight-week course, its syllabus providing an introduction to the whole spectrum of responsibilities that might fall to an Equipment Officer (see Figure 1); note that 61 hours were allocated to 'supply-related' matters while 77 hours were devoted to 'technical' aspects. By 1918 there was an emerging view that specialisation had become so marked that there was a case for creating a separate Stores Branch to handle the supply of, and accounting for, equipment rather than such matters being just one of the several strings to an Equipment (or Technical) Officer's bow.

The failure of the many government initiatives to solve the

conflicting requirements of the RFC and the RNAS, coupled with public concern on the growing threat of German bombing raids, led to Jan Christian Smuts being tasked with investigating the problem; his principle advisor was Sir David Henderson. Smuts produced his reports in August 1917. The Air Force Bill became law on 29 November and the Royal Air Force was formed on 1 April 1918. The Air Ministry became the central authority for aeronautical supply. The Air Ministry Equipment Directorate was the main link to the Ministry of Munitions. Maj-Gen W S Brancker was Comptroller General of Equipment and a full member of the First Air Council, thus recognising the crucial importance of procurement and supply, particularly of aircraft engines, in the prosecution of the war.

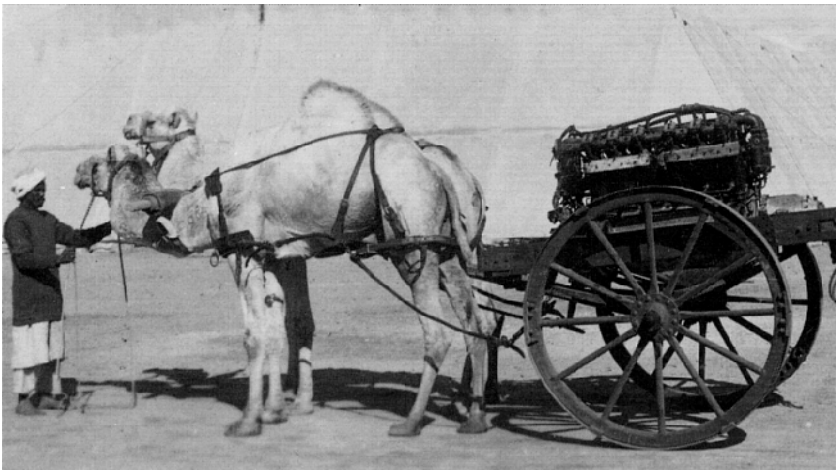
The German offensive in the spring of 1918 and the rapid advance towards the rail junction at Amiens caused major problems to the logistic staffs as the BEF fell back on its lines of supply. The RFC had made provision for a war of movement and had increased the establishment of vehicles held by squadrons in addition to creating Reserve Lorry Parks. On the first day of the Spring Offensive many aerodromes came under artillery fire. New aerodromes were identified and occupied on a day by day basis. The problem was complicated further by the need to redeploy the Aircraft Parks serving Third and Fifth Armies as soon as the assault began. As the German advance continued both No 2 Aircraft Depot at Candas and No 2 Aircraft Supply Depot at Fienvillers were also moved further back. The depot at Candas had been set up in July 1915 and over the next three years it had expanded into a vast organisation comprising workshops and a large accumulation of stores. The Official History pays tribute to the personnel who worked day and night under extreme pressure to move the whole depot to an empty sugar factory south of Etaples in just five days.

Further forward, the task of keeping the operational squadrons supplied fell on Brig-Gen Brook-Popham, by now Deputy Quartermaster-General at HQ RFC. His first concern was to ensure that supplies of POL and munitions were readily available. As soon as a new aerodrome site had been designated stocks of these items were deployed so that when the retreating squadrons flew in they could be refuelled and rearmed without delay. He also set up two convoys, each of eight light tenders. One convoy, loaded with machine-gun

Representative of the kinds of vehicles used by the RFC/RAF to move supplies around – a 25hp Crossley tender.

ammunition and 25 lb bombs, could move off at five minute's notice, day or night. The second was available to deliver urgently required spare parts. Replacement aircraft were flown directly to the squadrons. Throughout the German onslaught the RFC supply system worked well while the German system collapsed. During the offensive the enemy's supply service failed to replace damaged or lost aircraft thus allowing the British squadrons to range freely over the battlefield to attack and disrupt the advancing German troops. By mid-1918 entrenchment had given way to mobile warfare and, as the Allies assumed the offensive, it was recognised that effective pursuit would be largely determined by supplies and transport.

The Armistice came into effect on 11 November 1918 but it was not until 28 June 1919 that the Peace Treaty was signed. The focus then turned to the future of the RAF. Initially there were many who considered that a separate air force had been no more than a wartime expedient which would not survive the peace. As it became evident that the RAF was here to stay there was a need to develop structures which would allow the new Service to stand on its own without the support of the Army and Navy.



In regions where MT was less readily available and/or less capable of coping with terrain, the 25 horse power Crossley could be supplanted by a two-Camel power trailer.

There was an immediate requirement to form an Accounts Branch which would, at least, ensure that personnel were paid! The question which then emerged was whether that branch would also involve stores accounting. There were those who considered that the future lay with the establishment of a Quartermaster Branch of junior and warrant officers, possibly reporting to the Accounts Branch, such an approach being presaged by AMWO 1158 of October 1919. However, in 1920 the Director of Equipment successfully argued for a dedicated stores organisation which would handle both Technical and Q Stores with a common accounting system. A lively discussion then developed within the Air Ministry on the future responsibilities of Stores Officers. The division of responsibility between the Stores Branch, the Administrative Officer and the emerging Accounts Branch were topics which engaged Heads of Branches for a number of years. In January 1923 AMP pointed out that the Stores Committee had been deliberating for thirty-two months and he felt there was a need to draw a line under the discussion.

Away from the Air Ministry the officers of the Stores Branch had been involved in the disposal of large wartime holdings of aircraft and spares. There was the inevitable stocktaking and write-offs as the

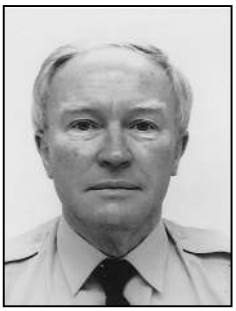
branch endeavoured to get down to a solid base on which to build a peacetime air force. All of this was happening while demobilisation was in full swing. Depots and Aircraft Acceptance Parks were closed leaving just three Stores Depots, at Kidbrooke, Milton and Ickenham, together with a packing depot at Ascot. An explosives store at Altrincham was added in 1924. A Stores and Accounts School was established at Kidbrooke with a Stores Branch Officer Training Course being initially set up at Henlow, before moving to Cranwell in 1937.

As stability returned, the Stores Branch (Equipment Branch from late 1936) emerged as one which would undertake the professional duties which would now be recognised as those of today's Supply Branch. There were a few unusual posting available to Stores Branch Officers in those early days, the most interesting probably being the half-dozen or so appointments aboard the Royal Navy's aircraft carriers. The numbers of officers in the Stores Branch rose from 167 in 1922 to just over 300 in 1930 which was about 9% of the officer corps. The Branch established an organisation to take over the procurement of non-technical equipment, develop permanent stores depots, training schools and the packaging depot. The inter-war years were a busy time for the Branch during which the foundations were laid for the expansion leading to the Second World War.

[1] Curiously, although AMO A.428 had introduced the term 'Equipment Branch' as early as July 1930, it was not actually adopted until December 1936 when the (then monthly) Air Force List began to use it in place of the original Stores Branch; at the same time the four existing Stores Depots were restyled Equipment Depots.

SUPPLY COMES OF AGE

Wg Cdr Colin Cummings



Colin Cummings served in the Supply Branch for 31 years. After a series of station tours, mostly in the Far East, he spent a significant element of his service involved with IT systems both within the Supply Branch and in other areas, such as the Directorate of Flight Safety. He was the first Supply officer to manage an aircraft Support Authority (the Jaguar). He is a member of the RAFHS committee and, not satisfied with one Queen's Commission, he currently he holds two; one in the RAFVR(T) and the other in the RAFR.

Taking the story of the RAF's Supply organisation forward, it is necessary to look at how it developed during the mid-1930s until the early part of WW II. To do this, I shall look briefly the following aspects.

- The development plans upon which the RAF's expansion was based.
- The formation of Maintenance Command.
- The construction & organisation of the supply depots.
- The development of some of the specialist elements.
- Maintenance Command and the disposition of its constituent Groups in the early years of WW II.

I shall not be looking at how individual front line units operated their supply services, since we must take it as a given that this happened, nor shall I dwell on any detailed process and procedure. Furthermore, I shall not delve too deeply into the rationale for all the decisions taken.

At the end of WW I, the newly formed RAF had more than a quarter of a million men and women in uniform, in what amounted to the largest air force available but the Government then disarmed unilaterally to find its air force – first with barely a cadre and by 1923 still only the fifth largest air force – with squadrons reckoned at a few dozens and manpower (a true gender specific title, since females no

Scheme Identity	Date		Home Based		Overseas	
	Approved	Effective	Sqns	Aircraft	Sqns	Aircraft
A	18 Jul 34	31 Mar 39	84	960	27	292
C	21 May 35	31 Mar 37	123	1,512	27	292
F	25 Feb 36	31 Mar 39	124	1,736	37	468
H	14 Jan 37	31 Mar 39	145	2,422	27	348
J	22 Dec 37	mid -41	154	2,331	45	644
K	14 Mar 38	31 Mar 41	145	2,305	39	490
L	27 Apr 38	31 Mar 40	141	2,373	39	490
M	7 Nov 38	31 Mar 42	163	2,549	49	636

Fig 1. *The approved expansion schemes: 1934-38.*

longer had a place in a peacetime air force) at barely 30,000. These figures remained essentially the same until the Service began its expansion in the mid-1930s. By 1938, however, that figure had increased some two and a half times to just over 73,000, with much of the rise attributed to an expansion of the support services.

From about 1933, the air force had developed an ever more detailed and complex range of plans which envisaged the size, shape and equipment requirements for a force able to counter the increasingly serious threat which the National Socialist regime in Germany posed. The size and scope of some of these expansion programmes are summarised at Figure 1.

The gaps in the sequencing are because some of the schemes never got off the drawing board, whilst others were overtaken by the development of other schemes before the earlier version could be approved. A major drawback with many of the early schemes was that they assumed everything to be ‘up front’ and no provision was made for attrition, maintenance or support. It is worth noting that only with the later schemes was any thought given to properly organised support services and even so, some of these schemes were modified in favour of cheaper options.

This unsound approach goes someway towards showing why the plans and development of comprehensive support was not always forthcoming and, if it was, it tended to lag behind significantly. It

must also be recorded that the most ambitious plans envisaged an RAF of 212 squadrons and 2,185 aircraft by January 1945. That the eventual result turned out to be 504 squadrons, plus many hundreds of flying training and support units which never featured in the pre-war plans, and over 20,000 aircraft serves to illustrate the difficulties of providing properly structured support services.

The RAF's pre-war organisation was not geared to any real expansion in its support services and most units employed on the maintenance function were controlled by the Director of Equipment, whilst their domestic administration fell to the AOC Training Command, who had no involvement in the role the units discharged. This led to a decision to form a Maintenance Command and – importantly – although not linked directly, to recruit officers with engineering experience to form a Technical Branch. Given all that has taken place over the last sixty-five years, it is worth pondering what might have been, had the technical and equipment officers allied themselves more closely than they did in the development of the maintenance organisation and in the years that followed.

Much thought and debate took place as to how best to set up this maintenance organisation but, in essence, it was decided to create a command of four Groups, set-up on functional lines as follows:

- a repair and salvage Group;
- an aircraft, mechanical transport and marine craft storage Group;
- an equipment Group, charged with the receipt, storage and distribution of equipment, and
- a Group responsible for fuels and explosives.

It will be readily apparent that the tasks of the last two groups were the areas in which the supply – or equipment – organisation would be most heavily committed. These were Nos 40 and 42 Gps. The initial plan suggested that each group would be controlled by an equipment officer working under the authority of a general duties officer.

There were many serious problems associated with providing the support required for an expanding air force and amongst these issues were the following.

- Many of the civilian staff recruited, were RAF reservists who would disappear at the first whiff of mobilisation.

- The maintenance units were often to be located in remotely populated areas and it would prove difficult to attract civilian staff unless there was adequate housing.
- Poor levels of interchangeability of spares, even between different versions of the same aircraft.
- A wide variety of individual types of aircraft or major equipment.
- The supply of incomplete equipment from industry – a configuration controllers' nightmare!
- It was anticipated that equipment supply activities would increase seven- or eightfold when war was declared and the ability to cope with this needed careful peacetime planning which was not forthcoming.

Looking first at No 40 Gp – the equipment Group – this organisation was set up at Andover in January 1939 moving in the summer to Caldicott House, Abingdon, whence it operated throughout the war.

The game plan for No 40 Gp was to create and operate seven Universal Equipment Depots (UEDs) located geographically and supporting the units in their area by a road transport network.

In general, these new depots were of modern construction and followed a standard pattern: a Headquarters Site contained most of the office and domestic accommodation required to provide home for some sixty or so RAF officers and 800 or 900 non-commissioned personnel, as well as canteen and support facilities for several thousand civilians. The central functions, such as transport, despatch and receipts areas, engineering support and specialised packing were also contained on the HQ Site, as were a share of the basic storage facilities. Surrounding the main area and at distances of up to a few miles were half a dozen sub-sites, each containing four or more storage sheds, some simple office accommodation, air raid shelters and the odd small building for storing hazardous items. Figure 2 shows the seven depots and the approximate boundaries they served.

Initially, it was intended to hold a complete range of equipment at each of the UEDs, thereby providing seven separate point holdings of *all* equipments. It can be imagined how inefficient this arrangement was in practice and how difficult for the multitude of contractors to arrange delivery of portions of the items off the contracts to the

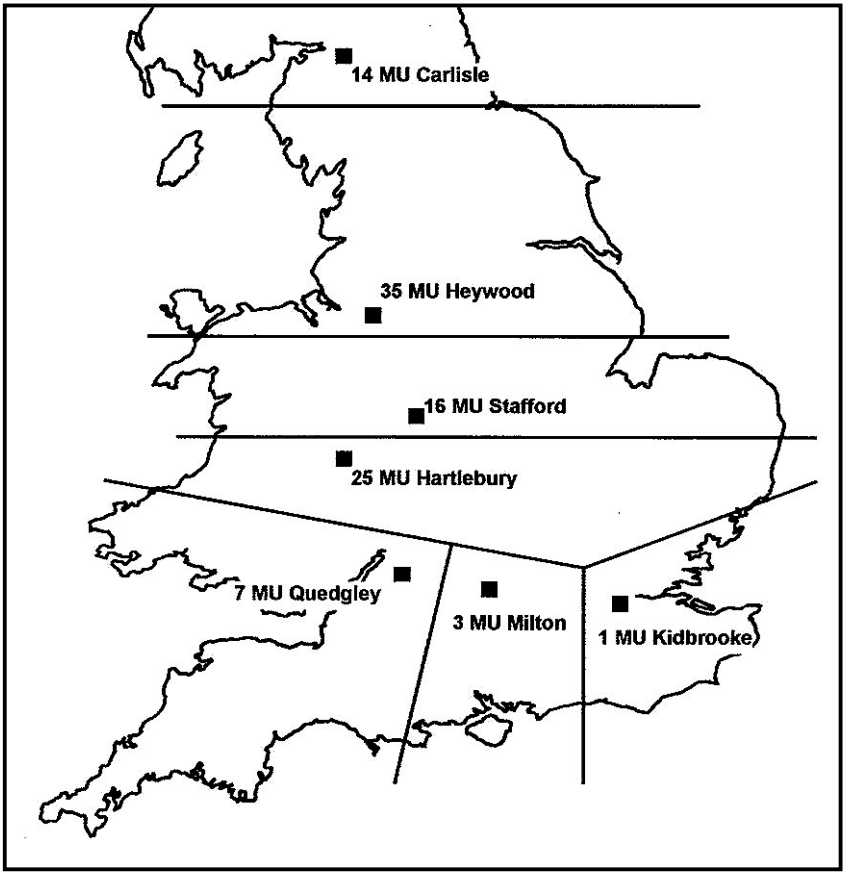


Fig 2. *The Universal Equipment Depots of 1939-40.*

appropriate depot. However, by late 1940, it had been decided to split up the Universal Depots and to create separate Maintenance Units to hold barrack and clothing items and these self accounting depots were formed, allied to the Universal Depots which had spawned them.

Whilst this arrangement worked reasonably well as far as it went, the continued expansion of the RAF, coupled with problems of supporting the operational stations effectively, led to several other decisions being made one after the other during 1941 and 1942.

First, it was decided to create Universal Equipment Wings. The purpose of these wings would be the overall management and control

Wing	Aircraft Equipment Depot	Ground Equipment Depot	Barrack & Clothing Depot	Equipment Parks
3	Milton	Woodcote	Wembley	Bough Beech (Kent) Bishops Stortford
7	Quedgely	Warminster	Newport (Glams)	Romsey Okehampton Carmarthen
14	Carlisle	Sandysike	Dumfries	Holywood (Ulster) Ballymena (Ulster) Perth Inverness Edinburgh
16	Stafford	Sutton Coldfield	Nottingham	Barton Mills
25	Hartlebury	Roade (Northants)		Rushden Bury St Edmunds
35	Heywood	Bolton	Wakefield	York Broughton
61	Handforth	Cuckney (Notts)	Glossop	Newark

Fig 3. *Principal No 40 Gp Depots – Post Reorganisation.*

of the UED and the Barrack and Clothing Depot in the area and those other units and sub-units which had sprung up as overspill storage was acquired.

A further modification saw the formation of Ground Equipment Depots – responsible for; tools, MT spares, paints, dopes, ropes and all manner of general items. With the UEDs now responsible mostly for aircraft related equipment, they were renamed Aircraft Equipment Depots (AEDs).

The third major change was a decision to create Static Equipment Parks in areas closer to the operational units and holding a proportion of the stocks moved forward from the other depots. The situation after these organisational changes had been pushed through is shown at Figure 3.

Before moving on to look at the specialised supply units, I want first to describe some other aspects of the general equipment storage and distribution business.

We have already seen that the creation of UEDs, had effectively created a multi-point stockholding arrangement but there were obvious penalties in doing this. It had also been proposed that the stocks at each depot should be further distributed throughout the associated sub-sites but this would have been a nightmare arrangement and completely impossible to manage.

What was attempted, however, was to split each depot's holdings between at least two sites and to distribute high-value items, such as aero-engines and propellers, even more widely. Stock within individual sheds was also scattered in different locations, asbestos screens were installed to impede the progress of fire, large packing cases were used to provide a modicum of protection from bomb splinters, whilst stocks being prepared for despatch or awaiting receipt were also dispersed from various 'choke points', such as the transportation hub, at night.

As the threat of serious air raids began to decrease, a new system was introduced in the spring of 1943 which reduced stockholding to a three-point system. This system had the effect of:

- reducing the total number of reallocations caused by dispersal within and between depots and their sub-sites – a full 30% of the total activity in the depots;
- reducing the overall response time required to satisfy demands;
- easing the difficulties experienced by contractors attempting to supply a seven-point distribution system, and
- concentrating equipment within a closer geographic area to the likely points of need.

For those who may have embarked on a canal boat holiday, you may be amused to learn that the Canal Transit Scheme was introduced at the end of 1941 in an attempt to reduce the dependence on road and rail transport. Transit Depots were set up at three locations and forty pairs of barges were allocated to the job. A couple of options were tried: one involved the carter delivering right through to the final destination using his road and barge transport, whilst the other involved deliveries between the Canal Transit Depots and final shipment by road using RAF transport.

During the three years the scheme operated, some 62,000 tons of equipment was moved in this fashion but, as will be appreciated, the

whole thing was painfully slow and it was assessed that only the equivalent of fourteen railcars of freight per day was actually being shipped by this means – pretty small beer in the overall scheme of things.

From what I have already said about dispersal, it will be readily apparent that kit was criss-crossing the country and being shipped hither, thither and yon to units in the UK and overseas without any overall control and with the potential for all sorts of problems arising, as they surely did.

Hand in glove with the dispersal policy came the creation of the Master Provision Officers (MPO), each responsible for different ranges of equipment, across the entire Maintenance Command. The roles of the MPOs were as follows:

- calculating requirements and determining when replenishment was required by contract or repair;
- issuing repair instructions or notifying requirements to the Air Ministry for purchases from contract;
- allocating supplies from contract or repair to appropriate stockholding units;
- progress chasing to meet inabilities or the hastening of supplies to ensure delivery within the production leadtimes, and
- arranging transfers between equipment depots to meet the requirements of the dispersal policy.

All the processes associated with the equipment management functions outlined thus far were dependent on manual records, which generated mountains of paperwork, so duplication was the order of the day and any sort of analysis was time consuming and prone to error.

However, from late 1943 Hollerith punched card systems were introduced progressively into the depots. The systems which they supported permitted some mechanisation of stock control functions which resulted in increases in speed of reaction, accuracy of data and the ability to gather statistical information, the better to inform the whole procurement process. It is worth noting that the Hollerith systems served the RAF well for the best part of two decades, until they finally gave way to a computerised system in the late 1960s.

Before leaving the equipment depots, I want to flag up some

Type Of Unit	Dec 1939	Dec 1940	Dec 1941	Dec 1942	Dec 1943	Dec 1944
Stores Depots	2	0	0	0	0	0
Miscellaneous Units	7	8	0	2	3	1
Aircraft Equipment Depots	6	6	7	7	7	7
Barrack & Clothing Depots	3	6	5	6	6	6
MT Companies	0	3	8	0	0	0
Equipment Parks	0	0	7	15	15	15
MT Units	0	0	2	2	4	4
Marine Craft Storage Units	0	0	1	1	2	2
Mobile Equipment Parks	0	0	0	2	0	0
Ground Equipment Depots	0	0	0	6	7	7
Totals	**18**	**23**	**30**	**41**	**44**	**42**

Fig 4. *Summary of Depots in 40 Gp: Dec 39-Dec 44.*

statistics which might serve to set the whole operation in perspective.

There were some forty-two equipment depots in total at the end of 1944, as shown in Figure 4, including one staffed almost entirely by WAAFs and another, at Tewkesbury, which stored complete marine craft. There were some 22.5 million square feet of covered storage and 45,000 service or civilian staff in No 40 Gp alone. The transaction load, again using 1944, totalled 18.5 million with 814,000 line items being classed as 'active' or in 'current supply'. The weight of equipment turned over in 1940 was some 527,000 tons and by 1944 this had quadrupled to 2.3 million tons.

Although post-war, it was found that the enemy knew all about the depots and their annotated recce photographs carry a pretty accurate assessment of the use to which the sites were being put, there was no concerted attack specifically against a depot nor any attempt to target the RAF's support system at large by destroying these units or their communications links. Some damage was caused as a consequence of general air raids and a Barrack and Clothing Depot in Coventry was destroyed during the major attack on that city in November 1940 with the site being abandoned in March of the following year.

In turning from the general supply depots to the specialist supply

units, in the rest of this paper, I shall consider explosives, fuels and compressed gases. I intend to outline the way in which the RAF responded to the requirements of the expansion plans and how the increase in the requirement for explosives and fuels storage was addressed. I shall not, however, go into the detail on the way in which the business was run during the war years or in the decades afterwards, since that rests in the capable hands of others later in this seminar.

For most of the first fifteen years of its existence, the RAF made do with two small explosives depots located near Altrincham in Cheshire and Pulham in Norfolk. These depots were small in acreage and were little better than glorified small arms magazines. Storage was available for limited quantities of the small bombs then in use but the depots were completely unsuitable either for expansion or as a geographical stepping stone in the supply chain.

The emerging philosophy for explosives storage envisaged for the RAF in order to support its expansion programme was as follows.

- There would be three main depots for ammunition storage.
- The depots were to be located, one each in the south, midlands and north.
- Ideally they should be west of a line running from Edinburgh to Southampton, so as to put them beyond the supposed range of German aircraft, the fall of France being a somewhat unlikely prospect at the time.
- The main storage areas should be underground, with a minimum head cover of 40 feet as protection against air attack.
- The main depots would hold identical stocks to each other for security reasons and each would control one or more maintenance sub-unit, typically located in disused railway tunnels.
- The main depots would feed a number of Forward Ammunition Depots (FAD), located closer to operational airfields and these in turn would feed bombs and ammunition to the airfields as needed.

Some of the most immediate problems encountered in trying to deliver this requirement, centred on locating and acquiring suitable properties for the main depots, since both the Royal Navy and Army were fishing in the same pond and both of these Services were better

organised and had been about their business for longer. It will come as no surprise to learn that neither of the other Services was above all sorts of skulduggery. For example, an attempt was made to take-over the Cheddar caves, simply as a spoiling tactic to prevent the RAF's gaining access to them. On another occasion, when the Navy was competing with the RAF over the acquisition of underground facilities in the south of England, they declared them to be unsuitable for storing anything, let alone weapons, and announced that they were not interested. The RAF naively followed the RN's lead and withdrew, only to discover that the Navy had promptly returned and secured exclusive rights to the site.

A detailed exposition of the search for suitable storage and all that went on around it, plus the conversion and development of the sites, their infrastructure and operation, would occupy a seminar in its own right so I shall simply confine myself to recording that two underground mines were eventually found. The southern one was a disused stone mine at Chilmark, whence much of the stone for Salisbury Cathedral had been quarried, whilst the other was a disused gypsum mine at Fauld near Burton-on-Trent. The latter was located adjacent to an active mine but by this time, many of the ideal limitations on the proximity of industry and population were allowed to go by the board and other aspects of safety were being similarly compromised.

The acquisition of a third site, a quarry at Harpur Hill near Buxton, was to have far reaching effects for it was decided to construct the storage on the floor of the quarry using concrete to create longitudinal roofed galleries, intersected by cross passages. The overhead cover would then be loaded to a depth of 40 feet onto the concrete roof. An identical method of construction was used at Llanberis, a disused slate quarry in North Wales which was to become another storage depot.

Further attempts to find suitable sites continued, since it soon became apparent that the capacity of just three main ammunition depots would be inadequate for the RAF's needs. Accommodation was obtained on loan at Eastlays and Ridge Quarry, two of the Army's storage mines, near Bath and Llanberis respectively, and both were subsequently developed by the air force. However, the use Linley Caverns, an underground quarry mine near Walsall, was curtailed but only after considerable sums of money had been spent in attempting to

The end of the armament supply line was the same overseas as it was at home. These 500 pounders are in ready-use storage at Kumbhirgram in India pending delivery by Vengeances dive bombers; the airman is LAC Bertie Aldridge of No 45 Sqn.

rectify inherent problems with flooding and to inhibit the prospect of serious roof collapses – the two reasons why the site had been abandoned by its civilian owners in the first place!

The Forward Ammunition Depots were being developed at this time and nine were constructed initially, each with a nominal capacity of between 750 and 1,250 tons. The FADs were rather easier to bring into service than the main depots, since they were built above ground and to a largely standard design without too many complications. The FADs served the bomber and fighter stations in their areas.

Whilst Altrincham and Pulham were retained for small arms and ammunition storage, the situation in the early part of the war looks something like that shown at Figure 5. The major depots in use, on loan or under construction are shown as circles, whilst the forward ammunition depots are squares.

It will be appreciated that the situation was remarkably fluid and the number of depots, their precise roles and the nature and volume of

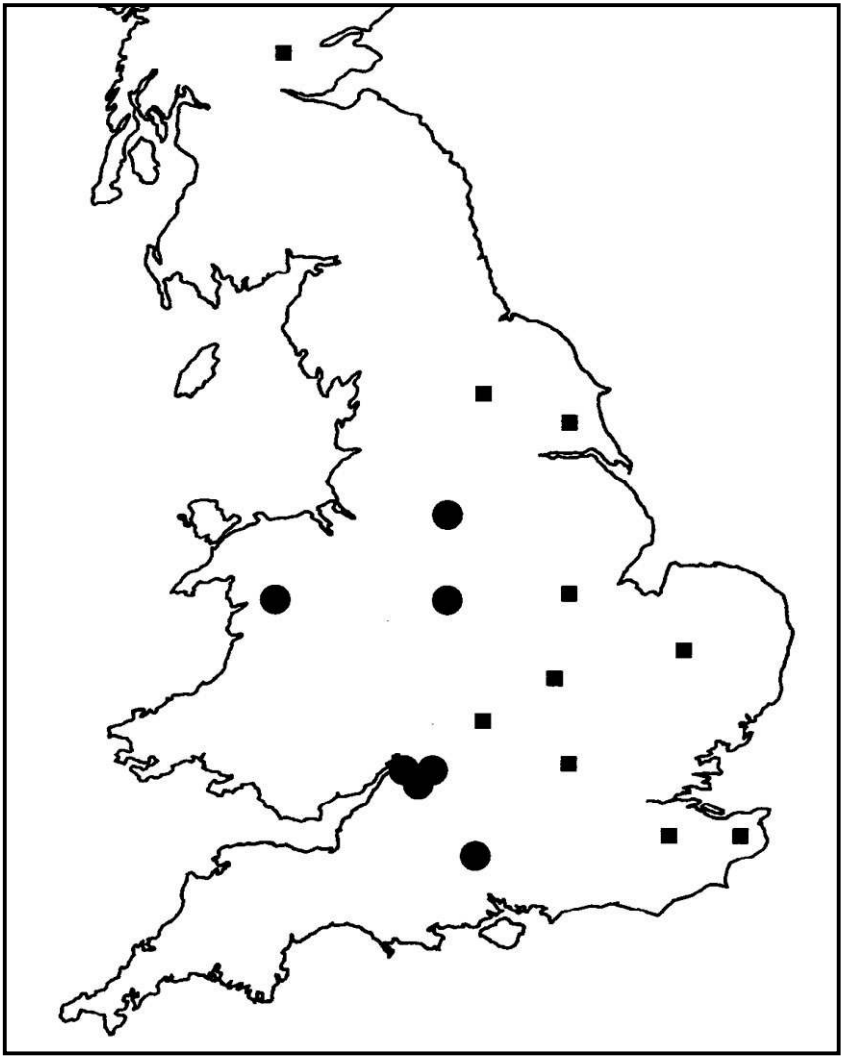


Fig 5. *Main* ● *and Forward* ■ *Ammunition Depots.*

their contents were in a continual state of flux – a situation which would continue throughout the war years.

The initial system of operation of the explosives supply system was as follows.

- Imports and production from the ordnance factories went to the main depots in roughly equal measure. Stocks were unloaded and stacked.
- Requirements to cover the stockholding needs of the forward depots were taken from the main depot stock, transported to the FAD, where they were again unloaded and stacked.
- Demands from the operating airfields were satisfied by the forward depots drawing on their stocks

It will be immediately apparent that this arrangement was inefficient and required multi-handling. The system was also unable to cope with the never ending and exponential increase in requirements for bombs from the bomber force and a more effective system was therefore needed urgently.

You will read later of the improvements that were made and of the role of the Master Provision Officers – whose tasks were significantly different from the work undertaken by MPOs dealing with aircraft and other stores – and you will also learn something of the delicate matter of chemical weapons. It may seem obvious, with hindsight, but a major, and unforeseen, problem arose immediately after the outbreak of war – how to obtain sufficient belted ammunition to feed the requirements of the front line units? At first there were a few hand-operated machines at Altrincham which could link 300 rounds per hour – which a contemporary aircraft machine-gun could dispose of in less than a minute! However, power operated machines were soon acquired, each having a capacity of 3,000 rounds per hour and capable of being handled by unskilled staff; twelve of these machines were installed at each of four units.

Before the declaration of war, compressed gases had been supplied direct to RAF units by the British Oxygen Company, who had established eleven filling stations across the country to satisfy the requirements. As far as breathing oxygen was concerned, high capacity/high pressure transport cylinders were provided to units, who in turn drew off the oxygen into aircraft cylinders, exchanging the transport cylinders as required. On the outbreak of war, the arrangement changed to a supply via the FAD to the operational unit or through the Main Ammunition Depot for those units not served by a FAD.

Within a week of war being declared, the RAF was also made responsible for the supply of shells for Army anti-aircraft guns located in the vicinity of RAF stations.

Moving finally to the supply of fuels, until the RAF's expansion programme had begun, the Service relied entirely on the petroleum industry for its aviation fuel which was supplied under standing contracts. After Munich, a programme for the construction of large capacity underground reserve and distribution depots was begun, mainly on the west coast, since the majority of fuel would come from the USA. In addition, depots of more modest capacity were constructed underground in East Anglia where bomber bases were, or would be, located. There were also plans for the construction of two factories for the production of containers and the mechanical filling of these with aviation fuel and oil. A fleet of rail tank cars for the distribution of fuel to the stations, eastern counties depots or to points from which it could be drawn off to road tanker vehicles was also obtained.

Immediately after the start of hostilities, the Air Ministry acquired all fuel stocks held by the petroleum companies and assumed control of all bulk fuel storage in the UK. The RAF and commercial depots were renamed distribution points and a system devised for units to draw supplies from appropriate points. Strategic dispersal of bulk reserves of fuel was achieved by loading large tanker vessels and berthing these at remote locations in northern waters.

The fuel companies were effectively nationalised and became the Petroleum Board and this Board managed the fuels supply on behalf of the Air Ministry throughout the war. It is perhaps worth noting that initially there were only two grades of aviation fuel and a single grade of engine oil but this was to change as aircraft engines became more sophisticated.

In conclusion, the equipment Groups within Maintenance Command had been created from scratch and set-up to deliver a supply support function to an air force whose growth then rampaged out of all control and which in war bore no resemblance to the plans on which the maintenance function had been formulated. That this element of support was delivering a reasonable service from the very first is a testament to those who served in it.

SUPPLY: TWO WARTIME EXAMPLES

Air Cdre Henry Probert

A Cambridge history graduate, Henry Probert joined the RAF Education Branch in 1948. During the 1960s he served in Singapore and on the Staff College Directing Staff before becoming, in 1976, Director of RAF Education. After 'retirement' in 1978 he spent the next eleven years as Head of the Air Historical Branch. He is the author of three notable books, his most recent being his acclaimed biography of Sir Arthur Harris.

While 'Supply' is not a subject on which I would claim any particular expertise, I did find myself touching aspects of it in both of my major books on the Second World War. So my offer to reflect on a few points in relation to Sir Arthur Harris and also to the war in the Far East has been taken up and here I am, yet again, in front of an Historical Society audience.

First Harris. One of the many qualities that I identified in researching his story was his abiding concern for the countless airmen and – during the war – airwomen who served under his command and his recognition of the importance of the huge infrastructure on which his air operations depended. As far back as the First World War, when he flew as a fighter pilot, both against the Zeppelins and later over the Western Front, he demonstrated his respect, indeed admiration, for the groundcrew who serviced his aircraft and did the other support tasks. Not until after the war, however, did he begin to experience what he was often to consider the malign influence of the higher bureaucracy. He thought it dreadful, for example, when commanding a night fighter squadron in 1919, that the main task of his men was to receive large numbers of surplus aircraft, tip them up and burn them. Some of these, indeed, were new, since the government was keeping production lines open until there was other work for the aircraft factories. He was still disposing of redundant supplies at Digby in 1920 when he specially recalled finding that thousands of gallons of fuel were missing. On reporting this he received an abusive letter requiring him to explain

and pay for the shortage. Being a resourceful young officer he asked several petrol companies what evaporation losses they would allow in two-gallon cans stored in the open over, say, a year. '100%', they replied, whereupon higher authority backed off. He was always to be good at playing the system.

Not long afterwards Harris took command of No 31 Sqn in India, where he had to cope with a dreadful shortage of spares and other essential supplies – partly because they had to rely very largely on Army support. The situation was much better in Iraq, where in 1922 he took over No 45 Sqn, flying Vickers Vernons. Nevertheless, despite now being in the RAF command and supply chain, it still took at least three or four months for him to get new equipment out from the UK by sea, but under far more co-operative local management he now proved self-help to be a pretty good tool when adapting his transport aircraft to drop bombs.

The next ten years saw Harris widening his experience and beginning to think more deeply about the ways in which the RAF ran its affairs, and during his four years as Deputy Director of Plans in the mid-1930s he was able to address a host of different subjects. A statement he made in 1936 is, I suggest, of particular relevance to us today. In his view the biggest enemy of RAF operational efficiency was:

> 'The personnel policy of attempting to make our pilots masters of all trades so that they never have time to become masters of their own – they are in effect a posting pool for the entire Service.'

In effect, the far-sighted Harris was calling for many of the RAF's ground tasks – and not just supply – to be undertaken by specialists so that the aircrew would be able to concentrate on learning and practising their collective flying skills.

Another thoughtful suggestion came when he was AOC 5 Gp in the early months of the war. He had just asked for a depot for Hampden bomber spares to be set up within his Group when he heard that a new Maintenance Unit was being formed for this purpose near Manchester. His protest was immediate. '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'. Since No 5 Gp was the sole user of

Hampdens for war purposes, spares supply could have been organised direct from the manufacturer. 'Minutes, let alone hours, days or weeks, will count when the war really starts', he wrote. I'm afraid I wasn't able to pursue this particular topic though I doubt if Harris had his way – maybe someone here can tell me. Even so, I reckon he had a point.

I think he had another when he protested about the continued presence of auditors on operational stations, calling it an astounding unreality, a fantastic distraction of staffs hard-pressed to cope with the stark realities of war. As for the supply and organisation departments in the Air Ministry, they seemed not to realise there was a war on:

> 'One gets the impression that the automatic reaction to every request is negative. All our urgent operational requirements seem to go meandering through a maze of offices and, no matter how urgent, to be subjected to endless scrutiny, delay, obstruction, idle chatter and superfluous minuting by whole legions of departmental subordinates, some of whom haven't the vaguest idea what it is all about.'

This, of course, was during the Phoney War; attitudes subsequently changed as the fighting hotted up during and after the Battle of Britain. For Harris, his appointment in June 1941 to lead the RAF Delegation in Washington gave him a new perspective, for part of his duties lay in fighting the RAF's corner for the continued delivery of military aircraft from the USA. This battle became increasingly difficult when it was decided to give priority to supplying the USSR, but Harris was more successful in helping to organise the provision of spares for the American aircraft which had already been despatched or could still be sent. American aircraft manufacturers and military services, he said, seemed to have little comprehension of the practicalities of carrying out military operations world-wide and the quantities of spares required. So in late 1941 an RAF equipment staff was set up to liaise with them and to provide experienced advice and, as a result, the USAAF formed a number of Defence Aid Depots to handle such supplies. As in so many other ways the Americans learnt a great deal during the war from our experience and expertise.

To conclude this little survey of Harris's attitudes I will make just two points from his time as CinC, when he directed the vast enterprise

that constituted Bomber Command. First, in my judgement as his biographer, he never lost sight of how much was entailed in enabling it to do its business. His copious correspondence files make it clear that he was always ready to support his specialist staff on subjects where his assistance was likely to be useful.

My second point can be illustrated by what happened when, in 1943, he wrote to Air Marshal John Bradley, a former Director of Equipment who was now Deputy Air Member for Supply and Organisation. Harris was worried about the practicalities of handling the growing quantity of bigger, heavier and more complicated bombs; to overcome the irremediable shortage of skilled manpower more mechanical aids, especially cranes, were essential, yet he had been told consistently that these could not be provided. Bradley's almost immediate response was not just to investigate but to follow up with a bomb handling demonstration that covered much more than cranes. Writing subsequently Harris told him that 'were it not for your great help we would still be arguing with the Air Ministry Directorates on questions of policy, instead of dealing with the allocation of a flood of useful equipment which has followed as a result of the demonstration.' As I myself wrote after reading this correspondence:

> 'Sharply critical of authority though Harris often was, he usually had good cause, and when he came across someone like Bradley, who was prepared to try to move mountains on his behalf, he was ever generous.'

On that cheerful note I will turn back the clock a couple of years to a very different part of the world – Singapore in 1941. Here much work was going on in the belated attempt to build up the air defences but unfortunately the RAF and the other Services out there were at the back of the queue for everything. A simple listing of the supply difficulties gives some idea of the problems. There was no maintenance group – nor even a chief maintenance officer at the Headquarters – to provide central direction. There was a great scarcity of spare parts for the limited numbers of, often elderly, aircraft; thousands of packing cases still lay unopened when the actual fighting started and there were far too few properly skilled tradesmen. Nor did the Air Ministry help; an instruction in August 1941 laid down that only equipment not available from the Commonwealth was to be

demanded from the UK. Moreover, as an RAAF equipment officer at the MU at Seletar commented, the accounting system was a perfect peacetime method of preventing loss or pilfering but useless in war. Furthermore, Seletar, the main RAF station, was a classic case of having too many eggs in one basket: not only did it provide most of the support for the whole Command but it was also a main airfield and flying boat base. In all too many respects Singapore in 1941 provides a perfect example of how not to organise for war.

In many ways India, which soon afterwards moved into the front line, was no better. Sir Richard Peirse, the RAF CinC who arrived in New Delhi in March 1942, described everything as being unbelievably primitive: the totally inadequate staff and complete lack of most things essential was quite devastating, and the Air Headquarters organisation would have made a loss if it had tried to run a perambulator hire service. Hitherto the seven antiquated RAF squadrons had all been located in the north-west to counter threats from across the border in Afghanistan, and their maintenance and supply was entirely concentrated in Karachi. Now, suddenly, the main threat had switched two thousand miles to the east and a truly mammoth task lay ahead of all three Services in order to meet it. For the RAF this would entail bringing the airmen, aircraft, much of the engineering and transport, and many raw materials round the Cape from the UK or USA, plus fuel from the Middle East. Internal transport, essentially the already heavily laden railway system, was another critical factor. So the building of new airfields, both for air transport and for military operations, was paramount and the plan laid down in March 1942 was to build no fewer than 215 in the next eighteen months.

To support them – and the RAF squadrons that would eventually use them – some eleven new maintenance units had to be set up to cope with aircraft erection and storage, airframe, engine and ancillary repairs, and equipment supplies. By the end of 1943 they were serving some sixty squadrons and looking after 500 non-operational aircraft and, thanks largely to the efforts of their countless tradesmen, working often in most exhausting conditions, serviceability had risen to 80% from the 40% of June 1942. These efforts are all too often largely ignored – not so, I hope, here today. Also to be remembered are the many transport aircraft, moving personnel and supplies right across India, as well as supporting the Army's land operations in the

The origins of the air transport fleet that would eventually underpin the retaking of Burma in 1944-45 lay in a number of ex-civilian Douglas airliners impressed and/or purchased in 1941-42 to supplement the handful of ancient Valentias then available to No 31 Sqn. This one, a DC-3 (LR231), was photographed at Myitkyina on 3 May 1942 while evacuating personnel of No 45 Sqn to India. Two days later, back at Myitkyina in the course of another sortie, it was destroyed on the ground during a Japanese air raid.

India/Burma border areas. So by the end of 1943 a whole operational air force had been created almost from scratch at the end of long and vulnerable supply lines.

By this time the great battles of the Burma war were building up and the aspect I want to stress is the critical contribution of air supply to the Allied victories. The techniques of dropping supplies by night were first attempted in aid of Wingate's Chindits in early 1943, and from then on the joint Army/RAF base organisation was built up in NE India to provide the support needed by the growing number of Dakotas. By early 1944, as demonstrated in the Battle of the Arakan, General Slim was convinced that it was the ability to keep the forward troops supplied by air that gave them the certainty that they would eventually be reinforced – air supply was becoming recognised in itself as a weapon of war. The acid test came in April when 150,000 men, including 6,000 RAF, were cut off by the Japanese Army in the area around Imphal and Kohima. For the next three months the 120,000 soldiers and airmen who had to remain there were supplied entirely by the RAF and the USAAF flying over the mountains from Assam – an unprecedented achievement and a permanent landmark in

the history of air supply.

From then on, Slim's forces continued to rely on air supply as they advanced southwards into and through Burma. With the transport force increasing in size and some of the aircraft having to operate from bases further forward in order to stay within range of the advancing troops, the support organisation also had to move up, and it all became something of an organisational nightmare. So by 1945 the whole emphasis was on mobility, a critical feature which had to be reflected in the dispositions and tasks of the vast supply, servicing, repair and salvage organisations that had been built up in Ceylon and India west of the River Brahmaputra.

There is no question that Slim's victory of 1945 would have been utterly impossible without the superb Anglo-American air supply operation. Yet incredibly, as I stressed in my book, those back in the UK, from Portal downwards, were unaware of the RAF's overall contribution and in particular the 14th Army's dependence on it for its maintenance. As Air Vice-Marshal Hardman, who commanded the RAF's transport force, wrote in his dispatch:

> 'The whole campaign has been a striking illustration of a fact new in warfare – namely that air power can be used to transport, supply and support ground troops entirely independently of ground channels. This has been South-East Asia's contribution to the art of war.'

That has all been very brief, but I hope it may have served to stimulate a spot of discussion later on.

EXPLOSIVES
Wg Cdr Mike Wooldridge

Mike Wooldridge entered the Service from Oxford, trained as a pilot and earned his wings before the 1974 Defence cuts deprived him of a flying career and he became a Supply Officer. He served at Leeming, Luqa, Chilmark and Hendon then became Staff Officer to AO Maintenance at HQ Support Command. There followed the Falklands, Brüggen, MOD, HQ Strike Command and a tour on the DS at Bracknell before he left to join Waitrose, where he has been since 1997.

You have already heard about the development of the maintenance organisation, of which the supply function was an integral part, from a previous speaker. It falls to me to describe one of the many specialisations within the supply function, and in this case it is explosives.

As many of you will know already, in the last thirty or forty years, rationalisation of most activities within the armed forces has taken place and the explosives business is no exception. My brief today, therefore, is to chart the supply organisation's involvement with explosives and associated materials and I intend to do this up to the time, a decade ago, when our last major storage facility at Chilmark was closed.

Over the next twenty minutes, I intend to:

- trace the development of the explosives organisation and the support provided to the RAF front line during the war;
- review the major issues associated with providing an adequate supply support service for explosives;
- briefly consider other things which were, and to an extent still are, classed as explosives, eg chemical weapons;
- discuss some of the major problems encountered with explosives storage such as the accidents at Llanberis and Fauld, and
- outline the drawdown and disposal plans implemented at the end of the war and which ran on for years afterwards.

I shall then hand over to Air Cdre Mike Allisstone, who will look at the supply organisation's role in the storage, custody and movement of nuclear weapons in which he was engaged during the early 1960s. Thereafter, I shall conclude by looking briefly at the transfer of responsibility for the storage of bombs, etc to the naval storage facility at Fort Douglas, which is now part of the Defence Logistics Organisation.

You have previously heard that the arrangements put in place for supporting the front line were sometimes afterthoughts and rarely adequate to provide for the changing situation and this was as true for explosives as it was for general and aircraft equipment.

It must first be said that, in practice, almost all predictions as to the size and shape of the explosives storage business proved to be underestimates and there was a constant search for more accommodation and storage. Calls on the transportation system led to serious problems with providing sufficient capacity and, for example, it was pointless laying on railway sidings for explosives storage sites when the rail infrastructure was already at saturation point further downstream.

Within the main depots and the forward ammunition depots it became necessary to compromise early on. Safety distances were reduced, store capacity increased and locations such as roadside verges were used to stack bombs. Furthermore, given that the principal bomb in use before the war was the 250 lb General Purpose bomb, the steady increase in the weapon capacity posed significant problems with regards to stacking, handling and the ability to store the bombs safely.

Whilst a 250 lb bomb could be handled by a couple of men, the 500 and 1,000 lb bombs required special handling aids and the introduction of 4,000, 8,000 and 12,000 lb High Capacity weapons along with the 12,000 lb TALLBOY and 22,000 lb GRAND SLAM meant that the physical dimensions of the bomb became significant factors in the safe and efficient handling of these weapons.

Changes of policy and procedure were made constantly to improve efficiency and reduce the manpower burden. It soon became apparent that the system of moving bombs from the manufacturer to the front line units via the main and forward ammunition depots was inefficient and demanded nine separate stages. It was also obvious that the

With the two airmen providing scale, this picture conveys some impression of the problems involved in handling large weapons; from the top, 12,000, 4,000 and 2,000 lb HC and 1,000 and 500 lb MC bombs.

concept of universal holdings at the depots was cumbersome and difficult to manage. The solution was to convert the main depots into reserve depots with their stocks being used to support surges in home consumption and provide the source of bombs for major overseas out-shipments. In addition these depots would also look after obsolete or obsolescent stocks of weapons. Supplies from manufacturers would be shipped straight to the forward depots which were renamed as Air Ammunition Parks. In some cases with specialist weapons, delivery would be direct to the operational unit.

Control and co-ordination of this arrangement was vested in a Master Provision Officer (MPO) at Fauld. However, the title is probably a misnomer, since the role of the Fauld MPO was to co-ordinate distribution of stocks from storage locations to units in response to units' daily updates of their consumption and immediate requirements.

One aspect of the RAF's equipment business, one which is not immediately obvious, is that, with the entry of the United States into

the war, some storage locations were given over to the US forces and this required another wave of re-brigading as the RAF moved from the selected bases. US military personnel were also given instruction in the use of British infrastructure equipment and training in RAF storage and safety procedures.

Before moving on to look at some major incidents and their impact on the supply system, I want to deal with the thorny topic of chemical weapons. I shall not, however, look at the industrial side of this story, although this is of itself an interesting topic.

On the subject of the British forces holding and using chemical weapons, the government was unambiguous in the instructions from the War Cabinet to the Air Ministry – and here I quote:

> 'Should the enemy initiate chemical warfare, HM Government intends to retaliate in kind with unrestricted heavy-scale bombing against centres of German population best calculated to bring about the collapse of German morale.'

When the AASF went to France in support of the BEF it took stocks of chemical bombs as a precaution but these were rapidly evacuated and returned via Fowey and railed to Buxton, where they were inspected and stored at Harpur Hill in the basement gallery – where it seems likely that ventilation would have been least effective!

By the end of 1940, almost all the main and forward ammunition depots held some stocks of chemical weapons, although, sensibly, they tended to be stored in remote sub-sites. However, it was decided to ensure that chemical weapons were segregated from conventional munitions and the best way to ensure adequate ventilation, and the safety of the wider population, was to set-up a dedicated depot. The site chosen was remote land at Bowes Moor about 10 miles south-west of Barnard Castle. The site was served by a rail link and wooden storage huts and open areas were soon prepared to allow bombs to be stored in the open under tarpaulins.

It was not thought necessary to fence off the site and local sheep therefore grazed the land, making short work of the covers but, more seriously, puncturing the thin casings of the 65 lb bombs – with fatal results to the sheep and much consternation to the RAF. Sheep-proof netting and gates were installed and the depot was subsequently rebuilt and extended with gas-proof air raid shelters being provided.

Major issues with chemical bombs were:

- They were light-cased and easily punctured.
- The sealing tended to decay, causing leakage.
- The desiccant reacted with impurities in the metal casing.

Unlike conventional weapons, there was no turnover of these bombs, hence the continued supply of filled weapons, which deteriorated dangerously giving rise to major concerns. The solution was the forward filling station. Five of these units were developed, the first being at Little Heath, a sub-site of Barnham. In essence, the chemicals were stored in lead-lined concrete tanks and stocks of empty cases and other items were stored on-site so that filling could begin only when a need for the weapons was determined. Eventually, two of the five filling stations were transferred to USAAF control but there was never an operational use for the weapons and at a cost of nearly £¾ million it was money wasted.

That said, it is worth noting that three squadrons of Boston light bombers were trained to use the 'low spray' method whilst three Stirling squadrons were capable of delivering 65 and 400 lb gas bombs.

Although, as already mentioned, the weapons were designated for retaliation rather than first strike, the *modus operandi* was either:

a. to attack the target with high explosive and follow with incendiaries before stoking the whole thing up with phosgene, thereby causing heavy civilian casualties, or

b. to use high explosive and then mustard gas – the thinking being that every mustard gas bomb would contaminate something and therefore hinder the enemy.

It was fondly expected that the main threat would come after the invasion of Europe when the enemy might feel minded to use these weapons against the allies.

I should now like to turn to some of the major events which caused disruption to the supply support provided from the explosives depots during the war years.

It is worth noting first, however, that enemy air action did not cause major problems or disruption to the supply depots themselves,

although the flow of explosives to the front line stations was sometimes impeded by air attacks against lines of communication. The depot at Altrincham was attacked during raids against Manchester but although some damage was caused there was no sympathetic explosion of the ammunition stored there. The site at Pulham was attacked several times and it was thought that the presence of a large airship hangar on the site made it more obvious. The hangar was, therefore, camouflaged after which the number of attacks increased!

You will recall, in an earlier presentation, that the depot at Harpur Hill, above Buxton, had been created by building galleried storage on the floor of a quarry and then top filling to provide the necessary overhead cover. The same principle had been adopted for the construction of another depot in a slate quarry at Llanberis, using the detritus from the quarry workings to provide the headcover.

There were many basic flaws in the design of Llanberis, as regards its efficient working. For example, the underground railway ran into two sidings adjacent to each other and displaced towards the western side of the depot. The floor plan and end view in the diagram at Figure 1 show that, as the bomb lifts were all located on the eastern siding, it was possible to offload ammunition into only one gallery on the lower level from the western siding. On 25 January 1942, a train with twenty-seven wagons of bombs from the Royal Ordnance Factory at Swynnerton was shunted into the sidings and a squad of twenty-two men began off-loading. Almost immediately strange noises were heard and serious cracks began to appear in the ceiling of the lower level in the area of the railway track. The workers fled towards the emergency exit. Almost immediately, the ceiling collapsed onto the train, the walls came down and the bombs stored on the upper level poured into the lower level in an unseemly heap. It was judged that, but for the strengthening provided by the ammunition lifts and the overhead gantries of the cranes, a complete collapse of the mine at Llanberis would have taken place. Nobody was killed or injured but some 40% of the site was unusable with the stocks trapped beneath the rubble. Whilst there were 75,000 bombs in the quarry, mostly either 250 or 500 lb weapons, the main danger was posed by 18 tons of bulk TNT and 23,000 rounds of unstable Smith Gun ammunition.

The enquiry into the accident revealed that the contractor had been urged to use the minimum amount of cement in the construction of the

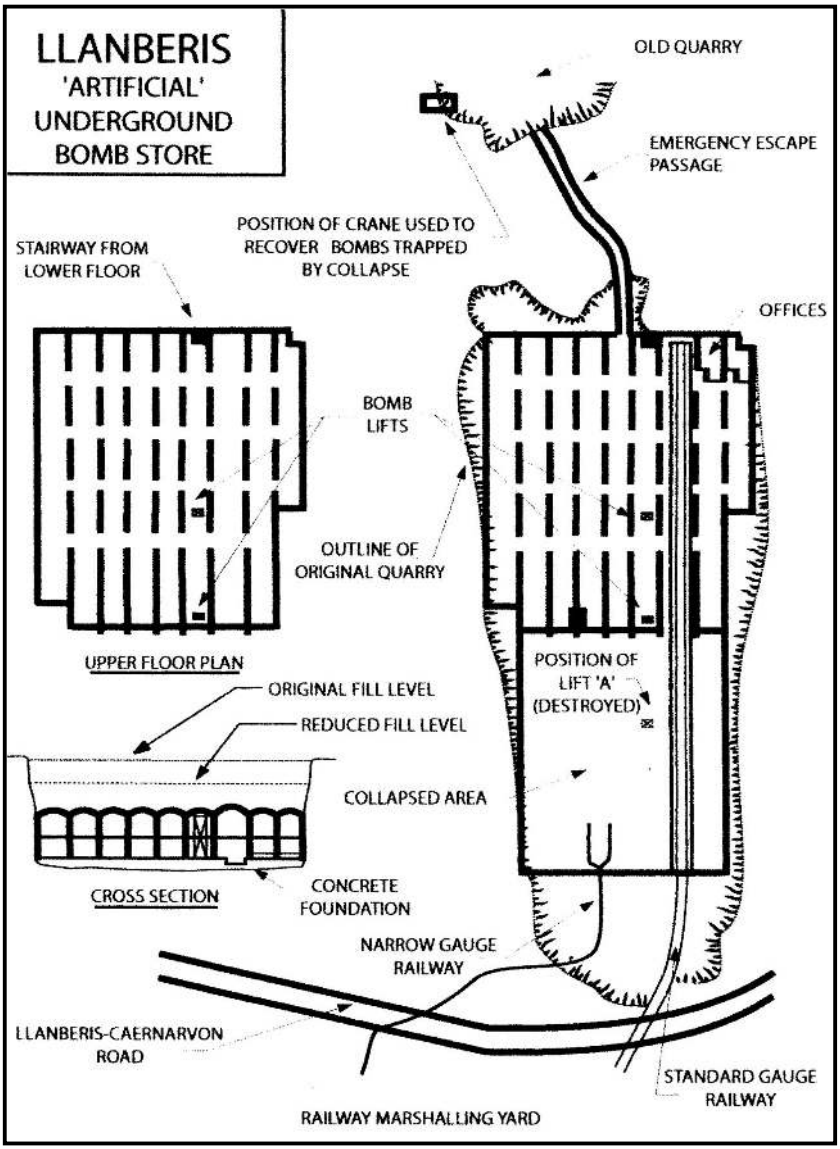


Fig 1. *Llanberis Bomb Store (the drawing is 'inverted' in that North is at the bottom).*

load bearing concrete; the perpendicular walls were not always vertical and the load bearing walls on the two levels were often displaced by several inches from each other, which meant that loads from the arched roof were not transmitted vertically to the bedrock but were, in fact, shear stress loads on the floor of the upper level.

What did not emerge until the enquiry was that a similar collapse had happened at an Army mine at Monckton Farleigh in 1940 but that details of the accident had been concealed, thus preventing the RAF and its Works Department from benefiting from the experience.

The dangerous task of removing the bombs from the quarry was set in hand as soon as practicable but initially this had to be done by taking them out of the emergency exit one at a time. A crane was brought in later and the recovery speeded up markedly. Much of the assessment and recovery work was undertaken by Dr Godfrey Rotter, an Air Ministry scientist of whom we shall learn more later.

Eventually, the Llanberis site was recovered with about half the gallery space being used and the demolished area being given over to the open storage of small arms ammunition under tarpaulins. Although it remained a main depot the majority of activity was undertaken at the maintenance sub sites linked to it. However, and again as we shall see later, Llanberis was to fester as a troublesome sore until comparatively recent times.

The repercussions at Harpur Hill were obvious and an examination of that site revealed similar cracks to those at Llanberis which had been optimistically dismissed as ‘settling cracks’ and of no real consequence. The backfill at Harpur Hill was removed to a depth of 12 feet only and the storage space was evacuated so as to facilitate repair work. Some 15,000 tons of bombs were removed to other locations over a period of 3½ months, whilst 3,000 tons of chemical weapons were also sent away to be stored in a railway tunnel at Butterton in Staffordshire. A programme of shoring up with steel arches and bricking up was implemented and the depot was then returned to use but storage of chemical weapons, boxed TNT, land mines and Smith Gun ammunition was excluded.

Several other incidents took place, for example, in December 1940 a still-fused 250 lb bomb, returned from Linton-on-Ouse, exploded whilst being off loaded at Brafferton, killing three airmen, wounding several others and setting fire to an ammunition lorry. The situation

was saved from getting much worse by the prompt action of two NCOs who were each awarded the BEM for their actions. In February 1944, an explosion in an ammunition train at Catterick Bridge killed an airman and caused serious damage but it was at Fauld that a major disaster occurred.

Shortly after 1100 hours on 27 November 1944, a massive explosion occurred in the old gypsum mine and some 4,000 tons of bombs were detonated, leaving a crater some 90 feet deep and covering an area of 12 acres. Upper Castle Hays Farm, immediately above the source of the blast, its inhabitants and all its livestock were obliterated, extensive damage was caused to surrounding properties as far away as Burton-on-Trent and a reservoir, used by a nearby plaster works, burst, causing the works to be flooded and many workers drowned.

A major rescue and recovery operation was immediately mounted, although at first it was not known what had caused the explosion, the extent of the damage underground or the state of the remaining bombs stored in the area, nor, because of the gas and smoke, was it possible to carry out any sort of inspection. Surprisingly, most of the buildings on the RAF's administrative site were relatively undamaged but the death toll reached seventy, including a handful of Italian former POWs who were volunteers working in the mine.

Rumours as to the cause of the explosion abounded and ranged from sabotage by the Italians, through a hit by a V2 rocket, via a 'spy' who had been reported to have been seen in the area, to a fault in some American weapons stored in the mine.

The immediate recovery operation was undertaken in conditions of great danger and resulted in the award of three George Medals and three British Empire Medals for bravery, as well as a number of commendations. Subsequently, the actions to make safe the mine, recover all the weapons from inside and set in hand the reconstruction of much of the storage led to the award of a further George Medal – to Dr Godrey Rotter of Llanberis fame.

The formal enquiry explored in detail many possibilities for the explosion and the deliberations would make an interesting and absorbing session of its own. However, there was strong evidence that two men were chipping out the composition explosive from a 1,000 lb medium capacity bomb using a brass chisel and steel hammer – a

practice expressly forbidden because the explosive will ignite readily if struck between brass and steel but apparently one regularly undertaken!

Disposal Of Surplus Munitions

In describing the disposal of surplus bombs, explosives and chemical weapons as the war ended and in the years that followed, I feel I need to issue a 'government health warning' for anybody who is of a nervous disposition, for the saga of weapons disposal is not one which would bear too much scrutiny in current times.

In looking at ordnance disposal, it must be remembered that responsibility for getting rid of some elements of weapons used by the United States forces fell to the RAF, as did the clearance of some German weapons found and, strangely, brought to the UK from Germany.

As the war entered its final phase, it became obvious that the ongoing and contracted procurement from the Ordnance Factories could not be turned off overnight and with the reduction of consumption, there would have to be a significant temporary increase in storage requirements followed by a disposal programme. The immediate solution was to allocate surplus airfields to the main explosives storage units and to store weapons in the open on the runways and perimeter tracks. The size of the problem can be gauged from the quantities of bombs and conventional explosives held:

300 × 22,000 lb GRAND SLAM bombs
3,250 × 12,000 lb bombs
27,000 × 4,000 lb 'Cookies'
250,000 × 1,000 lb bombs
17,000,000 rounds of 20 mm ammunition
35,000,000 rounds of .303 inch ammunition

In total some 400,000 tons of weapons, and that at a time when the authorised holding was less than half that amount.

Before looking at how the disposal problem was tackled it is perhaps worth remembering that over 50,000 tons of bombs were stored in the open several layers high, on verges besides minor roads and fully exposed to the elements. Alarmingly, the roadside storage facilities were not finally cleared until as late as 1951, nearly seven

years after the end of the war. Furthermore, it became necessary to undertake periodic servicing and maintenance work on weapons which had not been necessary in war because of the rate and speed of consumption. It is also worth bearing in mind that considerable volumes of storage had been given over to storing obsolete weapons and, as these were rarely inspected, they deteriorated and became hazardous.

Immediately after the conclusion of the war in Europe, some half-hearted and completely impractical methods were tried to get rid of surplus weapons. Live bombs were dropped on the German base at Heligoland and many sorties were flown by bomber crews over the North Sea and bombs dropped unfused into designated areas but such schemes were both uneconomic and completely inadequate for the volumes of explosives involved.

In essence there were only three practical methods for disposing of surplus bombs.

1. Return to factories for the fillings to be literally ‘boiled out’.
2. Demolition and/or burning.
3. Deep sea dumping.

Return to the factories for ‘boiling out’ was obviously the most environmentally friendly way to proceed but it was also the most expensive, time consuming and not without risk.

Demolition and burning was also undertaken but despite using remote ranges for much of this work, it attracted a good deal of opposition from the civilian population. As regards chemical weapons, the informal, and sometimes haphazard, methods used would cause much alarm today. For example, one plot was to pile mustard gas bombs in a heap and to add incendiaries to the stack before pouring petrol over the whole lot. At this stage, tracer rounds were fired into the mix with the aim of fracturing the bomb casing to release the chemical and then cause a blaze which, supposedly, destroyed the agent. When the conflagration died down, the whole lot would be covered in bleaching powder.

The final option was deep sea dumping and after a review had identified that only one suitable port existed in the country which met the requirements – for remoteness, a safe harbour which would not impose restrictions on other shipping and where only limited collateral

damage would result if an explosion took place – the port of Cairnryan was selected. No 275 MU was formed there and tasked with managing the deep sea dumping programme, much of which was to take place in Beaufort's Dyke, a trench in the northern Irish Sea.

To do their work, No 275 MU used four LCTs and disposed of 40,000 tons of stores at 100 tons per sortie during the first six months of operations. Two more craft were added as the task continued but it was only practical to get rid of the smaller weapons because of the difficulty of manhandling the larger bombs over the side.

During the immediate post-war period, and as recently as the 1950s, it had been decided that the only sensible way (and I use the term advisedly) to dispose of the volumes of heavier bombs involved, was to take a ship-load of explosives and scuttle the combination in deep water. Several vessels were used in a number of tranches and they were sunk in water off the Hebrides, beyond the continental shelf but, more controversially, the sinking of a ship loaded with chemical weapons in a location which allowed the tidal flow to carry any fall-out to the Norwegian fishing grounds, is still a source of considerable concern to one of our staunchest allies.

For those who know Kent and the periodic scares which accompany the latest news about the *Richard Montgomery*, an ammunition ship loaded with 7,000 tons of explosives sunk just off sheerness in 1944, the deep sea dumping programme reflects little credit on the Service.

In conclusion, I just want to dwell briefly on the final chapter in the Llanberis fiasco.

In 1943, and after the depot had been returned to use, wholesale destruction of obsolete incendiaries took place and this was followed from 1944 by an extensive disposals programme of unserviceable ammunition. Four disused slate pits were used, some of them nearly 900 feet deep.

Two main methods of disposal seem to have been employed. The first was incineration. Steeply sloping steel chutes were constructed and the ammunition was poured down these chutes into rudimentary furnaces at the bottom. Without satisfactory supervision, however, many explosives items came out of the chutes and lodged on ledges and in crevices in the rocks. The second means of disposal was the 'shaft method' which meant exactly what it said – simply tipping the

stuff down a disused mine shaft!

It was not until a decade after the war that some 70,000 Tabun nerve gas bombs, which had been taken from the Germans and brought to UK, were finally to be removed from North Wales and dumped at sea in three scuttled ships in a scheme ridiculously called Operation SANDCASTLE!

Activity at Llanberis eventually began to run down and the site was fenced off with warning notices erected but these were widely ignored and quantities of explosives were removed by civilians, with one boy being seriously injured when a device he was dismantling exploded. In 1961, the Air Ministry tried to persuade Caernarvonshire County Council to take over the site – an offer which it politely declined. With the approach of the Prince of Wales' investiture in 1969 it was finally decided to try to clear up the mess, a task that had been made even more complicated because, after the RAF had finished at Llanberis, sections of the quarry walls had been demolished in an attempt to cover up the debris.

Amongst the more serious things discovered was a three-acre lake which, when surveyed by a Royal Navy clearance diving team, revealed a 90 feet high heap of unexploded ordnance intermingled with all sorts of other rubbish. Another lake on the site revealed much the same and some 20 million gallons of water had to be pumped out before clearance work could start in earnest.

When the task was completed at the end of 1975, 352 tons of high explosive had been recovered, 1,400 tons of explosive components and 85,000 tons of non-explosive debris. You will not be surprised to learn that the site has still not been certified safe.

But the Supply Branch was not only involved in handling conventional explosives, it also had a great deal to do with the RAF's nuclear weapons from the late 1950s until the last one was returned to the makers in 1998, and to talk about the early part of that era I will hand over to Air Cdre Mike Allisstone.

NUCLEAR WEAPONS AND No 94 MU, RAF BARNHAM

Air Cdre Mike Allisstone

Mike Allisstone was commissioned into the Equipment Branch from Cranwell in 1954. After serving with Nos 101 and 542 Sqns in Bomber Command, he spent two years in Aden before specialising in explosives and fuels. His subsequent career included a stint in Germany, command of RAF Quedgeley and several MOD appointments, culminating as Director of Supply Policy & Logistics Plans (RAF). Following his retirement in 1988 he spent fifteen years working with a variety of charitable and welfare trusts.

Some of you may find some of what I am about to say vaguely familiar, as I wrote a piece about my time at Barnham which was published in Journal No 26 some three years ago. I have been asked to repeat that today, and to include one or two illustrations – insofar as there *are* any of such closely-guarded secrets – and I have taken the opportunity of adding a little to the script in the process.

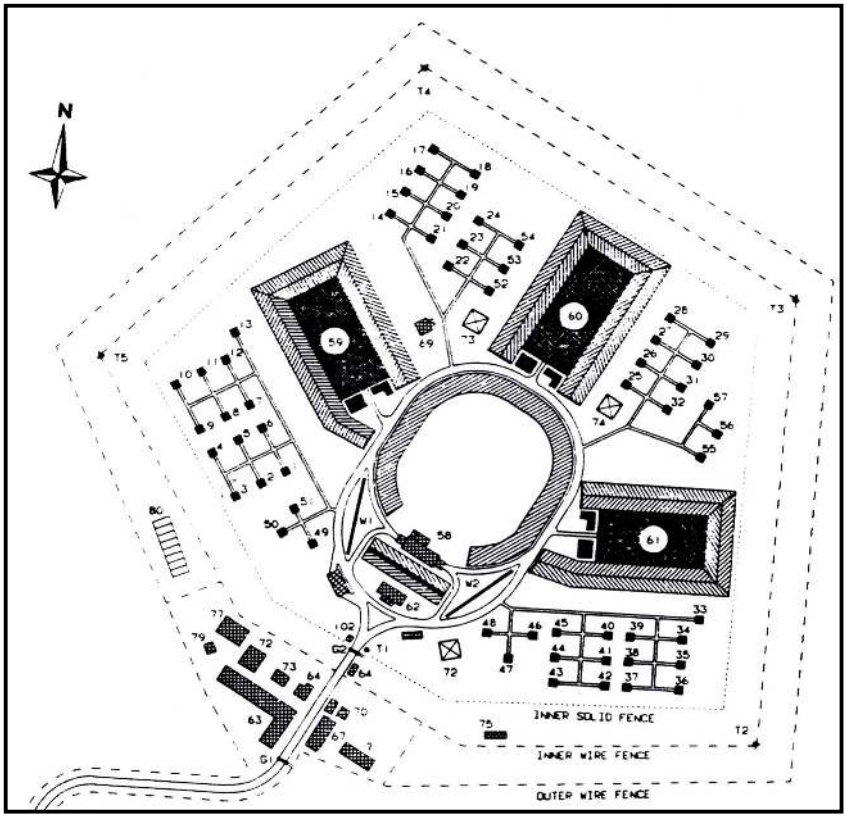
As a flying officer of the Equipment (now Supply) Branch, I did the conventional Explosives Specialist Course at RAF Calshot in 1959 and was posted from it to one of the two nuclear weapons depots within Maintenance Command: No 94 MU at RAF Barnham, near Thetford in Norfolk. This appointment required me to do a further one week's familiarisation training at RAF Wittering so that I had a basic understanding of what each weapon looked like, how it worked and the risks of fire, explosion and the various radioactive hazards which could ensue in the event of an accident in storage or in transit. I am not a nuclear weapons expert.

Barnham was then a very recently completed unit built on the site of a WW II Ammunition Depot, part of which was permanently sealed off, having apparently stored some form of war gases. I never did discover quite what at the time and Mike Wooldridge has now enlightened me! Apart from the off-base married quarters in Barnham village, virtually everything was brand-new, but on a much smaller scale than a full-sized RAF station. There was a domestic site by the

main Thetford-Bury St Edmunds road, and a separate technical area (known colloquially as 'Top Site') crowning a slight rise about half a mile behind the tiny Officers Mess, the whole unit being set in a naturalist's paradise of heathland and scrub, with great flocks of lapwings and, in season, much bright yellow gorse – nature's own barbed wire.

The unit was commanded by a wing commander of the Equipment Branch, with an Equipment squadron leader as his second-in-command, an Armaments squadron leader with an Electrical Engineering deputy and a Mechanical Transport Officer plus an RAF Police flight lieutenant with several flying officer and warrant officer deputies. There was also a Secretarial pilot officer who acted as Adjutant, although most support services to the unit were provided by nearby RAF Honington. In addition there were a number of flying officer/flight lieutenant equippers whose duties included Stock Control Officer, Officer in Charge of the Storage Site, the Area Fuels Officer and the Unit Equipment Officer, while two or three others acted as Convoy Commanders when nuclear weapons were moved by road. There must also have been about a hundred NCOs and airmen; it was a wholly-uniformed unit.

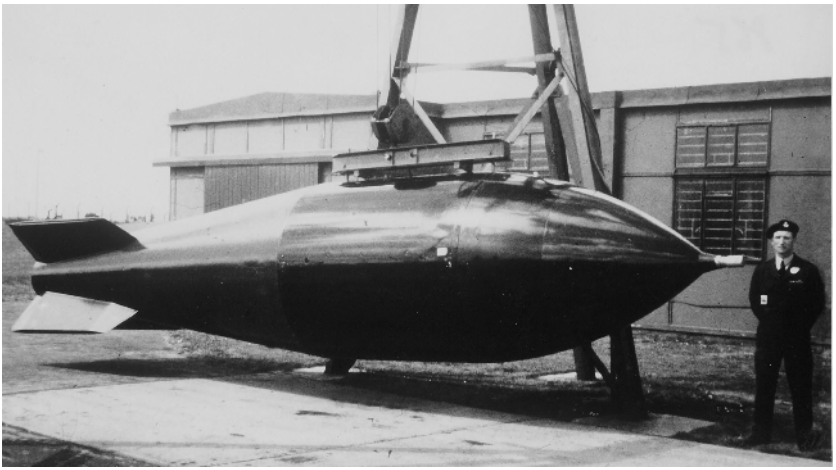
The diagram of Top Site (*on the following page*) shows two high, barbed wire security fences with two electric sliding gates, an inner solid fence (to prevent people outside from seeing what was going on) and three 'goon' towers. Not shown are the RAF Police dogs and armed guards with (we always understood) live ammunition; the whole area was floodlit at night. Locally rumoured to be breeding chimpanzees for a non-existent but convenient UK Space Programme, very few, in or out of uniform, knew that here were stored and serviced many of the RAF's nuclear weapons. Leading off a circular one-way road inside the wire, there were three very large semi-buried storage sheds for weapons, and fifty-seven individual tiny brick huts, each one of which could house one nuclear core, kept securely underground under double locks. There were electrical and armament workshops, a small Seco hut office for technical records, stock control, etc, and another as an RAF Police crew-room. There were three emergency water tanks. Entry and exit to/from Top Site was very tightly controlled and an unusually high level of security clearance was required to work therein. We all understood that, but we



No 94 MU's 'Top Site' at Barnham

were not exactly prepared for the over-enthusiasm of certain members of the RAF Police, who seemed to believe that their duties included covert observation of our extra-mural activities when bird-watching with our girl-friends on Thetford Chase!

Initially at Barnham I was a Convoy Commander, which involved sitting for hours at a time in a modified Morris J2 van with local radio communications, in charge of several six-wheeled Leyland Hippo load-carriers and a posse of RAF Police motor-cyclists, plus a specially-designed fire/technical safety vehicle with an RAF Armaments specialist aboard. We plied our trade between, on the 'wholesale' side, No 94 MU and various Royal Ordnance Factories, especially Burghfield near Reading, the Atomic Weapons Research



The 10,000 lb BLUE DANUBE.

Establishment at Aldermaston and sundry other suppliers, manufacturers of tail units etc, some of which went to quite unusual lengths to disguise what they actually did, including operating out of semi-derelict premises, Nissen huts, etc. Our 'retail' operations took us out from the depot to the Special Storage Areas (SSA) at V-Force stations such as Honington, Wittering and Cottesmore in what was, for us, the south of England because there was a sister depot (No 92 MU on the site of a WW II airfield at RAF Faldingworth, near Lincoln) which tended to deal with Bomber Command stations in the north.

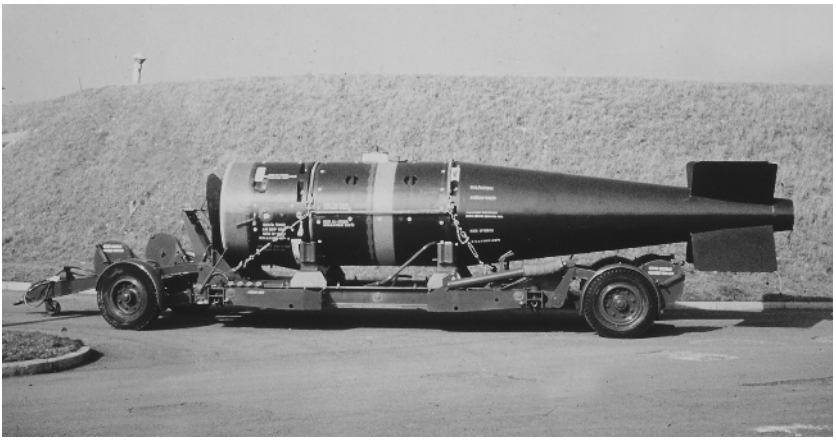
Most stocks of RAF nuclear weapons were held forward in the SSAs and were rotated through the depots for periodic servicing; depot stocks were, we understood, intended mainly for 'second strike' sorties. I remember hoping that we would be able to get these weapons forward to the front-line airfields and depart again before they became the subject of further attention by Soviet forces, although how long I expected to survive thereafter scarcely entered my head. The location of each weapon was dictated by the Air Ministry in London, (E18 Branch), theoretically working through Headquarters Maintenance Command at Andover and HQ 40 Gp at Bicester. In practice, however, E18 used to deal directly with each depot.

In the early 1960s, Barnham held stocks of (nominally) 10,000 lb BLUE DANUBE free-fall fission bombs, conveniently seen here

The 2,000 lb RED BEARD.

alongside a human being which demonstrates the size of the weapon. These were gradually superseded by physically much smaller 2,000 lb RED BEARD fission weapons. Both of these bombs had spherical implosion main charges in the centre section of the weapon, each sphere being made up of a number of shaped explosive 'lenses' which fitted tightly together to form a large ball. These shaped charges were detonated simultaneously from the periphery of the sphere and were designed to focus their shock-waves inwards, towards its hollow centre into which a small spherical core of uranium U235 was inserted shortly before take-off, thus radioactively arming the weapon. The implosion compressed the uranium core into a dense supercritical mass, which resulted in a chain reaction, or 'fission', the instant release of a huge amount of heat and other radiation, and hence the requisite nuclear explosion.

As I have said, the U235 cores were removable and stored separately in individual below-ground, double-combination safes to which no one person had sole access. Each core was kept inside a drum lined with heavy metal, just about man-portable (always with an escort) and special precautions were taken not to allow one core to come within a certain distance of another, again to avoid the risk of a



YELLOW SUN.

nuclear chain reaction. Those who were involved in working with these cores, including carrying them, were listed by the RAF medics as 'Radiation Workers', presumably to enable statistics to be kept of how many of us later developed any related disease. I am now nearing 72 and I am unaware of any of us having done so thus far! In my day, the cores were normally transported by road, separately from the weapons, which meant that any hijackers would not get away with a completely viable nuclear bomb. The cores were in large 'shock-proof' containers which were fixed to the floor of the load-carrying vehicle and designed to survive the most severe accident imaginable. I believe that the containers were tested for the equivalent of falling off Beachy Head, surviving intact and with no leakage of radiation.

BLUE DANUBE was a fairly crude device by modern standards: it was a large pointed tear-drop in shape, it had a maximum diameter of perhaps six feet and it was moved by road in one piece (minus its core) inside a long Queen Mary-sized trailer, which looked rather like a glider-transporter. RED BEARD was much more compact, with separate nose and tail sections – removable for servicing or transportation on wheeled frames called 'stillages'. The mighty YELLOW SUN fusion bomb was mainly dealt with by No 92 MU and I had very little knowledge of it, but its megaton yield invariably gave me a sense of awe on the few occasions on which I saw one. I had no experience at all of RED BEARD's successor, WE 177.

If convoys had explosive components or radioactive cores aboard and thunderstorms threatened, we were required to find the nearest parking area and to pull in until the squall had passed. This wasn't always easy, as we often had three Hippos, sandwiched between the two J2s and the safety van, plus four police motor-cycles to accommodate, and most lay-bys were too small. On one occasion a storm beat us to it; there was increasing lightning and a lot of noise, and then one exceptionally vivid flash hit a lamp-post right alongside one of the still-mobile Hippos just ahead of me, followed immediately by the biggest thunderclap I have ever encountered. The load-carrier swerved into the middle of the road and stopped almost dead in its tracks – and so did the rest of the convoy, narrowly avoiding a shunt in the process. As the RAF Police closed the carriageways in both directions, I leapt out of my J2 and went round to the Hippo where the driver was sitting transfixed and completely dumb-struck. We lifted him out of the cab, stiff as a board and still in the sitting position, and we laid him as gently as we could on the floor of my van. We then put a relief driver in his place and got the convoy moving again as quickly as possible. It eventually transpired that our victim, having seen the flash and heard the enormous explosion just to his rear, was convinced that the load he was carrying had blown up and that he was dead! It took him several days to recover.

There were scarcely any motorways in those days and I remember taking convoys through many towns, and especially through the middle of Maidenhead. The Hippos' exhaust pipes were fitted with spark-arresters which gave out a loud banshee wail, such that everyone knew we were coming from that alone, notwithstanding the police escorts with blue flashing lights. These pipes were positioned so that they exhausted to the front right-hand side of the vehicle, about two feet off the ground. In Maidenhead's one-way High Street the Hippo drivers discovered that, by keeping to the right and blipping their throttles at the right moment, they could lift the mini-skirts of the girls on the pavement alongside them – so our progress through such places was both noisy and hilarious, besides doubtless becoming known to every Soviet agent for miles!

After about six months of convoy work, I was re-appointed in 1960 as No 94 MU's Stock Control Officer, remaining on base for most of the time, supervising the manually-kept records on so-called

'Kalamazoo' cards bound in great ledgers, and scheduling the convoy work. I was also the direct channel for BROKEN ARROW incident reporting between our convoys out on the road and 10 Downing Street, who clearly would want to know of any nuclear incident straight away. I had to activate this link only once, when one of our Hippos experienced a runaway engine at the top of a hill in the outskirts of Reading. This was not an uncommon occurrence, arising, would you believe, from a design fault which routed a high pressure diesel fuel pipe actually *through* the engine sump. The ultimately inevitable fatigue fracture diluted the engine oil and the resultant fuel-rich mist escaped through the breather and directly into the engine's air inlet manifold, thus providing an uncontrolled fuel/air mixture. The standard procedure for dealing with this was to ratchet up the hand-brake and attempt to stall the otherwise unstoppable engine by putting it into gear and letting in the clutch. On this occasion it didn't work; the clutch immediately burned out amid clouds of white smoke and, with the engine screaming and apparently about to explode, the crew evacuated the cab. The driver then bravely attempted to turn off the external fuel cock but, before he could complete this, the extreme vibration shook the hand-brake off, the driverless Hippo set off down the hill and, at the first bend it encountered, it embedded itself in the front room of a terraced house. Fortunately the sole elderly occupant was in the back kitchen at the time, from which she emerged, dusty but unhurt, to offer everyone a cup of tea. The RAF Police did a good job of keeping the local press at a safe distance and the only national publicity was a small headline in one tabloid the following day entitled 'The Secret Something in Widow's Parlour', but they never did discover what it was! All this occurred shortly before I left but I understand that it helped to accelerate the supply of some rather more reliable load-carriers.

As a postscript, a few years ago I returned to Barnham, the domestic site having been handed over to the Army some years previously. Top Site had been sold off long since and was wide open to casual visitors so I wandered into a couple of the hitherto Top Secret Codeword storage sheds and noticed that, in one, old motor cars were being patched up. And the other? Well, it was a prime example of beating swords into ploughshares – it was being used to grow mushrooms!

THE CLOSURE OF No 11 MU, RAF CHILMARK

Wg Cdr Mike Wooldridge

And so to much more recent history and the closure of No 11 MU at RAF Chilmark. Chilmark had opened in 1937 as part of the rapid expansion that took place at that time in the face of the increasing threat from Germany. Much of its storage was underground in old stone quarries from which the stone for Salisbury cathedral and parts of the Houses of Parliament had been taken, but in fact the unit comprised a number of dispersed sites, some served by narrow gauge railway, in an Area of Outstanding Natural Beauty. By 1965, Chilmark was the RAF's only ammunition supply depot and was also its depot for packed POL

After a study by the MOD Conventional Armaments Study Team (CAST) into UK military ammunition storage facilities, it was announced in 1992 that, in order to save money in the long term, No 11 MU was to transfer its explosives stocks to the Army's Central Ammunition Depot at Longtown and close in 1995. Unsurprisingly this caused considerable dismay to the civilian workforce but, in spite of the efforts of an action committee to lobby Parliament, the closure decision was confirmed, but with the explosives now to go to the Navy's ammunition depot at Glen Douglas.

When I arrived at Chilmark in June 1993, a very good closure plan had been drawn up by my predecessor, Don Cannon, and my task was to execute it with as much efficiency, sensitivity and environmental responsibility as possible.

From mid-1993 the outload began: radiac sources to No 14 MU; packed POL to No 14 MU; non-explosive items and ammunition containers to various locations and, finally, explosives and ancillary components went to Glen Douglas by late-1994, most transfers being by rail.

The closure was a sad affair for the Chilmark workforce, one of my key aims being to maintain morale, retaining key staff while giving the workforce the best possible help in finding alternative employment, in or outside of the MOD.

Another key aim was to meet the many health and safety, conservation and environmental requirements of a closure. For 58 years, past generations of RAF, RN, Army and American staff had

been making, maintaining or disposing of explosives, including mustard gas, at Chilmark and what contamination might exist in its 343 acres was anyone's guess.

There were many anecdotal stories of past dumping activities at Chilmark but, apart from one known burial pit for mustard gas containers, there was precious little on record. We and our HQ knew that this time we had to do our best to clear up the results of any previous burial or dumping of explosives at Chilmark. The unit had to be thoroughly searched and cleared and an EOD team, lead by RAF EOD specialists, but staffed with EOD-trained Chilmark civilian armaments staff, was formed to carry out the work.

Chilmark is a site of Special Scientific Interest, famous for its Jurassic insect fossil beds, winter bat colonies and wildlife, including many protected species.

EOD clearance meant the initial clearance of all undergrowth, and the searching and, where necessary, draining of ponds. Health and safety requirements meant that all caves and air raid shelters had to be sealed off or filled in, all emergency water tanks emptied and filled in and unsafe buildings demolished or made safe. But how to do this without contravening the Wildlife and Countryside Act, interfering with roosting bat colonies, upsetting the mating season of the badger and the adder, killing fish or endangering dormice or crested newts? You think I'm joking, but I'm not – and the environmental groups and media were watching us.

Working closely with English Nature, and employing an eminent ecologist and bat expert, we did it. I could write a book about it, but not today!

The unit closed in March 1995, although EOD clearance continued until at least 1997. There were many finds that exposed lazy and irresponsible dumping, and the soil under the burning ground was so severely contaminated with burnt explosive and chemical residues that I believe it could not be certified as safe. However, I believe that in Chilmark's last days we had made strenuous efforts to do the right thing environmentally, and at the first attempt.

MORNING DISCUSSION

Air Cdre Derek Waller. I am surprised that neither Colin Cummings nor Henry Probert mentioned the malign influence of Lord Beaverbrook on the supply support of the RAF during the first half of WW II. The story is well covered in Anthony Furse's biography of Sir Wilfrid Freeman, which tells of Beaverbrook's decision in May 1940 to give new production sole priority and to put spares production on the back burner. This situation was not rectified until Sir Wilfrid returned to the MAP in October 1942 to re-emphasise, in the following January, the importance of producing spares as well as complete aircraft. As a result, by 1944, some 18% of industry's airframe labour was engaged in the production of spares, which was the equivalent of 110 Spitfires and 20 Lancasters per month. Perhaps it is this situation that goes some way towards explaining the low aircraft availability rates throughout 1941, 1942 and 1943 to which Henry Probert alluded. I wonder if anyone has any comment on that.

Air Cdre Henry Probert. I'm afraid not. It was not my intention to go into matters of that kind and I don't pretend to be an expert in them. That said, I would not question your basic contention – all sorts of peculiar things did happen as a result of Beaverbrook's rather self-centred approach, and the situation improved considerably once he had been edged out.

Wg Cdr Colin Cummings. Perhaps I could just add that, in order to establish some boundaries to the day, we specifically decided not to address certain topics. Perhaps we were wrong, but these included the work of the Ministry of Aircraft Production, and thus Beaverbrook.

Brig Tony Dixon. I feel a little like a ship out of water this morning, if that is an appropriate metaphor. I am a soldier, but I have served with the Royal Air Force, as a Ground Liaison Officer, and with the Royal Navy, so I'm not sure what that makes me.

Anon. A Fighting Cock! (*Laughter*)

Dixon. You're absolutely right – I actually served with No 43 Sqn! I cannot deny, as someone suggested earlier, that a certain amount of skulduggery does go on between the three Services, although I note that this was attributed exclusively to the Army and the Royal Navy!

More to the point, I just wanted to endorse what Henry Probert said about air supply being a weapon of war. I am currently studying this topic in some detail and, in view of recent events in Iraq, it is interesting to reflect that the first occasion that the British attempted to supply a Ground Force by air was at Kut in 1916 when aircraft of the RFC and RNAS tried desperately to sustain a garrison of some 24,000 people, which was, of course, a hopeless task at the time. One of the pilots, incidentally, was Miles Thomas who later became Chairman of BOAC. One last comment – in connection with the escorting of nuclear weapons. I had some involvement in that business in Germany and you would seem to have had a much easier time of it than we did with our American Custodial Detachments.

Leon Barker-Simpson. In the context of explosives, does Operation MUSIC, the monitoring of other people's nuclear capabilities, ring a bell with anyone?

Air Cdre Mike Allisstone. I have no specific knowledge of Operation MUSIC, although, I was at one time involved with No 542 Sqn which used to do some 'sniffing' for the fall out from atmospheric tests in 1956; they were operating from Gibraltar at the time. We had specially modified Canberras whose wing-tip tanks had been adapted for the purpose. They had an actuator which opened a vent at the front to permit air to be taken in and passed through a filter. Having spent most of my morning lolling about in a boat in the harbour, when the aircraft reappeared in the circuit, I would go back to the airfield to pick up the crew and download the filters which were then boxed up and sent back to London with a special marking which got them through Customs without any queries whatsoever.

(*If MUSIC was indeed the air sampling game, then whether by that or by some other name, it continued to smell as sweet for many years. In the Far East it was certainly being done by No 45 Sqn's Canberras*

in the mid-1960s, eg as Operations MONOMANIA and TENNON, and the task was subsequently undertaken by No 543 Sqn's Victors, No 27 Sqn's Vulcans – as in the accompanying photograph – and, with their demise in the 1980s, I believe that the torch finally passed to the VC10, although, with the moratorium on atmospheric testing, demand had more or less dried up by then. ***Ed.****)*

Air Cdre Peter Dye. From what has been said this morning, it is clear that the Royal Air Force recognised that warfare in an industrial age required a logistic system on an industrial scale and, notwithstanding the problems described, there was a clear view throughout the Service that Supply was hugely important to operational capability. This attitude contrasted sharply with that prevailing within the *Luftwaffe* where many officers tended to regard involvement in the supply business as being detrimental to their professional careers and, indeed, secondary to war fighting. I wonder if the panel would care to reflect on any other principles that they may have identified from their study of the history of Supply during WWs I and II, because such lessons will probably still be germane to the way that we do business today.

Wg Cdr Larry O'Hara. I think that there was a sea-change in attitudes during the First World War because Haig, in particular, decided that the provision of an efficient logistics system was far more important than respecting the Army's traditional methods. In effect Haig accepted that many of the support functions that the Army had always tended to provide for itself, would be far better organised on an industrial basis and that they should be run by professionals rather than trying to get military men to exercise an expertise which they simply did not have. With Lloyd George's support, Haig brought in experts, notably Geddes, to manage the railways and ports in France which completely changed the way that logistics were provided on the Western Front and, indeed, throughout the whole of the Army – and when Geddes took over as First Lord of the Admiralty there was a similar impact on the Navy as well.

Cummings. Interestingly, before the Second World War, attempts to get Lord Nuffield actively involved in the RAF's logistics business failed, because Nuffield simply didn't want to play. He thought that

the RAF lacked the capability, the capacity and the organisational skills to set up an arrangement with which he would be prepared to be associated, so, initially at least, Nuffield declined to become involved in the expansion of the Royal Air Force.

AVM Peter Markey. I think, Peter, that you, as an engineer, but also as a writer, have identified a lot of lessons through your research and through your publication. I think one of the themes that has come out of this morning is that lessons may be identified but that they are not necessarily learnt or applied; I notice that after the recent Operation TELIC, the MOD set up a system for registering 'lessons identified'. It is no longer considered appropriate to say 'lessons learned', which was what we used to say in the past.

O'Hara. One final point. There were three topics that were causing a great deal of concern at the Air Ministry in 1919 and 1920 and you may consider that all of these still have some resonance today. One was the amount of paperwork generated by the supply organisation; the second was the provision of support for the air force in Iraq; and the third was a dispute as to who should command the Supply Depot – an engineer or a supplier….

Cecil James. To end on a humorous note, we have been reminded that much of the labour force underpinning the supply organisation consists of civilians. Post-war it became important to maximise the civilian element because, of course, the civilian is cheaper than the serviceman. But there was one Director General of Equipment to whom 'civilianisation' really was a very dirty word and he resisted all sorts of attempts to replace airmen, right down to arguing over individual posts. When he eventually retired he took up an appointment as Secretary to a Diocese, Chelmsford I think it was, and a colleague of mine remarked 'It's going to come as an awful shock to him when he realises that God himself was happy to be a civilian carpenter!'

FUELS

Air Cdre Andy Spinks

Andy Spinks graduated from Cranwell in 1973 and subsequently served in Oman, Canada, the Falklands, Norway and Saudi Arabia before commanding the Tactical Supply Wing at Stafford. Following a tour in Air Plans and four years with the PJHQ and Strike Command, he served in the Balkans with 101 Logistics Brigade. After a tour at Wyton and another stint with the PJHQ he went back to the Middle East for Operation TELIC. He is at present Director of the Defence Fuels Group within the Defence Logistics Organisation.

My presentation will consider the following aspects:

- the supply of fuel in WWII, especially to support the Normandy landings;
- fuel supply in the post-war years;
- the Government Pipeline and Storage System;
- today's arrangements, and
- where we might go in the future.

I could have researched many different facets of the supply of fuel to expeditionary air forces in WW II but I have chosen to concentrate on the provision of fuel to UK bases, since that provides a useful thread throughout this short brief.

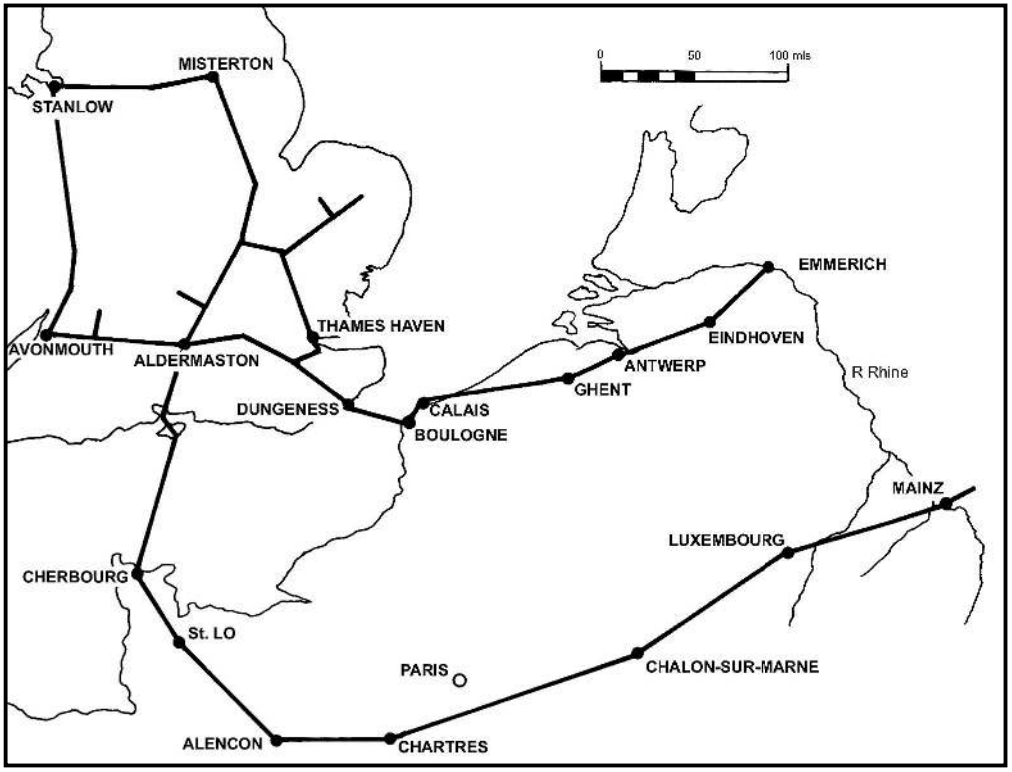
Construction of a fuel pipeline, linking the Humber, Mersey, Avon and Thames estuaries in a matrix arrangement, started in about 1936 and continued for the next twenty or so years. Most air bases were linked to this secure, and then secret, pipeline, which was largely completed (using hundreds of war powers wayleaves) during WW II. It then carried petrol, but it still exists today (and I will bring you up to date later) but the RAF pipeline probably gave Lord Mountbatten, the Chief of Combined Operations, the idea for fuel supplies to the forces being planned for the counter-invasion in France.

To quote from Adrian Searle's book on the project[1]…

> ‘To many of those consulted, it seemed a preposterous idea…an undersea pipeline laid across the bed of the English Channel to fuel the advance of the Allied Armies from the Normandy beaches. Nothing like it had ever been attempted before. It would have to be carried out in the utmost secrecy – concealed from friend and foe alike. The experts shook their heads. It was surely impossible.
>
> Fortunately, not everyone shared that view. The project called for the highest levels of engineering prowess and ingenuity – and an abundance of endeavour, enthusiasm and energy. It needed a flair for the unorthodox and a determination to succeed against the odds. That there were people who were both able and willing to fulfil such a formidable mixture of requirements, and turn this ‘impossible’ idea into astonishing reality, speaks volumes for the indomitable British wartime spirit.
>
> They produced one of the greatest of Britain’s wartime secret projects. In the words of Eisenhower, “it was second in daring only to the artificial Mulberry harbours.” It ran – initially at least – for 70 miles from the Isle of Wight to Cherbourg, and then on the shorter route between Dungeness and Boulogne. They called it Operation PLUTO – Pipe-Line Under The Ocean. And it worked!’

To be fair, the RAF had relatively little to do with the construction of this pipeline, which was in the hands of two Government Departments, the Army, and Industry. Nevertheless the RAF used the fuel, of course, and PLUTO moved 379,000 tons of it across the Channel (albeit that this was only 8% of the total Allied requirement). After the landings, the pipeline was extended into France and Germany, and many of these pipelines remain in use today, nearly seventy years after construction started.

Products were shipped in bulk in similar modes to today: ships, pipelines, bowsers and drums. In this sense, we could be accused of lacking vision, as each of these modes is still in use. But we have largely got away from the ubiquitous 45-gallon drum for the carriage of fuel, something the movers in WW II must have hated with a vengeance, and which is actually pretty dangerous for a volatile



The extended PLUTO network. There were seventeen pipelines between Dungeness and Boulogne (a total of some 500 miles of submarine pipe) and four to Cherbourg (another 280 miles of pipe).

product.

Thus fuel supply in the post-war years changed relatively little. The pipeline carried products to RAF stations and there will be few of you who do not recall the layout of horizontal tanks in the bulk fuel installations – and OC Supply's monthly dips (which continue to this day). For gases, oils and lubricants, the products changed in some cases with aircraft technology but the process remained much the same. Where history does play a part is in the advent of the jet engine. You will, I am sure, know that jet engines use a different cut of the barrel from internal combustion engines and, because the RAF effectively introduced the jet engine, we find ourselves to this day the custodian of the Defence Standard for jet aviation fuel. What this means in reality is that other standards follow the RAF's (now the Defence Fuel community's) lead and set world wide jet fuel standards based on Defence Standard 91-91. It is a sobering thought for me in my secondary role as Chairman of the Defence Fuels and Lubricants Committee.

The Cold War was epitomised in my view by RAF Germany (in which, to my regret, I never served, only visited), and RAF Germany also relied on a pipeline for its fuel, in this case called the Central European Pipeline System (or CEPS), which continues in a truncated form today. CEPS was, and is, run by a NATO Management Agency based in Versailles, but the UK unilaterally withdrew from the arrangement in 2001 when it closed its last main operating base in Germany, RAF Brüggen.

Let me now say a little more about fuel supplies in the UK, flowing through, what is now called, the Government Pipeline and Storage System (GPSS). It has been updated and modernised but its core remains much as laid down in the 1930s and '40s. Spurs were added to supply St Mawgan (from Falmouth), Kinloss and Lossiemouth (from Inverness), and Leuchars (from a rail terminal nearby) but otherwise most RAF stations and all USAF flying stations remain on the main system. This system is now owned by the Secretary of State for Defence (and I am the owner's representative) but it is run on MOD's behalf by a non-departmental public body called the Oil and Pipelines Agency (OPA). I sit on the Agency's Board to represent MOD's interests. The primary customer and *raison d'être* for the pipeline remains the RAF (and, with me as their agent, the USAF), but

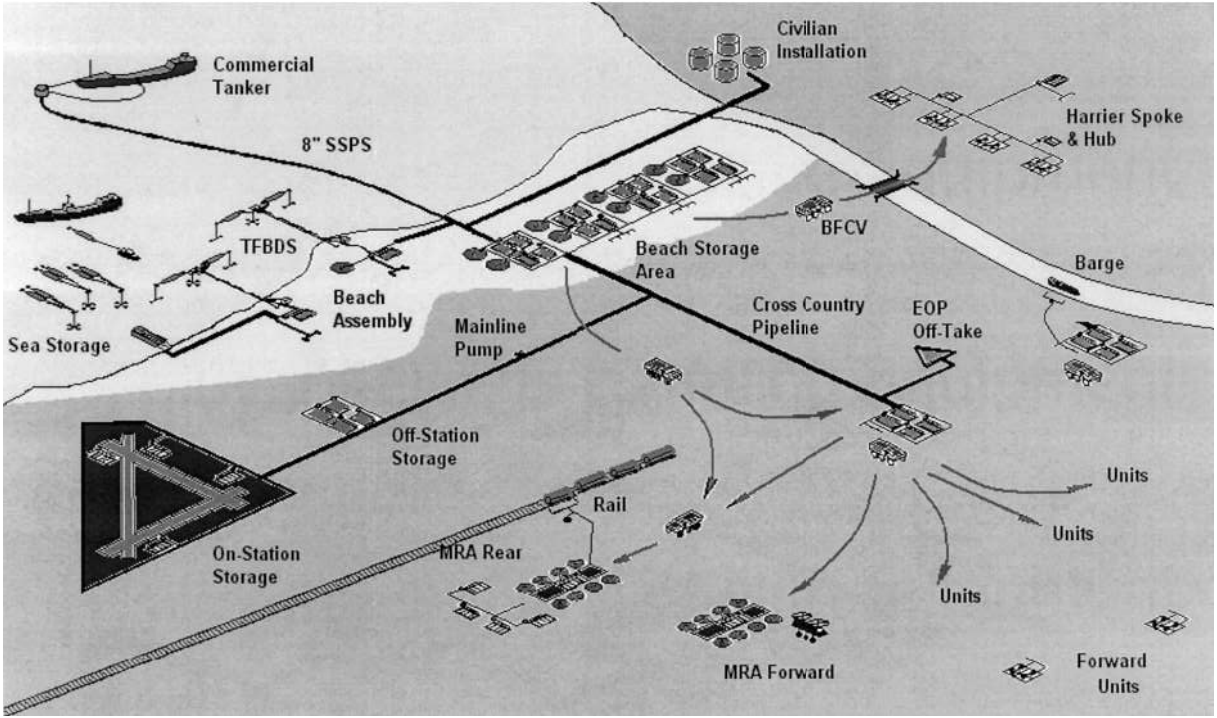
the capacity is now much greater than the much-reduced RAF footprint requires. So OPA arranges for commercial fuel companies to ship fuel on repayment through the Government pipeline and, for much of the time, it is now used for commercial products. Another interesting statistic is that over 30% of the UK's commercial jet fuel requirements flow through the GPSS, and two international airports in the UK are wholly reliant on the GPSS for their supply. For this we receive revenue, which offsets most of the system's costs.

So what fuels do we now use? We still use petrol in some vehicles, and diesel in most, but the UK now has a single fuel for deployed land-based assets (including aircraft): that is aviation turbine fuel (AVTUR). In this way, we now have to supply only one type of fuel on the battlefield. Actually, it's not quite that straightforward but that's the theory!

Oils and gases remain pretty much the same as they have been for the last thirty years, but RAF Cardington has closed and we now have a direct delivery contract with the British Oxygen Company (BOC), which works extremely well and provides 48-hour delivery to all RAF units. We have an exemption to continue to use some otherwise-banned Montreal Protocol refrigerants in older aircraft, and these are also stored on our behalf by BOC on Humberside.

All of these arrangements are now made by the tri-Service Defence Fuels Group, set up as one of the Defence Logistics Organisation's (DLO) first initiatives in 2000. Bloodied by the fuel tanker drivers strikes in that year, my Group is based at West Moors in Dorset – the spiritual home of Army fuels – and looks after the procurement, storage where necessary, and supply chain to the front line. It is an exciting and challenging job in this return to expeditionary warfare, and I'd just like to touch on some of those challenges.

First, we need to be able to move fuel as far afield as Singapore, Afghanistan, Iraq and the Falklands. For example, we initially flew fuel into Afghanistan aboard an Antonov freighter, complete with tanks in the fuselage; we can now rely on road delivery from Pakistan. For many operations, we would deploy a tactical fuels handling capability. The accompanying schematic (opposite) shows the capability, which is laid down by Royal Engineers and then operated by either the Royal Logistic Corps or, in support of RAF helicopters and on air bases, Expeditionary Logistics Wing or Tactical Supply



Deployable Fuels Handling Equipment.

SSPS – *Ship-to-Shore Pipeline System*; TFBDS – *Tow Flexible Barge Dispensing System*; BFCV – *Bulk Fuel Carrying Vehicle*; EOP – *Emergency Offtake Point*; MRA – *Main Refuelling Area.*

Wing of the RAF. It is a now somewhat dated but still a very effective system, which we deployed on Operation GRANBY in 1990 and at RAF Akrotiri during Operation TELIC last year.

Bulk supply to Cyprus, Gibraltar, Ascension Island and the Falklands (and operations where appropriate) is now carried out by the Maersk Company under contract; we charter the *Maersk Rapier* on a 365-day a year basis for five years. It is actually a very cost-effective way of delivering multiple fuels products in bulk, and we also reduce the cost by sub-chartering it commercially when it is not needed for the carriage of MOD fuel.

Finally, I would very quickly like to look back at recent operations for any 'Lessons Identified'. The first is that we need a bespoke supply chain for fuels. Although the Royal Fleet Auxiliary plays a role in deploying fuels and other spares for the Fleet, we usually have to use special-to-type ships, bowsers and storage equipment; for most products, we cannot share the general transportation assets. Secondly, as I briefly mentioned, it is now UK policy to use just one fuel – AVTUR – on the battlefield and in land-based aircraft. There are, however, issues with supporting older vehicles, and some cultural issues with having to use a different fuel on battle-winning equipments. We are also working increasingly with Allies in the supply of fuel. One nation now normally acts as the Role Specialist Nation, whereby one nation is nominated to look after the supply of fuel to all coalition forces.

Looking further ahead, we need to consider emerging fuel technologies that may replace fossil fuels. Frankly, I think we are behind the drag curve here and that the UK could reasonably be expected to drive, rather than respond to, the agenda. Synthetic fuels and fuel cells are going to be the future and, as we were when the jet engine led to a new type of fuel, I want to be in the driving seat rather than a passenger.

It is an exciting job but due to time constraints the future will, I am afraid, have to wait for another day.

[1] Adrian Searle, *PLUTO – Pipe-Line Under The Ocean* (Shanklin Chine, Isle of Wight; 1995).

THE SUPPLY BRANCH AND MOBILITY

Wg Cdr David Powell

David Powell joined the RAF via Cranwell and earned his spurs during the Indonesian Confrontation. He later served on a MAMS Team in the Gulf, ran the Supply organisation at Little Rissington and subsequently became involved in mobility plans. His contribution to the logistics of Operation GRANBY earned him an OBE. After leaving the Service, he has had considerable success as an academic.

Lessons of the Suez Crisis

To understand the development of current RAF mobility concepts, we need to go back almost fifty years to 1956 and the ill-fated Suez crisis. Many lessons were learned, one of which was the need to provide deployable support to air operations in what came to be called Out Of Area (OOA) locations.

Two important organisations for planning, exercising and executing deployed operations were HQ 38 Gp, for UK-based forces with a mobile role, and HQ 224 Gp in Singapore, to cover Far East operations. Often forgotten, formed in 1957, No 224 Gp was at Seletar, also home to No 389 MU, the theatre supply depot, and No 390 MU, which provided in-theatre engineering support.

The mobility pack-ups held at Seletar provided basic tented operations, technical and domestic accommodation, generic MT, and some specialist facilities such as Air Traffic caravans. The front line aircraft would deploy with their own squadron technical support and spares pack-ups with re-supply usually from their parent base. Procedures were covered by a useful pocket-sized stand-alone 224 Gp Admin Instruction booklet. No 38 Gp had similar tented pack-ups deployed from stocks held at RAF Tangmere. These subsequently moved to Watlington, then Hullavington before winding up at Stafford in the late 1980s.

In the late 1950s and until June 1969, when the V-Force handed over the nuclear deterrent to RN submarines, priority in terms of planning and resourcing was given to the V-Force. The V-Force plans

A classic illustration of a unit deployed to a bare base in the Far East and supported in the field by HQ 224 Gp – this is No 45 Sqn's tented camp at Kuantan, then offering no more than a runway and bulk fuel installation, for Exercise MERRYDOWN in 1963.

included dispersal plans and the force enjoyed a mix of partially pre-stocked dispersal airfields both in the UK and overseas. Technical spares were deployed as Fly Away Packs from the Main Bases.

Of the other RAF fleets, when Transport Command operated 'off route' they were self-supported by Ranger pack-ups of spares, carried in the aircraft belly holds. A similar system was used by Coastal Command.

The *RAF Mobility in the 1970s* Policy Paper

In 1968 the Air Force Department produced what was to become the seminal document on RAF Mobility in the 1970s, although many of the jig-saw pieces had been around for some time; for example, the AP1827 Scales of Mobility Equipment. The paper's author was Sqn Ldr J Craven-Griffiths. It brought together the key elements of mobility thinking. In particular it set out the boundaries of first and second level support. First level support would come from the operational unit being deployed and supported, typically a squadron's first line technical equipment. Then there were the generic second level functions which would turn a bare piece of real estate into an

operational base. This would include: accommodation, usually tented, supply, air movements facilities, communications, catering, police etc. In many cases these second level functions were the responsibility of trained and equipped organisations such as UKMAMS, TCW, Mobile Catering Support Unit, No 1 Mobile Air Traffic Unit, etc. There were, however, some significant gaps including second level supply support.

Tactical Supply Wing

On return from his involvement with Exercise BERSATU PADU in 1970, now Wg Cdr, Craven-Griffiths was given the remit to form a Tactical Supply Wing (TSW) based at RAF Stafford to meet the second level supply support remit. Of the main second level support units, the wing was unique in that it was based on the concept of a permanent cadre reinforced by uniformed trained and regularly exercised uniformed supply personnel drawn from No 16 MU at Stafford. Although administered by, what was now, Support Command, operational tasking was by Strike Command.

The *RAF Mobility in the 1970s* paper also covered the unit engineering function. However, the latter never produced a permanent second level unit, possibly because of the problem of supporting so many different aircraft types at second level in terms of skill, specialist tools and test equipment. In practical terms, the only significant second level engineering function to appear on deployed ops and exercises was MT support. Consequently, the reality of mobile operations and exercises tended to be (for engineering) to continue to deploy first line (complete with first line Fly Away Packs [FAPs] of spares) with the squadrons involved and return items to the respective parent bases for second line engineering support. This had a major impact on supply support with the development of base mobility supply flights to look after and deploy with the FAPs. At the same time, because second level engineering 'stayed at home', it left the deployable second level supply aspirations of TSW somewhat high and dry.

One of the key assumptions of the post-Suez Out of Area support doctrines was that there would be a runway, especially following the demise of the RAF's Airfield Construction Branch in 1966, and some form of airfield fuel facility. The arrival of the Harrier in the 1970s introduced the idea of the runway-less airfield, so that just left the

The provision of fuel in the field – a Royal Navy Sea King and a desert pillow tank farm.

question of the provision of aircraft fuel. Denied the opportunity of exploiting their second level technical supply support, TSW developed considerable expertise in field refuelling, especially in support of Harrier and SH operations. The wing exploited this niche opportunity to the full, developing a range of deployable pumps, filters, and pillow tanks and the associated training and skills.

This was also the time of the troubles in Northern Ireland. The first SH re-force package deployed to Aldergrove in July 1969. Subsequently, TSW provided an important force multiplier for the in-theatre SH force by establishing a number of permanent forward refuelling points, thereby cutting out the time needed to return to Aldergrove to refuel.

Developments in Command and Control

The 1970s had seen significant developments in managing mobility. Many of these changes were made to meet the needs of activating transition-to-war logistic measures as were tested in the biennial Command Post Exercise WINTEX. This led to the emergence of a structure of logistics focal points in MOD Air Force Operations,

and at the Command Headquarters and specialist satellite cells, covering the various support functions such as the POL Ops Room (POLOR). As a consequence, when faced with managing deployed support in Operation CORPORATE (the Falklands campaign) the RAF had developed comprehensive logistic reporting procedures and an operational logistics support organisation, albeit largely manned by diverting headquarters staff from their peacetime offices.

The next major test of mobile support of live operations came with Operation GRANBY and the first Gulf War. In terms of mobility, this opened with the deployment of the Jaguars in the summer of 1990, and arguably it has still not ended, with the Iraq No-Fly Zone detachments in Turkey and Saudi Arabia providing continuity of deployed support through to the more recent Iraq war. In terms of supply support, a significant development was the deployment of some second level test benches, particularly to cut down on returns of No Fault Found items.

Another evolution had been in information technology. From the manuscript Articles-in-Use stores inventories of the 1960s, the automated production of hard copy inventory listings of the 1980s to the introduction of deployable unit supply ADP systems – USAS in a suitcase – in the 1990s.

Post-Cold War

The 1990s also saw the emergence of post-Cold War doctrines and pressure for the long anticipated peace dividend. However, the reality of deployed operations was that instead of two-week exercises or two month operations we were now faced with open-ended deployments to Turkey, Saudi Arabia and the Balkans.

One significant difference was that, at long last, logistics support planners could now assume that re-supply was a given and not a bonus. This resulted in expensive FAPs scaled to support thirty-days of self-supporting operations being replaced with much smaller Priming Equipment Packs (PEP) designed, as the term implies, to deploy sufficient stocks to prime the extended re-supply chain.

However, in terms of mobility, one thing has never changed and that is the way the air staffs seek to deploy air power in roles never envisaged and to places never considered when the aircraft and their support were first funded and procured.

MOVEMENTS AND THE SUPPLY BRANCH

Gp Capt Duncan Grant

Duncan Grant joined the Service as a Halton apprentice and was commissioned in 1966. He served at Sharjah, Marham and MOD Carlisle. He helped to hand over Little Rissington to the Army. He commanded the Movements Training School at Brize Norton and then the Tactical Supply Wing, where he worked on concepts of operation for the Chinook. After several tours in Plans and Movements, Duncan retired in 1994 and now runs his own consultancy business.

> 'There is little romance or glamour about the duties which they (*the Movers*) have performed, unless one sees in the maintenance of the long lines of communication, something of the romance of the merchants who travelled the trade routes in days gone by. Their battle has not only been against the enemy, but against geography and the weather, and most of all, against time.' *AHB Leaflet*.

Pre-WW II

From the formation of the Equipment Branch until 1942, movements was an *ad hoc* affair organised either locally or piggy backing on arrangements made by the Army. However, as early as 1916 the RFC and RNAS were air dropping food and supplies to the besieged garrison of Kut el Amara in the Middle East. Indeed within the space of fourteen days nearly 9 tons were air dropped. The use of troopships for posting of personnel and freight movement by sea to the far flung outposts of the Empire were the order of the day. Large transport aircraft tended to be temporarily converted bombers with no inherent capability until the late 1920s and early '30s. Rather topically, it was the RAF mandate to police Mesopotamia that began to change the emphasis of operational deployments from surface to air means through the use of converted in-theatre bombers such as the Vernon. Mobility did not start in the 1960s!

WW II

The Advanced Air Striking Force deployed by air, land and sea to France in September 1939. Air elements in part used civil aircraft. All of this was achieved without a structured movements organisation. Prompted by the threat of invasion, a network of RAF Movements Units was established at ports of embarkation and at the Headquarters of the Regional Transport Commissioners, the Army Commands and certain key railway junctions and railheads. So, from its early days, the movements specialisation was used to working in a joint service environment. However, it was not until May 1942, as the momentum of global warfare gathered pace, that the Directorate of Movements was formed within AMSO's bailiwick. Air Cdre F H Sims was the first Director. In 1942 three MT companies, operationally controlled by the Directorate, were established at strategic points in the UK in support, primarily, of the bomber offensive, while control of the other movements units became more centralised.

The impact of *Luftwaffe* bombing on the UK's industrial base caused considerable disruption, particularly on the delivery and distribution of raw materials critical to wartime production. The RAF movements organisation was tasked with ensuring that materials affecting the production of RAF equipment were moved with the minimum of disruption. This extended to acting as the importer and forwarding agent for the Ministry of Aircraft Production, covering the importation of all aircraft, spares, munitions, production equipment, raw materials and machine tools. Two representative figures: 28,993 aircraft and 2,838,000 tons of equipment

Of course, the increasing challenge of logistics operations meant that training could not be forgone and, following the formation of RAF Transport Command in 1943, the RAF Movements Traffic School was formed at St Mawgan in March 1944. It provided a five-week course on surface and air movements for officers and SNCOs – more of training later.

One of the less well known roles undertaken during WW II was the reception in the UK of some 70,000 Dominion and Allied air force personnel who were received at the port of disembarkation, entrained (a lovely word!) and distributed to their nominated UK bases. In addition, a continuous stream of trained aircrew returning to the UK from training in the USA, Canada, South Africa and Rhodesia were

processed through the RAF Movements Organisations.

In contrast, RAF movements staff embarked on troopships to assist in the administration of RAF personnel. Indeed Movements Officers were the nominated Commandants on a number of vessels.

Away from the UK, RAF movements featured large in the successful operations in the Far East, Africa and Italy. In the Far East India was, of course, the base from which Slim's Army was supported by land and air, with the Dakota being the in-theatre workhorse. Between October 1942 and June 1944 over 6,000 vehicles and 350,000 tons of equipment were shipped to the North African theatre prior to the landings on Sicily and Italy. RAF Movements personnel were formed into beach units to facilitate the transit of men and material to the front; a forerunner to the D-Day landings.

The movements contribution to D-Day saw the establishment of an RAF Concentration Area at Old Sarum through which all RAF personnel and vehicles were processed before moving to the ports of embarkation. By then RAF Transport Command, with the ubiquitous Dakota had introduced an air freight service which gathered momentum as the battles for Northern Europe rolled east. In the last three months of 1944 an average 4,000 tons of stores per month were airlifted from the UK into France.

The Immediate Post-War Years

The first post-war challenge faced by the RAF movements organisation was in 1948-49 in support of Operation PLAINFARE, the Berlin Airlift. During the operation some 65,857 sorties were flown by RAF aircraft. This massive task was supported by movements personnel in both the UK and Germany. Loading aids were minimal, muscle power and initiative being the order of the day, particularly with sacks of coal and potatoes! In July 1949 101 RAF transport aircraft (including the newly introduced Hastings) were augmented by forty civil registered aircraft. The use of the civil air fleet was a foretaste of things to come in the decades ahead.

By the end of the airlift an RAF movements presence in Germany was firmly established at RAF Wildenrath in the west and Gütersloh to the east of the British Zone, with Gatow in Berlin itself. Collocated with the Movements Staff at HQ BAOR was the in-theatre RAF Movements Staff of HQ BAFO, later HQ 2nd TAF and ultimately HQ

RAF Germany. By the end of the Korean War, which saw movements in the Far East controlled from Singapore, using the resident transport squadrons of the Far East Air Force, there were Movements Staffs in all of the key areas required to keep the Russian Bear and Chinese Tiger at bay: with HQ FEAF in Singapore; HQ MEAF at Aden; HQ NEAF in Cyprus and HQ RAF Germany at Rheindahlen.

Here in the UK, HQs Bomber, Transport and Maintenance Commands all had Movements Staffs, complementing these overseas commitments. In the case of Maintenance Command its task focused on surface movements and transportation, continuing the historic WW II task of delivering to, and collecting from, the aerospace industry. During this time, and well before industry had conceived its 'Just In Time' concept, the surface movements organisation provided the key components of a Priority Freight Distribution Service-primarily in support of the V-Force. No 16 MU at Stafford became a major transport nodal point with distribution tasks met principally by No 2 MT Sqn. In the South East, the London Movements Unit undertook similar work, initially operating out of Kidbrooke before moving to Woolwich.

By 1956 the majority of troopships had been phased out and the deployment of personnel for both administrative and operational movement changed from one focused on surface movement to predominantly air movement. Initially, air trooping was undertaken by charter companies, but with the introduction of more sophisticated long range transport aircraft such as the Comet, Britannia and VC10, Transport Command (to become Air Support Command in 1967) took over most of the long-haul routes. This was a sensible optimisation of the Air Transport Force's war mobility capacity. However, the need to deploy most of the British Army from the UK to Germany in the event of an outbreak of hostilities meant a significant reliance on the British civil air transport fleet managed by the RAF movements organisation – a policy predominant to this day and applied during both Operations CORPORATE and GRANBY in particular.

During this period, movements personnel were also employed in support of the UK's nuclear deterrent. Bomber Command stations had specialist officers and airmen geared to supporting deployed operations, while a number of Movements Officers acted as Convoy Commanders for special weapons movements. Of course, by the early

1970s the V-Force task had changed. Even so, Mobility Supply Flights, as they were by then known, offered support in deployed operations across a range of aircraft types.

An integral part of this change in emphasis was the recognition that, in the case of passenger movements in particular, the shape and size of the Services, particularly after the end of National Service, did not warrant a single-service approach to movements management. Although the RAF had primacy, the Army, through the staff of the Quartermaster General, acted as an 'Intelligent Customer'. This was effected in the main by two joint service units under the functional control of the Director of Movements (RAF). They were the Joint Services Air Trooping Centre (JSATC) at Hendon and the Joint Services Booking Centre, later to be restyled as the Services Booking Centre (SBC), at Albert Embankment, London.

The JSATC provided day to day contract supervision of all civilian air trooping flights mounted from civil airfields, particularly the London airports, compassionate travel support and manpower for employment at civil airports in a crisis. It also offered a military (and family) stopover facility as required. Complementing the JSATC, was the SBC which provided a passenger reservation and booking system for travel from the UK.

The Impact of the Labour Government Defence Review - The Late-1960s and Early-1970s

Following Dennis Healey's Defence Review our world wide commitments based upon a strategy of Empire policing had changed. Flexibility and mobility, with operations mounted through rapid deployment from the UK Base, were now the order of the day. A somewhat familiar concept that has stood the test of time.

To support this concept, the RAF's strategic air transport fleet of VC10, C-130, Belfast and Britannia aircraft supported by the tactical transports, the Beverley and latterly the Argosy and Andover, offered an inter- and in-theatre airlift capability second only to that of the USA in the western world. At their peak these fleets were based in the UK at Abingdon, Benson, Brize Norton, Colerne, Lyneham and Thorney Island, with additional Argosies, C-130s and Andovers located in the Near, Middle and Far East.

Deployed support of these air transport assets was provided by

Mobile Air Movements Squadrons (MAMS) based in-theatre, with UKMAMS being the centre of excellence and now sole such organisation. Originally based at Abingdon, it moved to Lyneham in 1974 and has the proud boast of being 'First in and last out'.

The capability for deployment and mobility support was tested in 1970 during Exercise BERSATU PADU to the Far East. This exercise involved full deployment by air of a range of air assets to Malaysia and follow-on support in-theatre. Some 2,800 passengers and 900 tons of cargo were deployed over a ten-day period with 4,000 passengers and 650 tons of freight being recovered. A sea change in capability and support of deployed operations from the UK base had been successfully demonstrated.

The 1980s and 1990s

By 1980, the effects of the 1975 Defence Review had filtered through to the movements organisation. The need for economy drove rationalisation of fleet management and aircraft utilisation. This resulted in the acquisition of a Global Information Technology based Movements Management and Reservation System operated by British Airways on behalf of the MOD. The system offered global aircraft scheduling visibility and capacity availability for both RAF and MOD charter airlift. Booking centre staff world wide had instant capacity and availability information for the first time. Key Point Indicators showed utilisation to be as much as 92% for scheduled services, while in terms of operational planning visibility, allowed prompt management decisions to be made. Indeed such was the capability and flexibility of the system that the British Military Train operating on the Berlin Corridor during the Cold War was managed through the system.

On the equipment front the exceptional wide-bodied airlift capability of No 53 Sqn's Belfasts had been sold off to commercial operators, while the multi-capable turboprop Britannia had been retired. However, the Cold War had not yet been won and the need to ensure sufficient manpower for support of the lines of communication into Germany and outloading of men and material saw the formation of No 4624 Sqn Royal Auxiliary Air Force to provide a cadre of personnel to reinforce the range of movements units requiring support in what was then known as Transition-to-War. The formation of the

squadron came too late for the heavy tasking occasioned by Operation CORPORATE, the recovery of the Falkland Islands. Movements personnel served on the troopships *Uganda*, *Norland*, *Cunard Countess* and other vessels, just as their predecessors had done fifty years previously. Wideawake airfield on Ascension Island played a pivotal role in the 8,000-mile supply chain and remains so today. During CORPORATE the availability of the civilian air fleet, including the large capacity Belfast, by then commercially operated by HeavyLift, ensured that shortfalls in military capacity were bridged.

One beneficial outcome of the lessons learned from Operation CORPORATE was the acquisition of nine Lockheed TriStars which, although mainly converted to the air-to-air refuelling role, offered a modern dual-capable airlift capacity for personnel and materiel.

Operation GRANBY, the first Gulf War, depended in equal measure on air and sea re-supply and saw movements resources managed in a joint environment on a significant basis by both MOD and the Joint Headquarters at High Wycombe. In-theatre Joint Helicopter Support Units were an integral part of the Chinook force, while UKMAMS teams operated in support of the tactical air transport effort both in-theatre and at Akrotiri. RAuxAF personnel of No 4624 Sqn provided reinforcement here and elsewhere in the supply chain. Yet again the civil airlift capacity proved essential to meeting the military shortfall. However, the lack of a heavy lift capacity was to prove a disadvantage in moving heavy equipment in the right quantities to the right place at the right time. The need to deploy large quantities of freight by air also reinforced the need for more effective cargo handling equipment and associated asset tracking systems.

During the crisis there was an early decision not to use Powers of Direction for the Civil Air Fleet-mainly because there was no effective legal tool to ensure that aircrew were willing to fly into designated war zones! Accordingly, normal commercial procurement of airlift by competitive tender still applied. The competition for air freight capacity was quite severe, although one well known UK airline ultimately declined to fly east of Cyprus on MOD business. These lessons learned reinforced the case for additional in-service capacity, particularly that of large cargo carrying aircraft. However, it is of interest to note that, notwithstanding the challenges, the airlift was not insignificant, amounting to some 45,579 personnel being deployed by

air along with 52,661 tonnes of freight (including munitions).

This airlift bill was met by both the Air Transport Force and the Civil Air Fleet, including chartered Antonov 124 aircraft, not all operating from the UK as their home base. In-theatre a deployed fleet of C-130s was supported by an in-theatre movements staff and UKMAMS personnel on the ground at Main Operating Bases and various tactical locations, including Forward Operating Bases supporting the re-supply of 1st Armoured Division.

Much has been said of the challenges, tasks and achievements of the RAF Movements Organisation. However, without the right quality of people and associated training, as with the rest of the Royal Air Force, little could have been accomplished. From its origins at St Mawgan, through Kidbrooke, Abingdon and now Brize Norton, as an outstation of the Defence College of Logistics, the RAF Movements School has provided this training and it currently offers a range of courses for more than 1,000 students of the three Services each year.

As the majority of airmen in the movements trade, and most of the officer throughput, is geared to first appointments in a front line environment, attitudinal training plays an important part in the training process for *ab initio* students. Given the exposure of this element of the Supply and Movements Staffs to the operational environment and on-aircraft work this is designed to ensure safety, accuracy, timeliness and responsiveness under pressure. It also offers the Supply Officer direct exposure to the front line with its attendant pressures which stands him (or her) well in career development.

Pressures manifest themselves in many ways. During the early 1990s pressures became particularly political within both the Army and the RAF, covetous eyes being directed on the place where the movements organisation should most properly rest; either in the logistics or operational structures of the downsized Services. With the establishment in 1992 of the Directorate of Logistics Operations, as the successor organisation to the Directorate of Movements, the RAF finally recognised at MOD level the synergy between movements and mobility.

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POST-WW II IMPERATIVES FOR SUPPLY

Air Cdre Mike Allisstone

In putting this short talk together, I first reminded myself of one or two definitions by referring to the old NATO Logistics Handbook, which I helped to write in 1986. Logistics is defined as 'the science of planning and carrying out the movement and maintenance of forces.' 'Maintenance' is described as 'all supply and repair action taken to keep a force in condition to carry out its mission.' So that is where the Supply organisation fits into the big picture: besides its contribution to the movement of forces, supply plays a major role in their maintenance, hence enabling the operators to carry out their mission. If we fail, it is a direct threat to the success of the mission. Heady stuff! Then a dog-eared note dropped out from between the pages, on which some long-forgotten wag had written his own definition of logistics as: 'the science of the re-distribution of shortages.' I don't think he was far wrong either. We are also short of time today: please bear in mind that, in compressing my view of some of the imperatives of the last fifty years into twenty minutes, I have had to be selective.

The historical basis for the immediate post-war supply posture is covered in great detail in Air Publication 3397 – the official record of RAF Maintenance *during* the Second World War. Just as the Royal Air Force had to provide a, so called, peace dividend following the collapse of the Soviet Bloc, so the Service had to reduce in size quite dramatically at the end of WW II and then modify its stance to accommodate the beginning of the Cold War. I think it would be fair to say, however, that the Equipment Branch, as the Supply Branch was then called, did not see a need for much change in the supply support structure until the nation was well into the Cold War era.

When I was doing my initial specialist training in the early 1950s, it was proudly explained that the RAF had widely dispersed its holdings of technical equipment, mainly airframe and engine spares, using a multi-point holding scheme, as a defence against air attack. We visited some of the storage depots that had been set up during the expansion period of the RAF, in the late 1930s. They were simply enormous, both in area and in the sheer size of some of the, mainly asbestos or corrugated-iron, sheds, one of which was literally as big as

a cathedral and indeed that was the name it was given. Many were, even then, still groaning with bits and pieces of wartime aircraft and vehicle types.

To give some idea of the depots' scale, I have a few figures for one of them which I later commanded – No 7 MU at RAF Quedgeley, just south of Gloucester, and it was fairly typical of most, if not all, of the other depots. The modernists in the audience must forgive my imperial measurements but No 7 MU covered nearly 600 acres of land, within which there were about two million square feet of storage, packaging and workshop areas. Note the two-dimensional thinking of those days; we did not then have figures for cubic capacity to judge how effectively we were using the space at our disposal. In more recent times the figure would have been fifteen million cubic feet. Quedgeley was served by both road and rail, and it comprised eight sites, most of which were themselves widely dispersed throughout the unit, again to reduce the risk of damage due to air attack. I have not been able to establish exactly how many personnel were needed to man the depot in the late 1940s and early '50s, but it is likely to have been around 1,500. They were mainly civilians at Quedgeley, but significant numbers of servicemen were also involved in the management of the unit. One other storage depot, No 16 MU at Stafford, was almost entirely Service-manned, in part to guard against any industrial action threatening to cripple the supply chain, and also to provide a pool of uniformed manpower for rotating people through the storage depots in Commands abroad. Bear in mind that in those days the RAF had four fully-fledged air forces overseas: a tactical air force in Germany, and other air forces in the Near, Middle and Far East, each with its own Service-manned storage depot.

In the 1950s there were few mechanical handling aids in depots – muscle-power was the order of the day – and there were no computers. The location of every item, and there could be several hundred thousand of them, was recorded by hand. Much of the replenishment of stocks was also calculated manually in the Provision and Stock Control Offices at each depot, huge rooms filled with perhaps several hundred people, each one beavering away at ledgers on his, or often her, desk. Although, by the mid-1950s, the introduction of mechanically-sorted punched cards for such work was beginning to lighten the load. Where more than one depot held stock of an item,

there had also to be a master record, which showed the total stocks and where they were, what was due to come into stock and what was due to go out. The whole thing was a highly expensive, manpower-intensive operation and, as I have said, there were six more of these storage depots scattered across the country, from No 14 MU up near Carlisle, down to No 3 MU at Milton near Didcot in the South.

I am not sure that the true cost of continuing to run the multi-point holding system for some years after WW II was ever known – we were rather less cost-conscious in those days. But, as the number of aircraft types, as well as our overseas commitments, reduced, it became possible to bring down the holdings of spares and then to start closing some of the storage depots. It was eventually decided that, with the dispersed design of each depot, a single-point holding system would suffice, given that there would also be further stocks of many items at operational stations.

But the sheer size of the RAF inventory, coupled with the need to buy often large airframe components off the production line while the aircraft were being built, and then to store them until they were needed, still meant that four Equipment Supply Depots, or ESDs as they became known, were in being at the end of the 1960s. No 25 MU at Hartlebury, near Worcester, closed towards the end of the 1970s, by which time the task of supplying Defence Accommodation Stores to all three Services had been rationalised to No 7 MU at Quedgeley. That unit had by then relinquished most of its remaining stocks of airframe spares, leaving only No 14 MU at Carlisle and Stafford's No 16 MU to carry the technical ranges. In addition to these ESDs, of course, there were several other Maintenance Units holding reserves of complete aeroplanes – the Aircraft Storage Units of which, at one time during the war, there had been no fewer than seventeen, mostly commanded by Equipment Officers. These ASUs represent another part of the supply story in themselves. But the enormous cost of support was certainly one of the imperatives to bear down on the supply function following WW II.

Another post-war imperative was the need to change attitudes. To be blunt, there was a feeling at the sharp end of the RAF in the late 1940s and early '50s, that the Equippers sometimes held the operators back; that we were forever finding reasons why things could not be done, instead of discovering innovative ways of providing what was

required. There was a real need for a more 'can-do' approach. Direct-entry trainees recruited after the war helped, but the arrangements to train full-career Equipment, and Secretarial, cadets at the RAF College from 1948, and the later decision in 1953 to collocate them with their GD counterparts actually at Cranwell, were unquestionably major steps towards transforming attitudes on both sides into the all-of-one-company approach which thankfully prevails today. I also believe that the re-branding of the Equipment Branch as the Supply Branch in 1970 had its part to play in this.

There was one driving force in particular during the latter half of the last century which, among many other applications, enabled greatly improved visibility of, and hence control over, stock, while dramatically reducing the cost of doing so in manpower terms. This was, of course, the advent of computers, and we shall be hearing about that shortly from Colin Cummings. But I would like to turn now to some of the more strategic matters which influenced supply, and especially stockholding policy, during the post-war era. Perhaps the first of these was the infamous 1957 Defence White Paper, in which Secretary of State Duncan Sandys foresaw the end of the manned fighter, given the advent of the guided weapon. Whilst his thinking proved to be somewhat premature, the White Paper did provide something of a wake-up call to all three Services. They began to realise that the Defence Budget was by no means limitless, as it might have seemed during WW II, and that the immense cost of modernising the RAF, for example, with the V-Force and other new aircraft types, plus the cost of improving conditions of service for the all-volunteer air force following the end of National Service, would have to be met, at least in part, by greater efficiency and other economies.

The overall size of the RAF inventory was approaching 1.5 million items, and the prospect of economising by disposing of surpluses and closing storage depots made the supply chain an obvious target for savings. Cost-effectiveness became the new cry, the only problem being that we didn't really know what the true costs actually were. We knew how much it was to buy something, but the costs of preserving, storing and modifying it when necessary, and then transporting it to the point of use almost anywhere in the world were, in those far-off days, rather lost in the noise. That said, the costing of all support activities was revolutionised in the 1960s, with the introduction of

work measurement and improved management techniques. The savings at Quedgeley alone, in the early 1970s amounted to a reduction of 400 industrial civilian posts, saving in excess of £½ million per year, significant figures in those days and an indication of how much fat there was to trim in the supply area. Nowadays, many civilian businesses seek to hold minimal stocks of expensive hardware, preferring instead to rely on rapid reaction from order-hungry manufacturers, and a highly responsive and effective delivery service. This is the so-called 'Just In Time' concept, which must also be very tempting to politicians and financiers in the Ministry of Defence. But support for defence operations simply isn't like that; there has to be resilience, another word for which is 'sustainability', and I want to spend the next few minutes talking about what recent history has to tell us about that.

First NATO. As you will know, the North Atlantic Treaty Organisation was set up in 1949 in response to the growing threat from the Warsaw Pact. In joining NATO the United Kingdom, together with all member states, agreed to accept the logistic implications of the defensive strategy set out by NATO's Military Committee in its series of edicts issued under the reference MC14. For many years it was thought that the only possible means of deterring the Warsaw Pact from attacking the West was to threaten massive nuclear retaliation to any incursion into NATO territory, the so-called 'tripwire' response, ultimately embodied in the Military Committee's document MC 14/2. For the RAF, the supply support implications of such a posture were fairly straightforward: we needed primarily to ensure that the quick-reaction element of our strategic nuclear deterrent – the V-Force – was always capable of taking off within four minutes, with the rest following as soon as possible. To help meet that imperative, the supply organisation adopted a completely new approach to the initial provisioning of spare parts for the V-Force, purchasing some 2½ times as much kit as we normally did for the introduction to service of a new aircraft type. We also brought in some special super-priority procedures for urgently needed items.

Of course, the tripwire strategy did not envisage a long drawn-out war of attrition, such as in the First and Second World Wars, and hence, to be simplistic, we did not really need stocks in excess of that very basic but vital requirement. Unless, of course, they were intended

to contribute to the recovery phase, after a nuclear exchange, which was so blithely forecast by the optimists. Fortunately, we hadn't got around to fully disposing of all the surplus stocks which were thrown up by such a strategic posture, before the Military Committee had second thoughts. Third thoughts actually as, in December 1967, they issued MC14 version 3, which introduced the more realistic notion of a flexible response by NATO to an attack by the Warsaw Pact.

Essentially this new strategy meant trying to meet a conventional attack with conventional forces, but it was not a stance to which the Alliance was going to adapt overnight and it involved, for example, an enormous change in the stocking of conventional weapons. The overall logistic impact of this new strategy on virtually all its members was dire, especially in financial terms, as the provision of support for national contributions of forces to NATO was largely a national responsibility and very little help was likely to be forthcoming from anywhere else, apart perhaps from some fairly basic support from the host nation.

The Alliance went on to agree to stockpile planning guidance requiring member states, as a first step, to set aside, at a minimum, basic stocks for thirty days of conventional fighting. Thereafter nations were expected to build up sustaining stocks, ultimately sufficient to maintain the front line in battle until continuous re-supply could be established from industry. This would mean that fighting could, in theory, continue indefinitely, although it rather ignored the vexed question of battle casualty rates and other variables which are outside our purview today. But, bearing in mind how long it would have taken to gear up factories for re-supply at war consumption rates, of even the less-complex items of equipment used by modern forces, the notion of continuous re-supply really was pie-in-the-sky. Yet we, like almost all of the other NATO member states, solemnly subscribed to the idea while consistently failing to provide much of the finance for implementing it, despite the fact that this left the Alliance close, some might say dangerously close, to the nuclear threshold, or indeed to capitulation.

Even twelve years later, in 1980, very few of the NATO Allies could swear to having thirty days'-worth of all they needed for the first phase of war and, with the exception of the Americans, virtually none had any sustaining stocks at all. I used to call this situation

MC 14/2½, and I don't think the Alliance had moved very far from it when I retired in 1988! So far as the RAF was concerned, my recollection is that our overall record was better than most but, at the comparatively micro-level, there is not much point in having, say, forty-five days'-worth of fuel if you are going to run out of certain weapons or maybe something like aircraft tyres, after only thirty days of fighting. Better to save some money on the provision of fuel and spend it on boosting the more deficient areas. It isn't as simple as that, of course, but I do believe that our logistic support posture lacked a certain amount of balance in those days. Nor would it make macro-sense for an air component to be fully equipped to fight a long war if the land component could only sustain a short one. There is, I believe, an argument for adding the concept of 'balance' to the Principles of War, but we do not have time to go into that today. However, one aspect of supply support which was greatly strengthened in the early 1970s, and necessarily so, was when the RAF Director General of Supply took over responsibility from the Procurement Executive for the direct progression of spares deliveries from industry. After a period dominated by shortages and much frustration, their availability greatly improved as a result of this major change in management.

So much for the RAF supply organisation's contribution to NATO sustainability, but what of so-called 'out-of-area' or 'Rest of the World' operations since WW II? In 1982 the politicians discovered that greatly extended lines of communication were no barrier to air or land operations overseas when we went to war, at very short notice, in the Falklands. Some twenty-five years earlier, when I was a young flying officer, there was only one way of working out what one needed to support, say, a detachment of Canberras in the Far East where we were busy bombing Communist terrorists in the jungle. That was to sit oneself down, months beforehand, and go through piles of ledgers, page by page, working out what the probable consumption of each and every one of the thousands of items was likely to be, while also taking account of a hot and humid environment. Having allowed for differing rates of effort, etc, we added a modicum of common sense and then wrote out our requirements by hand. Over the years the concept of the Fly Away Pack was born and it was later refined as a result of many exercises. Moreover, there was a considerable investment in overseas pre-stocking to match both NATO and some

non-NATO contingency plans.

By the time of the Falklands War (for which, you may remember, contingency planning was skeletal to say the least), we had not only a fair idea of what would be needed but most of the stock actually existed; it was not in the right place for going to war in the southern hemisphere, of course, but at least much of it was available and air-portable. We learned even more from that war, and it was just as well that we did, in view of the subsequent deployments in the Gulf, the Balkans and a number of other places since. Now things have moved on again, and no doubt somebody is busy producing revised stockpile planning guidance to match the current need for rapid-reaction forces with, it seems, a capacity for rapid world-wide deployment. But I do sometimes wonder whether sufficient funds have been made available for an adequate scale of Fly Away Packs (or whatever they are called now), palletised weapons, tactical refuelling equipment and everything else needed for such an expensive posture. In these times of 'lean support' I hope too that the risks of relying too heavily on direct re-supply ex-manufacturer have been recognised by Ministers. What is quite certain is that the difficulty will continue of translating the paring down of logistic support into terms of potential loss of operational capability, and of lives put at greater risk in the front line – it always was a perennial problem.

To summarise, the post-war imperatives for supply which I have picked out for today's seminar, and there may well be others, are as follows:

- Cost-effectiveness in all that we do was the most pervasive imperative and will always remain so.
- Attitudes have been transformed, but the Supply Branch must never forget that *that* is what it is there for – to *supply*.
- Suppliers were among the first to adopt computers, and you will be hearing much more about that shortly.
- And finally, sustainability is vital, but it needs to be in balance, both *within* the overall logistic posture itself and also in balance with the operational forces which it is designed to support.

THE ELECTRONIC ERA

Wg Cdr Colin Cummings

In an era when almost everybody has access to a personal computer and much of our daily routine is influenced by computers, it is perhaps surprising that less than forty years has elapsed since the RAF supply organisation started live operations with its first computer system.

This paper will examine the following topics.

- The main inadequacies of a supply support system based almost entirely on labour intensive manual processes.
- The development of the first computer system and an outline of its architecture.
- The extension of computer systems to the main stockholding areas.
- The transition to 'on-line' computing.
- The use of computers for specific projects.

As you read in an earlier paper, the RAF introduced Hollerith electro-mechanical card reading machines into the main depots between 1943 and 1945 and these machines produced consolidated reports of activity to be used by the depots' Provisioning and Stock Control Offices (PSCO) and Equipment Provisioning staffs to assist in various aspects of the provisioning process.

The key punch input process required a small army of, almost exclusively, female operators to produce the cards and, in these politically correct times, I perhaps should not mention that a supplementary advantage of employing this bevy was to provide Summer Ball partners for successive generations of single officers who found themselves posted to a depot!

To all intents and purposes, the Hollerith system was the sole attempt at introducing any sort of automation into the equipment management and stores accounting processes and whilst it might seem rather laughable now, at the time it was the best available.

By the mid-1950s, therefore, the Hollerith system had been in use for just over a decade but the new technology of EDP – Electronic Data Processing – was beginning to show its commercial potential and the RAF realised that this was the way to go.

Many of the problems faced by the RAF equipment organisation will be self evident and most were shared by any large business, heavily dependant on paper and manual processes. In summary these problems were as follows.

Air Cdre A S Woodgate
Commandant SCC 1964-69

- There was a massive duplication of activity. At units, for example, manuscript forms to demand, exchange or return an item of equipment had to be completed (there were different forms for each activity), a stock record card was then updated and a bin stock card amended within the store. Except for consumable items – nuts, bolts, oils, etc – an inventory record would need to be actioned. Four separate activities and this does not include a sinister process called 'voucher progression' – the finer points of which I shall not trouble you with today.
- The whole process was time consuming and prone to error.
- The supply process was massively inefficient and led to considerable waste in the procurement of supplies.

Importantly, however, the RAF was introducing the V-bomber force and the vastly expensive technology which backed it up. It was inconceivable that the support of these costly and vital aircraft, packed with electronics, could continue to be undertaken using the quill pen methods of yesteryear. The case for automation, therefore, was as essential for operational support reasons as for any other.

By 1957, a team under the leadership of Gp Capt A S Woodgate, was set-up to consider how the supply business might best embrace the emerging EDP revolution. I say 'a team'; at first Tony Woodgate had an office, a clerk and loads of blank paper but little or no real direction. His team gradually expanded and began to map out the approach that the supply business would follow. One of the early

decisions flew in the face of established thinking but it provided the RAF with a fundamental advantage, the dividends of which would be reaped in the years of live operations which would follow.

The British Army, Royal Navy and the United States forces were all engaged in introducing computers to their equipment management business. Without exception, each chose to provide the major stockholding centres – the supply depots – with the computing capacity and to allow the user units to carry on much as before. Woodgate took the view that it was the unit element of the business that had the priority and hence his team's solution was to provide computer support at unit level *first* and thence attack the depots and other elements of the business.

Woodgate's team faced enormous problems and challenges as they broke fresh ground. One of the most significant was how to make the new computers communicate with remote users. At that time, for example, systems being installed in major insurance companies took manual inputs from the branch offices and sent them via a company messenger service to a data processing centre where the information was keyed into the computer through a punched card interface. Furthermore, the insurance firms operated within the bounds of the UK; there was no thought of an international dimension.

At that stage also, telephone systems were entirely manual. Many readers will recall the painful process of trying to deal with other units, the first stage being through one's local PBX, thence to a regional exchange and on to another and so on until one arrived at the receiving unit to be connected, if you were lucky, with the person being called. Frustratingly, one's plug could be pulled, without warning, at any of the interim connections, and woe betide the caller who dwelt on any sort of personal business!

Nonetheless, consideration was given to using the telephone lines during off-peak periods to transfer data collected on punched cards but this was rejected for a variety of reasons.

Whilst looking at using punched cards and off-peak telephone lines, the study also focused on the implications of using punched paper tape, sent via the Telegraph Automatic Switching System (TASS) or via a private wire alternative. Paper tape was found to be significantly better in terms of availability, capacity and cost and, although slow by modern standards ($6^2/_3$ characters per second), it was

adequate for the task.

To avoid having to carry punched tapes between the supply squadron and the communications centre, extension spurs were incorporated between the two locations so that the punched tapes could be transmitted direct. The Post Office even designed the system so that tapes were transmitted back to front to save the need to rewind!

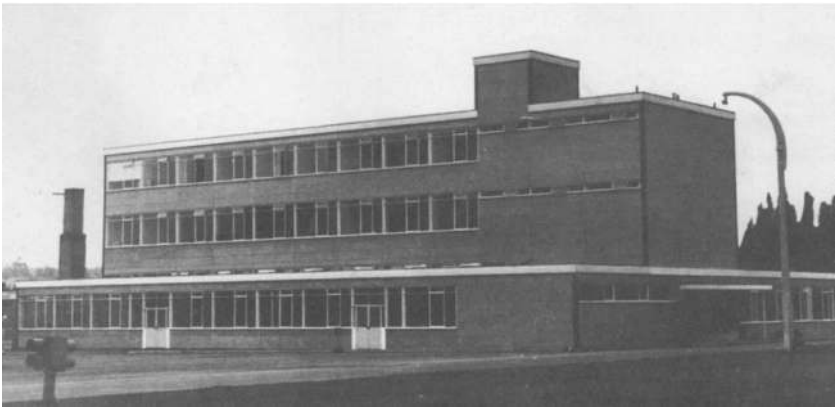
Stepping back from the interface to see how the data would be gathered, I have mentioned the inefficient way transactions were recorded. In the new system, stock record cards were filed in large bins, with the cards overlapped so that the stock numbers could be seen easily. Requirements were now to be telephoned by users to the Stock Control Clerk who pulled the cards, raised the vouchers and advised the user of the supply position.

The voucher and stock card were then passed via an interim process to a machine operator who would post the transaction to the stock record card using, what would, by today's standards, appear to be a large and unwieldly NCR Keyboard Accounting Machine Type 31W – 'W' because it was wired to a punched paper tape perforater and this produced the tape to be sent via the teleprinter network to the central computer system.

Although the process might still seem somewhat cumbersome, it was actually quicker, provided the user with better information and saved him the need to come to the Supply Squadron. The transactions were pre-posted and hence the equipment was taken from stock and could be collected or delivered to the user as needed. As a by-product of the automated process, calculations to assist better informed procurement decisions were made.

Flitting quickly to the Computer Centre, this was established in a purpose-built location at RAF Hendon. Besides office space on the upper two floors, the ground floor of the main building housed various facilities such as the communications centre. The single floored structure had a data preparation room at the front with the computer hall at the back.

The computers procured were AEI 1010 machines and they were amongst the most capable 'mainframe' computers available at the time. However, it is equally true to say that the rate of progress was such that, as with most computers, they were probably already obsolescent when they were delivered.



The Supply Control Centre at RAF Hendon.

The machines held a Central Processing Unit, made up of layers of ferrite core through which electricity was passed to magnetise the rings and represent the digits 'zero' or 'one' – the whole concept being based on binary arithmetic. The computer programs, and the operating system which controlled the computer, were written in user-code; the lowest order of instruction which the computer can interpret. In their way, the computer programmers of this era were the equivalent of today's operating system software writers.

Fast access to the computer was achieved by using magnetic drums. If one can imagine a 45-gallon oil drum revolving at high speed with the magnetic tracks about its circumference and a sort of demonic gramophone arm picking up the information when required, that is the best description I can convey.

The main data storage was provided by numerous magnetic tape decks, the equivalent of the open-reel tape decks of the early hi-fi systems. Although punched paper tape was the main input media, control consoles were used to manage the computers and their activities.

Initially there were two configurations but a third was added in due course as capacity problems were encountered. Each configuration was slightly different with regards to the peripheral devices and how they were usually used.

It would be impractical to attempt to describe the *modus operandi* for the system in any detail; suffice to say that it was based on a series

of specific processes. To outline just one process, the Priority Process, this was run hourly and priority demands from units were run against something called 'the low stock tape', which recorded all items in the inventory where there was little or no stock. If there was no match, the assumption was made that there was stock at the depot available for issue and a demand was placed on the appropriate supply depot.

The AEI 1010 system went live on 3 January 1966 when the Jet Provost range of airframe spares was brought under control. The transition programme quickly gathered momentum and within three years most ranges of technical equipment were being managed by the system.

Many improvements were claimed for the AEI 1010 system, although some of the hoped for developments could not be realised within the constraints imposed by contemporary technology. However, it is worth dwelling for a moment on one area where the availability of data collected by the computer system allowed massive savings to be realised. In the summer of 1969 a small research team was set up at the Supply Control Centre, staffed by RAF officers, some representatives from the Chief Scientist's department, a USAF exchange officer and representatives from the Army and Navy. By great good fortune; the USAF officer, Major Bill Ellis, was something of a whiz with inventory control systems and the Army's Major 'Lawrie' Lawrence was a computer systems guru and programmer *par excellence*.

The team's first task was to analyse the RAF inventory of consumables and low value items and develop new methods of forecasting requirements more cost effectively than was being done by the existing system (which had been inherited from the Army in 1918 and had functioned essentially unchanged ever since).

Through the intervening years, the researchers have undertaken very many tasks aimed at improving the supply business and the majority of these have relied on either data extracted from the various supply computer systems or based on computer simulations developed in-house.

Following the delivery of the AEI 1010 system, the focus of attention turned to the computerisation of the Equipment Supply Depots, of which only four remained: No 14 MU at Carlisle, No 16 MU at Stafford, No 25 MU at Hartlebury and No 7 MU at Quedgeley.

Despite an inventory which had increased from 600,000 items in 1961 to 800,000 in 1967, and was forecast to rise still further with the advent of the Hercules and Phantom, and additional responsibilities posed by rationalisation of supply across the Services, improvements in the utilisation of storage had meant that a fifth supply depot, at Heywood, was closed in April 1967.

With the prospect of computer support for the depot functions, not only could the basic accounting be improved but further major enhancements implemented. Whilst not all these enhancements were predicated on the availability of computers, the presence of automated systems provided a catalyst.

It will be recalled that the main depots had been built with dispersed sites about a central hub; fine for security against wartime air attack but a major nightmare for the conditions obtaining in the 1960s. At Hartlebury, for example, the depot occupied a total of 350 acres; contained twenty-eight storage sheds; had a site four miles away from the central site – and the circuit around the depot was sixteen miles long.

Prior to computerisation, no satisfactory system could be devised to allocate storage space, other than on a range-by-range basis; the sheds contained all the equipment for a particular range or ranges, say several aircraft types or several versions of aero-engines. Hence small, fast moving items shared a store with the most cumbersome or rarely used items. If located remotely, equipment had to be moved to the central site for packing and transportation, whilst receipts went in the other direction. Storage space was also largely viewed as being two dimensional, measured in square feet, rather than cubic feet and hence a considerable waste of shed space.

The answer was to create High Density Storage Sheds at depots, adjacent to the receipts and transportation points so as to minimise unnecessary movement. In place of tall racks requiring ladders, several internal floors were built, connected initially by lifts but later by conveyors, thereby increasing significantly the useable storage space. Larger items were also re-brigaded using pallet racking and high-reach fork-lift trucks. Modern handling aids permitted aisle gaps to be reduced from 18 feet to less than half that, so allowing more pallet racking to be installed.

The contribution from the depot computer system was to allow

transaction vouchers to be produced in picking sequence and to direct, automatically, paperwork to the storage point quickly and without the need to check locations manually. Sub-sites were closed and disposed of, used for overspill storage or allocated to alternative uses.

The ICL 1900-series computer system, designed for the depots, benefited from advances in technology and provided storage of data on direct access disks, supported a sophisticated operating control system called 'George' and allowed the computer programs to be written in a higher level language, thus improving the speed of development of the system software. 'Go live' at Stafford took place on 31 October 1968 and the system was quickly rolled out to the other depots.

By 1967, the AEI 1010 system had settled down and was working well and the depot computer system was operating in the four remaining supply depots. No 21 MU at Fauld had closed whilst No 217 MU (the compressed gases plant) at Cardington and Chilmark's No 11 MU were not to be included in the roll-out of computer systems in the immediate future.

At the Supply Control Centre at Hendon, a new development team was put together to begin the feasibility studies for a replacement computer system, since received wisdom was that computers lasted seven years and as soon as one was implemented, research into its replacement should be set in hand.

This new team was led by Gp Capt J G Ireton. 'Roaring Jack' Ireton had the dubious distinction of having been second pilot in the crew of the first Halifax to be successfully ditched, having been shot down during a daylight raid on La Pallice in 1941. He spent the next four years as a POW and it was generally considered that if the Germans had known what they were getting, he would probably have been left in the water! However, there can be little doubt that the ultimate success of the project owed much to Ireton's vision, strength of character and force of personality and, dare one say, sheer bloody-mindedness at times and it is sad to record that his efforts over many years received no official recognition.

The design for the new system was to be as revolutionary as its predecessor's and its scope was to embrace many more facets of the supply work area. The conceptual design of the new system was aided by advances in both computer technology and communications

systems. The new computer system introduced a number of significant innovations.

First, the units would use visual display units (VDU) and keyboards and would input their transactions directly to the central computer system. No longer would punched tape be generated and sent via the teleprinter network to Hendon to be updated many hours later. The stock record would be held on-line at Hendon, the bins of record cards would be no more and the complicated coding and vetting processes would be redundant.

Secondly, transactions submitted through the VDUs would initiate a sophisticated response, depending on what the transaction was about. For example, if the transaction related to an issue from stock, the computer would update the unit's stock record immediately and produce the appropriate vouchers. However, if the unit did not have stock, then a comprehensive stock search covering the entire RAF holding would be undertaken, the precise details of the search pattern being determined by the priority of the requirement. The whole of the initial process would normally take something of the order of 5 seconds – an unbelievable improvement in response time.

Apart from speeding up the process, the new system would also:

- possess an inventory management facility to update inventories from the issue or return transaction;
- offer an on-line interrogation facility;
- be able to manage both alternative items and supercession chains and ensure that the resulting procurement was based on the appropriate item in the chain; and
- be a comprehensive Management Information System (MIS) with the ability to recommend procurement actions or to undertake Automatic Ordering off established contracts within certain predefined parameters.

Moreover, links to other systems, albeit mostly 'off-line', would allow for the support of co-operative logistics projects.

Interestingly, the system had a facility called 'Asterisk D messages'. These were text messages sent from one VDU to specified other VDUs, in much the same way as could be done via the Operations Staff's contemporary ASMA network and, like it, an early example of a practical on-line email system. This facility was used to

very good effect during the Falklands conflict when suppliers could get messages between Ascension Island and the UK more quickly than traditional signals, even those with an 'Immediate' priority. Unfortunately, the system was greatly restricted by 'top brass', after messages from an airman on the island to his girlfriend back home, describing in detail his intentions on return to the UK were intercepted!

Time does not permit as full an exposure of the replacement system as it deserves. The new computers went live in the summer of 1975 and since then it has undergone four 'hardware transplants' and numerous changes, probably now numbering several thousand, have been embodied within the software.

The original ICL 4/72 system had half a megabyte of memory and 2½ gigabytes of disk storage. The current system hardware sports five times the memory and more than 200 times the disk storage, albeit not all on-line at once.

In the spring of 1987, the whole kit and caboodle was moved from Hendon to RAF Stanbridge, near Leighton Buzzard, using a loaned computer as a stepping stone. With a service break of just four hours, for some vital work to be completed, the system was back on line; an achievement that deserved greater recognition than it received.

With the system now in its 30th year, there is a sporting chance that in the summer of 2005, those who worked on the system in the past stand a pretty good chance of being invited to an above average cocktail party!

The decision by NATO to change from the 'tripwire' strategy to that of 'flexible response' had a fundamental effect on all aspects of support. The policy meant that units would need to continue to operate in a conventional role and that, if the central computer system at Hendon or the major communications links should be disrupted, there was a need for the operational units to be able to carry on regardless.

In addition, an aspect of 'flexible response' was that many operational airfields would be configured for dispersed operations and 'hardened'. The construction of hardened accommodation included provision for hardened aircraft and equipment shelters (HAS and HES) and the dispersal of the station's stocks of equipment to the hardened locations from the main supply facility.

The RAF Supply ADP System (RAFSADPS) was not designed to

provide support for dispersed operations and, as already indicated, the centralisation of the computer hardware in a vulnerable building in NW9, within easy striking distance of that hotbed of Irish nationalism that was, and probably still is Kilburn, presented a significant security issue.

The solution to both the vulnerability of Hendon and the need for a system which allowed computer support of dispersed operations, was to make the more important operational units semi-autonomous in computing terms: this system concept was called USAS – the Unit Supply ADP System.

The USAS design philosophy replicated almost all of the RAFSADPS's functions, whilst allowing units to manage dispersed stocks effectively, calculate establishments for stock at each HES and move stocks from one part of the unit to another if required. System parameters identified items requiring bay checking prior to issue and hence these could be routed through the parent unit, before being moved to a remote detachment. A further feature permitted a squadron inventory to be recreated at a remote site with a single transaction.

At the time of the conception of USAS, other disciplines; operations, engineering and administration were developing computer systems for roll-out to stations and all four projects fell under the overall title of 'Station Computing'. Although there was some thought that the systems might profitably be developed as an entity, their underpinning operational requirements were significantly different and it was recognised that any attempt to develop a single system would serve only to complicate and delay matters unacceptably for all. What was decided, however, was that all the systems should use hardware architecture from the same stable and hence installation and contractor support could be simplified. As laudable as this idea was, what resulted in practice was a hardware architecture which was a significant compromise for all parties and which led to some avoidable problems.

Roll-out of the system was made to thirty RAF stations, three RN air stations and a pair of Army Air Corps bases. The presence of these systems at naval and army units opened up some very interesting prospects, since there was no logical bar to prevent the systems being used to demand and manage any NATO codified item for which the RAF held a record.

By time the invasion of Kuwait took place in August 1990, some work had been undertaken to see if USAS could be installed and operated from remote sites and whether the communications links were sufficiently robust to permit this. Whilst USAS terminals were taken 'in-theatre' by deployed forces, they were linked back to the parent unit rather than to the SCC. It follows that detachments from two units on the same base, say Bahrain, could deal with their home base but not with each other!

Following the conclusion of Operation GRANBY/DESERT STORM, much time and effort was invested in developing a deployable version of USAS and, with the current Government's propensity to adventurism, this is probably just as well!

The new USAS hardware, which came along in the 1990s, was robust and small enough to be air transportable and even rack mountable in the back of a long-wheelbase Land Rover. The first deployment of USAS was to Exercise PURPLE STAR in the USA in 1996, which turned out to be a pretty decent rehearsal for Gulf War II, since the US Marines were invading an unspecified country with substantial British support, against an enemy comprised of the US Army.

The vehicle-mounted version was first used operationally in Pristina but the major issue has always been the communications and the young supply officers who take deployable USAS to overseas bases quickly become experts in communications.

Turning briefly to some of the special IT projects, I want to look quickly at the following three areas.

- Small IT Systems.
- Support Management Terminal Network.
- Supply Aero-Engine Record Office.

However, it will be appreciated that there are several other systems which might qualify equally for mention, if time permitted.

Small IT Systems

A little over twenty years ago, small computer systems began to make an appearance, as micro-processor technology evolved. The first microcomputers were of very limited power, as those who started their home computing using a BBC Micro or an Apple II will recall.

Importantly, however, these microcomputers needed to be programmed in the same way as mainframe computers using complicated, and very prescriptive, software, such as BASIC or DB2. By today's standards, the comparatively simple microcomputer was also very expensive.

At HQ Strike and Support Commands, as well as at the Personnel Management Centre (PMC) at Innsworth, Small Systems Groups were established to harness this new technology and to deliver systems to users who might not otherwise have been able to obtain computer support. Our engineering colleagues at Swanton Morley were also quick off the mark with a team established at the Maintenance Analysis and Computing Establishment (MACE) and in January 1986, the Supply and Movements organisation followed suit with a team comprising a solitary squadron leader based at SCC Hendon and functionally tasked by the Supply Policy staff at MOD – for those who might recall some of the personalities involved in the higher echelons of the Supply Branch at that time, this was not always a happy arrangement, particularly for the poor squadron leader!

The supply team quickly demonstrated its worth with a number of projects which saved money, improved efficiency and cost effectiveness but also paid back the costs of the manpower deployed on the work. Within a few months, the officer had been joined by a warrant officer and a flight sergeant and thereafter the team expanded like Topsy. In due course, as the '80s gave way to the '90s, the logical step was to merge the Supply and Engineering Small Systems Groups and thereafter this joint team plied their trade from Swanton Morley before moving to Wyton.

Support Management Terminal Network

One major inadequacy which was never addressed satisfactorily by either the original AEI 1010 system in 1966, or its on-line successor a decade later, was the availability of sufficient numbers of data input devices or on-line terminals to support the work of the Supply Management Branches (SMB), located principally at Harrogate.

In general, prior to 1975 the entire process relied on manual inputs sent to Hendon for transfer to the computer by a legion of keyboard operators and later there was one on-line terminal per twenty staff at Harrogate. These terminals were often located away from the

immediate work area, they were invariably utilised heavily and gatherings of folk around the terminals may well have been a social interlude but hardly an effective use of time. More importantly, the mix of on-line and off-line inputs, led to high levels of rejections because of mismatched transactions.

As time went by, it was inevitable that the supply managers and their staff would become involved in all manner of other computer systems and the proliferation of different terminals connecting to different systems, each with its peculiar requirements threw up fresh problems. The grand old 'swivel chair' interface might have been all well and good when computers were a fairly minor business support tool but it was no longer satisfactory by the late 1980s.

An attempt to get an agreed system requirement from the plethora of supply management interests was never going to be an easy option and so it proved. However, a team, led by Wg Cdr Malcolm Oliver, discovered that British Telecom had demonstrated that it was possible to use a single remote terminal to connect to many different host computers by 'spoofing' the host computers into believing they were communicating with a remote terminal using the correct connectivity protocols, and thus to use the same terminal for connecting to several computers.

This then was the basis of the Supply Management Terminal Network (SMTN) which involved VDUs on individual desks, each VDU being capable of imitating all manner of other terminals, using emulation software lodged on a computer situated between the host systems and the supply managers. The most obvious benefit derived from this arrangement was that much more business could be transacted on-line; in addition, error rates fell, duplication of effort was reduced and the whole process was speeded up.

Supply Aero-Engine Record Office

The management and control of complete aero-engines used to be a fairly straightforward process. The complete engines were never taken onto computer control but were formally allotted to a unit and installed in an aircraft, where their presence was recorded in the aircraft inventory. This quaint arrangement worked satisfactorily, if somewhat incongruously, until the advent of modular engines such as the Adour, which powers the Hawk and Jaguar, and the Tornado's

RB199.

These modular engines do not exist as a single entity but are built up from a series of separately identified units. For example, the Adour 151 has eleven modules whilst the '104' version fitted to the Jaguar has an additional reheat system. Of the apparently eleven common modules in the two versions of the Adour there are also other incompatibilities which makes simple linking more complicated than might appear.

The Supply Aero-Engine Record Office (SARO) was developed specifically to address these thorny issues and to provide both a track of individual modules, their characteristics and modification state as well as a record of complete engines.

Conclusions

In conclusion, computers in the RAF supply business have been a success story – despite many trials and tribulations. I offer two of the reasons why this was probably so.

First, the Commandant of the Supply Control Centre was 'double-hatted'; he was also an MOD director –the Director of Supply Control. It followed that he was able to argue the information technology corner on an equal footing with other one-stars and, if necessary, he could deal directly with the Director General.

Secondly, the supply organisation deployed its uniformed manpower within many areas of the computing business so that those involved could understand both the technical IT system issues and the professional imperatives. It followed that when issues on priorities, costs, timescales and other complexities had to be addressed, the supply officers were capable of weighing matters and deciding what was or was not worth pursuing. Had 'Supply' simply been the 'customer', I venture to suggest that this would not have been the case and problems due to lack of objective focus would have arisen.

Those responsible for the £30+ billion NHS national computer might care to take note!

My final thought, however, is to record that there was, and still is, a significant cadre of civil servants who have contributed significantly to the Supply IT story and to whom a substantial debt is owed.

SUPPORT FOR THE RAF IN THE 21ST CENTURY

Air Chf Mshl Sir Michael Alcock

Sir Michael began his career as engineer and logistician when he was commissioned into the Technical Branch in 1959. He was Air Officer Engineering at HQ Strike Command at the time of the first Gulf conflict before filling some of the most influential appointments in the Service, including those of Chief Engineer and Chief of Logistic Support, AMSO, and AOCinC Logistics Command and Air Member for Logistics; as such, he has the distinction of being the first non-aircrew officer to have had a seat on the Air Force Board.

(Since Sir Michael was unable to be present on the day, his paper was read by AVM Baldwin. ***Ed****)*

'Never start with an apology', is usually a good dictum for public speaking but today I must do just that, through these words delivered for me by Nigel Baldwin. When Colin Cummings first outlined to me what he had in mind for this day I was initially attracted to his request to contribute, the only drawback being that I knew that I was already committed elsewhere on the due date. So, my first apology is for not being present in person as I know that I would have much enjoyed meeting up with old friends and colleagues. My second apology is to admit that I have very little reference material to draw upon for this talk, so you are getting a first hand account of what I remember of events that took place some twenty years ago. Maybe not the best provenance for a Historical Society, but better than nothing I suppose.

I was mildly surprised to have been asked to take part in the first place as your seminar title – 'Supply: An Air Power Enabler' – is all about Supply, not a subject on which I have that much expertise. Indeed, it is my first point of difference today, as I would have preferred the word 'Support' instead. Why do I say that? Well, I hope that becomes clear later on.

First, let me say what I hope to cover in my allotted time.

I want to briefly review the support philosophies that were in being in the '80s and set that in context with the 'Maintex study'[1] that myself and Tony Woodford completed in March 1985, ably assisted by Neil Buchanan and John Charlett-Green – a well balanced group of two engineers, a pilot and a supplier, you might say. Incidentally, Neil

Buchanan, whom I had hoped would give me some moral support today, also finds himself otherwise occupied, which is a pity but Colin, Neil and I did confer over lunch at the RAF Club before setting this thing in train – so I have at least consulted my Supply experts!

And I want then to go on and say something of how Logistics Command was formed, and its subsequent evolution into the Defence Logistics Organisation, and finish with my vision of how 'Support' to the front line will be delivered in the 21st Century.

Support Philosophies

So what about support philosophies? Up until the mid-'80s the RAF was very much the leading light in delivering a philosophy of 'Supporting the Design'. We took the weapons systems from their inception in Industry and did our best to understand the technology, matching our engineering skills to that technology and then determining how best to make it all work so that the front line had some workable weapon systems to use. Our maintenance policies were based on manufacturers' initial recommendations, refined over time as we gathered in-service performance data. Spares were similarly procured and we paid for post-design services from the original manufacturers so that our continuing decisions were based on the best evidence. We managed safety and configuration ourselves through the concept of Engineering Authority, a self-regulating system of governance. In short, we did all the thinking ourselves, and we controlled and managed all the activities, buying advice, spares and repairs from industry and carrying out the work from squadrons at First Line to stations at Second Line and our own in-house Third Line facilities at St Athan and Sealand. We had a formidable corporate knowledge base in the shape of the Central Servicing Development Establishment (CSDE) at Swanton Morley whose work in many areas was adopted by the industry as well as many other air forces. Incidentally, I hope that one day this society will follow up the history of CSDE, for this was where we did our thinking and where practices that today are the norm, actually began. It was CSDE that developed the concept of Reliability-Based Maintenance, of studies into Reliability, Maintainability and Testability, who undertook ground breaking work on computer modelling to test the effect of different support strategies to decide how best to work within cost constraints.

It was all this work and more besides that led to the 'Inception Procedures' that made the first attempt to get Prime Contractors to take an interest in how their products would be supported. Remember that Prime Contractors made their money by selling us more spares, repairs or advice on which to base further modifications – they were simply not interested in containing the life cycle cost of their products, quite the reverse. And it was the rising cost of supporting ever more complex technology that was beginning to distort the Air Force and Defence budgets alike. It was not until the mid-'80s that the AFB took their first paper on the subject of 'Reliability', an issue – unreliable equipment – that was thought to be costing us many millions of our hard won budgets. Getting widespread support for the notion that we should target reliability and insist on support cost being contained was not an easy task, but it gained strength from the same movement taking place in the USA under the banner of Integrated Logistic Support (ILS), a concept that was almost identical to ideas from CSDE and that took us now from 'Supporting the Design' to a philosophy of 'Designing for Support'. At last we had a methodology that was accepted throughout the industry and one on which the USAF and we were joined up.

I mentioned earlier that we managed all of these activities ourselves. We did, but not in a very coherent way. Our organisations were 'smokestacks'; of Supply, of Engineering, of Procurement and of Contracts staffs. We had no real idea of what it all cost and we did not have a single authority of management, or even alignment of financial authority with management responsibility either. Little wonder then that we were unable to contain costs. However, we did have reasonable system availability and safety management, and we did have a very effective supply system, albeit one based on demand in which those requiring parts simply demanded them and the system then did its best to meet the demand. In today's jargon we 'decided' everything about Support – but in a 'smokestack' organisation – and we 'provided' everything, using industry to sell us what we could not make in the shape of piece parts, materials and repairs.

The Maintex Study

So it was that our happy band came together on a freezing cold day in January 1985 in a couple of gloomy rooms on the fourth floor of the

Old War Office building to set about changing things! Our task was not to do some real original thinking, but rather to build on an earlier study done by Air Mshl Sir Alec Morris, a former Chief of Engineering and Supply, who on his retirement in mid 1983 prepared a lengthy report – the 'Morris Report'[2] – which concluded that:

> '…decision making for in-service support could be improved and some manpower and financial economies might eventually be achieved by collocating sections of RAF staffs working in the Engineering Authority (EA) and Supply Management Branch (SMB) activities with elements of the Post Design staff from the Procurement Executive and financial representation from F6(Air)'.

Our first task was to read as much as we could of the extensive number of reports, all of which had a very familiar thread. We had good ideas and good people but we were wrongly organised. We were inefficient; our processes needed changing and we could make considerable economies if only we were prepared to make changes. What was interesting to me was that none of this was new. As far back as 1970 there was a report prepared for the AMSO of the day – Engineer and Equipment Working Party[3] – that had said much the same. There was also a report on the process of managing and repairing equipment that highlighted issues that are still relevant today, including the fact that we need to track valuable, repairable items by serial number![4]

Our study of past reports was soon complemented by interviews with some 150 staffs at all levels in MOD, the Procurement Executive, the RAF Commands and the Fleet Air Arm. And it was here that I was exposed to one of the nubs of the question as to why change was so difficult to implement. 'Supply' and the Supply Branch was seen by many as a very staunchly defended discipline, forever worrying about its status and position within the hierarchy of the RAF. Many people admired the branch discipline and organisation that always seemed to have all its members so well briefed on the views of its leadership, but many were nevertheless often disturbed by the uniformity of views expressed. Clearly the 'Branch' mattered, but what of the purpose behind the branch? Supply Branch cocktail parties were much admired by guests, but again one wondered why other branches never felt the

need to do quite the same. By contrast the Engineer Branch was much less well disciplined and had no regular forum at which a party line could be disseminated. And on those occasions when Engineer Branch conferences were held a different atmosphere altogether prevailed.

All our Supply briefings inevitably began with a look at the size and inexorable growth of the inventory – 'look how big this thing is' and 'how its size grows.' The implication being that we could not make economies, rather we needed more money to service the inventory growth. But if the RAF was shrinking, why was the inventory growing? We never received an answer to that one! And what about the evidence of inefficiency, of hopeless management data, of disconnected management structures, of huge modification backlogs and so on, ad infinitum. What's more, the RAF was coming under great financial pressure, as usual, and countless efficiency exercises and studies were underway. Somehow the Supply Branch had no role to play beyond wringing their hands and expressing confidence that we would always have the spares we needed, provided we made adequate funding available, though the evidence of 'D' states, Priority Progression Cells and experience at units was the opposite, as was the growing evidence of how many provisioned spares were never used; we quite literally had hangars full of unused and often unusable kit. The Maintex Team were agreed that the system was broken – but how to fix it?

The team were clearly dealing with a number of powerful 'smokestacks' – Supply, Engineer, Procurement, Contracts and Finance – but Supply came across as the most staunchly defended 'empire', rather than a team player contributing pro-actively to reduce support costs and improve operational availability and capability, surely the only worthwhile goal of any support activity. One striking symptom of this was a prevailing attitude that only supply officers could determine the way ahead for professional matters. To my mind the issue was not Supply, for spares alone don't solve the problem; it was multi-disciplinary Support, and only three things mattered:

1. Availability – of weapon systems.
2. Capability – of weapon systems.
3. Sustainability – of the whole combat force.

I don't recall much of that from our Supply colleagues and never

heard much commitment to change either. I think that the then Head of Branch felt that there were other more pressing things on his agenda and we never felt that there was going to be any commitment to join in our best endeavours to introduce a new order. There were too many perceived problems, which was probably why Neil Buchanan feels today that his main contribution to our Maintex studies was to give us our splendid opening quote by Abba Eban – a most distinguished Israeli statesman:

> 'History teaches that men and women behave wisely only after they have exhausted all other options.'

Our Team felt that achieving the magnitude of change required in the face of such powerful smokestacks was only going to work if we could limit the damage on structure and people. Which was why we decided to build on the existing Directorate of Tornado Engineering and Supply (DTES), a structure that had already combined Engineer and Supply staffs into an integrated multi-disciplinary staff responsible for bringing the Tornado into service; moreover Tornado was set to consume a major proportion of our support budget – it was running then at some £125 million per year. And we also added in all engines, as another major cost driver and one that would be much more manageable in staff numbers and potential disruption. We felt that if we could get a grip on the big cost drivers – and numerous other studies, such as Life Cycle costs for Hawk[5] and Harrier GR 3[6] as well as work done for Parliament in the shape of the Controller & Auditor General[7] and the Public Accounts Committee[8] all pointed to the same conclusion – then we would start rolling the stone and gather some moss in the process. We also felt that the potential for disruption from change would be minimised by starting with Tornado before it fully entered service.

Our other main recommendation was for a review of engineering and supply ADP systems; a conclusion that led in fairly short order to the establishment of the Logistics Information Technology Strategy (LITS) Team that did so much to bring order to our previously disparate data gathering activities and which has led, over ten years on from the contract being placed, to a new order of information available for managing logistics functions in the Service.

Why then did it take another ten years before any progress could be

achieved? The short answer is that I have not been able to research this part of the story and perhaps others can offer some answers? My personal view in retrospect is that the RAF lost a once only opportunity to make a far-reaching change that would have altered so much that is on our plate today. Lack of commitment from the Supply Branch undoubtedly played a part, but without access to some evidence it is difficult to say how much this affected the issue. Like so many other reports before, the Maintex Study gathered a fair amount of dust on many shelves before playing its part in leading to the eventual creation of Logistics Command.

Logistics Command

So, let us fast forward now to the formation of Logistics Command on 1 April 1994. Logistics Command came about as a direct result of Options for Change, plus a tri-service agreement that each service would move to a similar organisation and in so doing rusticate each of the Principal Administrative Officers (PAO) – Chief of Fleet Support for the Royal Navy; Quartermaster General for the Army; and AMSO for the RAF – to form three new Commander-in-Chief appointments. Without this inter-service symmetry and without Options for Change, which was of course a direct consequence of the collapse of the Soviet Union, I very much doubt that we would have seen the consequential massive changes that took place.

The 'smokestacks' were undoubtedly wobbling, but the external factors, the peace dividend and further reductions in defence expenditure were the things that dictated something pretty revolutionary and so it was that I took over in 1993 as the last AMSO – and the first ground branch officer to fill the post – some 58 years after the post was formed in the big organisational changes[9] that preceded the Second World War. My task was to bring Logistics Command into being and set about creating a new 'logistics centre of excellence', a centre that was to include a Directorate General of Support Management, organised into Multi-Disciplinary Groups, with its own Finance and Contracts staff together with a budgetary structure which set out to control all support costs for the RAF under one High Level Budget. Responsibility, at last, aligned with financial accountability – Nirvana! But we still had to get the Procurement Executive to release to us control of some of our mature aircraft, and it

would be a long time before Tornado came into that category, but we had made a good start at getting a single authority for managing the whole life cycle support process and we still had the services of our old centre of expertise at Swanton Morley. We had decided to mortgage a good proportion of our expected savings to pay for LITS and it would have been nice if one could have waved a magic wand to deliver the improved data and information services to match our reorganisation – the fact is that LITS only went to contract after the command formed and we were put under considerable pressure from the outset with defence cost studies – 'Front Line First' – that were intent on piling yet more change on top of the considerable challenges already on our plate.

To my mind Logistics Command was never given the opportunity to deliver the change it was capable of and it was a sad day for me to learn that our best endeavours were to be overturned in favour of a 'Purple, tri-service solution' in the shape of the Defence Logistics Organisation (DLO). That only makes sense to me when the Army start driving Tornados and we start to fly tanks! I submit that the DLO is based on a false premise, but that is another long story. However, what the DLO did do is to set off another several years of studies and rearranging of deck chairs whilst the ship began to founder as Life Cycle Costs – for our combat systems – continued to grow. It is at least comforting for me to read that after four years of its existence the DLO[10] decided that its priorities were to:

- Reduce costs by eliminating excess platform and capital spares holdings.
- Implement reliability centred maintenance and condition-based maintenance tools & techniques.
- Improve fleet management, and implement a supporting Management Information System (MIS).
- Exploit opportunities to optimise repair and overhaul.

All of the above are things that many in this audience will be well and truly familiar with. So why has it taken over twenty years for these standard, RAF developed practices to be the driving force behind another transformation exercise? Good question! However, even more comforting for me to discover that the recent ensuing, so called, End-to-End Study[11] has concluded that efficiency of managing

the whole enterprise depends, amongst other things, on having a single budget for all support costs of any particular weapons system – which was precisely the budgetary model we had in Logistics Command. So, if nothing else, I can say, 'I told you so' and reflect on all those who helped me to achieve a measure of rational change during my service and who may share my sense of wonderment at the new order that confronts us today.

The Defence Logistics Organisation and beyond

But the new order is ever changing. I suspect that the DLO may prove to be a similarly short-lived organisation to Logistics Command as our forces shrink further and maybe that is a good outcome. What is certain is that the current DLO philosophy of transforming industrial engagement, so that the MOD becomes the 'Decider' and industry is the 'Provider', will produce a fundamental change from the practices we have evolved in our illustrious past. The best outcome of this long awaited transformation is that we are now going to contract with a Prime Contractor – the same Prime Contractor who we trust to design and manufacture the platform – to deliver a defined fleet availability and, importantly, he will only be paid by results.

Our past model has been described as one in which we contract for failure – the more spares or repairs we buy, the better the contractor's reward. The new model will contract for success – the contractor is rewarded for improved fleet availability and he bears the overall responsibility for deciding how to support the whole enterprise. Not a lot different from how we buy the product in the first place, when we seem content to trust a Prime Contractor to design, manufacture and test a highly complex piece of kit; now we are asking the same contractor to take full responsibility for how his design performs in practice.

A new era of Support is upon us, one in which the 'Decider' – the MOD – will work in close partnership with the Prime Contractor and, for the first time, the Design Authority has to take full responsibility for both the performance and the Life Cycle Costs of his product. Quite an achievement and one that I applaud, but the jury is still out as regards a successful outcome. What is interesting to note, as the Maintex Study predicted, is how the Tornado dominates the whole life costs of deployed platforms (in FY02/03 around £1,700M per year,

including STC costs) – indeed at one stage BAE Systems, for whom I have worked as a consultant for several years – offered to supply free of charge all their contractual commitments for all aircraft platforms, other than the Tornado, and that would still fail to deliver the cost savings required of the RAF support budgets!

The current challenge for so called Partnered Support for the Tornado is to reduce the cost per flying hour by 31% for 20% less flying hours – from £1,700M in FY 02/03 to £1,100M in FY 07/08. And if these techniques work for Tornado then they will work for any platform. If we fail to grasp the challenge of containing whole life support costs for the Tornado then I suspect that in the Typhoon era, air power is terminally doomed as being unaffordable. Did we miss an opportunity in 1985? I think so, for I'm sure we could we have saved the taxpayer massive sums in the interim, achieved real efficiencies, better fleet availability and capability than we have now: in short we could have delivered 'Affordable Air Power' in a much shorter timescale and proven that 'Support' really is a pervasive 'Air Power Enabler'.

Notes:

[1] *A Study of the Proposals for a Maintenance Executive for the Royal Air Force*, 'The Alcock Report', by Air Vice-Marshal R J M Alcock – D/MEST/32 March 1985.

[2] *A Maintenance Executive for the Royal Air Force*, the 'Morris Report', by Air Marshal Sir Alec Morris, KBE CB RAF retired – D/MEST/31 dated February 1984.

[3] Engineer and Equipment Working Party – AF/AMSO/EEWP/3 dated 26 June 1970.

[4] *A Review of the Management of Repair and Overhaul in the Royal Air Force*, by Air Marshal R E W Harland CB MA CEng – REWH/MRO/01 dated 30 May 1973.

[5] Hawk T Mk 1 Life Cycle Engineering Costs, Hunting Engineering Document No TP 27254, Ref, HE/Q5301/800 dated August 1984.

[6] Harrier GR3 Life Cycle Engineering Costs, Hunting Engineering Document No TP 27132, Ref, HE/Q5301/800 dated May 1984.

[7] Reports by the Controller & Auditor General: Economy of Stores Support – 28 March 1984; Maintenance of Major RAF Equipments – 11 June 1984.

[8] First Report from the Committee of Public Accounts Session 1984-5: Maintenance of Major RAF Equipments – 15 November 1984.

[9] AP3397, The Second World War 1939-1945 Royal Air Force, Maintenance, issued by the Air Ministry (AHB), 1954.

[10] The Defence Logistics Organisation, Strategic Plan, issued by the Chief of Defence Logistics, Air Chief Marshal Sir Malcolm Pledger, December 1993.

[11] The End-to-End Study, D/E2ES/431006 dated 1 July 2003.

FULL CIRCLE

Air Cdre Nick Morris

Nick Morris joined the Service as a University Cadet in 1973. After early tours in Supply and Movements, he worked on the Anglo-French Jaguar project in Bordeaux. before serving in the Balkans. After a stint as PSO to Sir Michael Alcock, he contributed to the Logistics IT Strategy and then commanded No 16 MU at Stafford when the depot was being transferred to the Defence Storage and Distribution Agency. Following a tour in Logistics Policy and Plans at Strike Command, he has filled two senior appointments within the DLO. He is currently Head of Branch.

Ladies and gentlemen, it is my privilege to round off the formal presentations and, in so doing, to give you a view of the Supply Branch today. It is particularly instructive to do so by situating the Branch in its historical context but time precludes the analysis from looking at more than a sample of potentially relevant issues. Sir Michael has set an interesting question – why did it seem that the Supply Branch was reluctant to grasp the nettle of change? Moreover, when the Branch realised the need for change, why did it take ten years to respond to the needs of increasingly sophisticated weapon systems with their attendant higher costs of support? I believe that the answer lies in the Branch's origins and the task it had taken on by the end of the Cold War.

Much of today's effort is centred on support to operations but it has long been my contention that the Branch runs a serious risk of polarising into two fields, those of operations and acquisition, which represent the principal career choices for our officers. Today's officers are proving particularly adaptable and flexible in taking on a wide range of challenging appointments but there is a risk that the superficially more appealing and, without doubt, higher visibility operational tasks will eclipse the slightly more remote and less appealing jobs within acquisition logistics. It is precisely in the latter field that there is greater scope to influence the cost of support.

However, while the joint-Service nature of operational posts has been embraced by many officers, there is a perception (false, to my mind) that acquisition is a field dominated by technical considerations with scant attention paid to supply.

All officers begin their careers on main operating bases within the home base. As a feature that has run through today's presentations, this is the ideal starting point for considering the changes that the Branch has wrought for itself. For that home base organisation may give some clues as to why change was initially slow in coming. There had been little change over the years to the traditional structure of the station organisation known as the 'Binbrook' model. This structure reflects the traditional three base wings, supporting a number of flying squadrons. Within this structure, Supply and Movements Squadrons resided for many years in Administration Wing before the RAF Germany model became the norm and the squadrons migrated into Engineering Wing in 1986.

It was only four years ago that we looked seriously at whether or not the Supply and Movements Squadron organisation itself actually reflected the needs of the Royal Air Force in the post-Falklands era, working increasingly along business lines. The conclusion reached was that we should structure our squadrons according to the processes that they support – which reflect the needs of our principal customers – the operators and the engineers. In so doing, we moved at a stroke from, if I may mix a metaphor used by Sir Michael, supporting a structure to structuring for support. From here it was relatively easy to create the necessary focus for mounting operations and then to set up logistic focal points to replace centralised progression facilities. In the latest round of re-organisation, the whole support environment has changed with the collapsing of our four traditional lines of support into just two (forward and depth). The aim of this radical change is to enhance the quality of support by providing a more integrated service to the front line. I believe that our officers, formed in this spirit, are now more ready to take up the challenges of tomorrow's environment.

There is a related aspect that interests me personally but has escaped our attention thus far – that of infrastructure. I do not propose to dwell on this subject but I do want to use it as an illustration. Our one remaining depot site at Stafford has changed little since it opened as the second Universal Equipment Depot under the Expansion

RAF Stafford and the Defence Storage and Distribution Centre.

Scheme in 1938. Yet, today, it forms an integral part of the Defence Storage and Distribution Agency working at the heart of the Defence Logistics Organisation.

Aside from the closure of the railway line in the 1970s, the infrastructure has seen little change, but it has adapted to meet the needs of a modern, high technology air force and is now proving to be the best configured for a distribution-centric, as opposed to storage, operation. Similarly, our unit supply squadron buildings remain largely unchanged although the use to which the storage space has been put has changed beyond all recognition.

The point is that, if we can use sixty-five-year old buildings to support a vastly different air force from that for which they were designed, then we must be able to adapt our role to meet the professional challenges that we face in the 21st Century.

So, what has shaped that environment and how should the Branch face the challenges to ensure that a collection of professional logisticians continues to play its part in enabling air power? Since the

Standard, pre-WW II pattern, Supply Squadron HQ and storage building.

1998 Strategic Defence Review (SDR), the face of military logistics has been in constant evolution. At the very time when operations were demanding greater reach and deployability, logistic support was having to play its part, quite rightly, in funding investment for the front line. The need for a reduced logistic footprint has been clearly articulated and the new chapter of the SDR that built on operational experiences following the terrorist outrages of 11 September stressed the need for agility and responsiveness. In this respect, the Branch has been tested many times, for example in leading the formation of a multi-national movement control centre for operations into Afghanistan. Its officers and the airmen from supporting trades have performed magnificently.

In 2003, the Defence Logistics Organisation produced a defence logistic vision which, if nothing else, shows that logistics is not an end in itself but a means for the delivery of capability, stressing the need for a fundamental change in the relationship with industry. Personally,

I believe that these two factors add the two ingredients that Defence Cost Studies and the SDR lacked; because they link operations, support and industry in a way that begins to make affordable air power everyone's business. I also have the feeling that, in the formation of Logistics Command, the Supply Branch may have missed opportunities but perhaps those opportunities have been compensated in more recent history. From where I sat at the time, as a squadron leader desk officer engaged in support of Tornado, I am not convinced that it could have been any different as we struggled to support legacy fleets whilst introducing a complex new platform on a very taut budget.

In terms of the supply – or support – element of operations, three issues underpin this new approach. These are deployable mounting bases, a 'pull' re-supply system and formed units. You will see immediately that we have built on an enduring legacy. We can trace an evolution of the logistic footprint from the RFC's air parks and depots in France through the air stores parks that supported the advancing air arm across Europe to the Harrier logistics parks and today's force mounting bases or ports of disembarkation. Re-supply, governed by the 'pull' from theatre, was a feature of the re-supply system operated from D-Day, while in organisational terms, we have rediscovered the importance of 'formed' units. Rather than gathering together a set of people on the eve of a deployment, we aim to train them together and deploy them as a cohesive unit, and possibly with their own unit number and badge. The formation of an Expeditionary Logistics Wing, badged as No 85 Wg and taking its traditions from the former Group of the same number is a good example of this approach.

But of course, there can be a penalty to pay for reducing the logistic footprint. Sir Arthur Harris, recalling his days in command of No 31 Sqn in India, wrote that:[1]

> 'We lacked practically everything which an Air Force squadron anywhere else would regard as essential for maintaining its aircraft. We came under the Army Vote and, as a result, we got little of everything and much of what we got was useless … we had single-ignition Rolls Royce Falcon engines when new dual-ignition engines were being sold for a song as surplus in

'…..the intricacies of re-supply of a highly technical force deployed in inhospitable regions far from home.'

England!'

We have already heard from Henry Probert that Sir Arthur Harris had a feel for things logistic and some of our efforts today might produce a wry smile on his face. While we are far from the situation in which Harris found himself, history does have a habit of repeating itself and we have continually to educate our colleagues to the intricacies of re-supply of a highly technical force deployed in inhospitable regions far from home. The challenges facing the Branch in this operational construct are many but they boil down to good logistic practice. In this respect, if the Branch had an insular attitude, it has borne fruit.

Deployed operations of recent years have bred a different mentality in the Branch. Instead of managing a large pool of assets and maintaining those in condition for a conflict in line with Cold War doctrine, we now have to manage a lean supply chain, be absolutely sure where our assets are, and confident that the inbound spare is appropriate for the fit required. We have heard of the development of information systems to serve the needs of supply and it is interesting to note that the system developed for Cold War static war-fighting has evolved into a highly successful deployable system.

Supply officers themselves have adapted well to the joint environment, but, in the context set by Sir Michael, one wonders if they really do understand the part that their role plays in the engineering context. In other words, we need to consider whether or not they understand the causal factors that lead to the need for the items that they are managing. This is perhaps where the opportunity was lost years ago because it is in the less glamorous area of acquisition that people will gain an understanding of those causal factors. In 1979, the marriages that had formed a Directorate of Engineering and Supply Policy and a Directorate of Engineering and Supply Management were dissolved. Yet the Directorate of Tornado Engineering and Supply Policy was a success, perhaps because of its focus on one aircraft type. The Central Servicing Development Establishment similarly proved the interdependence of information and technical expertise to refine support policies for existing and new weapon systems. The Supply Branch fared less well in the formation of Multi-Disciplinary Groups, leading to the perception that acquisition was dominated by technical considerations. At the same time, there was undoubtedly an evolution in our thinking as we led the move to support chain management in the early '80s. In many respects, by combining technical and supply factors and considering the 'reverse' flow of materiel back to repair facilities, the RAF's logisticians were ahead of the commercial world. Today's thinking emphasises 'end-to-end' logistics – another buzz word perhaps but a recognition of the continuity of logistic activity in which the supply function sits. The new era heralded by DLO restructuring requires a joint approach, this time with the Defence Procurement Agency, to reduce through-life costs of support.

So, is there any foundation in the accusations of insularity, and will tomorrow's Supply Branch shake it off? Some might suggest that we never will shake off the yoke of historical perceptions, for they are as old as the Branch. An article entitled 'On the Future of the RAF' published in *The Aeroplane* on 27 October 1920 proclaimed:

> 'In the later days of WW I, the RAF was a huge inchoate mess. The flying personnel were, in the main, excellent fighting men. They were backed by mechanics, technical officers, stores officers … and so forth … mostly very willing, and many very

incompetent.'

On the other hand, perhaps the very nature of the Branch encouraged its insularity? It seems that the Branch had attained a life of its own because Stores Officers were indispensable to the creation of an air arm. We have to ask ourselves why that should be and the answer probably lies in the similarity of their role to that of the quartermaster in an infantry battalion, an officer commissioned from the ranks who was key to the victualling and life support on which the battalion depended. An article on RAF Branch structures in *The RAF Quarterly* in 1978 by John James referred to the Stores Branch as composed of:

> 'The men who had learnt how to run the supply system of an Air Force and whatever their origin, they had to be retained while 27,000 other officers were being discharged, otherwise the whole system would break down.'

As the air arm became increasingly complex, so the role evolved and the need grew for systems to support the costly process of provisioning and procurement. In turn, the need arose for people who could operate and, occasionally, outwit the systems that were being built up in support of the 'E' branches evacuated to the hotels of Harrogate. The following lines will be familiar to all who have served in supply squadrons the world over, but it surprised me to learn that the ingenuity that we thought came with the computer age was, in all probability, as old as the Branch itself:[2]

> '…those who had drawn up the maximum/minimum stock levels pre-war did not realise how many of these (critical) components would be required to keep the squadrons flying once operations started in earnest … The Senior Equipment Officer at Northolt … instructed us to use our discretion and amend them accordingly…'

Norman Morss went on to explain how spares were hidden from the eyes of Fighter Command inspection teams in an effort to turn round the maximum number of damaged aircraft during the Battle of Britain. Northolt's Senior Equipment Officer had rightly anticipated that his station would receive more than its fair share of damaged aircraft.

Today's officers are playing their role in the widest sense possible as they fill joint logistic posts in our permanent and deployed headquarters. For the first time, we now have coherent logistic doctrine and concepts. Many of the paragraphs in the soon-to-be-published doctrinal document bear an uncanny resemblance to the Air Publication describing the role of No 85 Gp but I see that as an enduring legacy of the physical side of logistics. It is still more difficult to bring influence to bear in the essential interface between engineering and logistics but there are encouraging signs that the skills required on the beach-head or in the logistic element of a desert air force headquarters are appreciated in formulating innovative support proposals

In conclusion, this is a Branch confident in its abilities, contributing to the wider defence and operational context. But it needs to understand the totality of support if it is successfully to prosecute deployed operations. Is it finally free of the quartermaster image? I sincerely hope so – but perhaps I could leave you with the words of one of today's officers, whose unit went to places that no other elements of the Royal Air Force visited on the most recent operation:[3]

> 'On Operation TELIC, as a theatre, rather than single-Service asset, we are pushing back our operational envelope, regularly operating to within a few kilometres of the front line … all my personnel have set aside concerns for personal safety and comfort to ensure the vital logistics lifeline to the front.'

Ladies and Gentlemen, I give you the Supply Branch 2004.

Notes:

[1] Personal correspondence quoted in Chaz Bowyer's, *RAF Operations 1918-1938* (London, 1988).

[2] Flt Lt Norman Morss, RAF Retd, personal letter to presenter 19 Jul 98 referring to supply during the Battle of Britain.

[3] Sqn Ldr Axel Jinadu, OC No 2 MT Sqn, *RAF News* 18 April 2003.

AFTERNOON DISCUSSION

James Pettigrew. Our title for today has been Supply: An Air Power Enabler but I have come to the conclusion that 'Supply' is the wrong term. It should be 'Delivery', which seems to me to be the key word, whether one is a manufacturer, a member of the armed forces, a politician or an accountant.

AVM Peter Markey. I think that that is a powerful point, and it is what is actually happening. As Nick Morris pointed out, the airmen and officers of today's Branch are literally 'delivering'; they are on the Front Line, and they are performing very well.

Air Mshl Sir Reginald Harland. Rather than ask a question I've got a few short comments, particularly on what Mike Alcock had to say, followed by some contradictions. I was saying earlier to Henry Probert that unless one studies the past, one tends to repeat it (a quotation I've got from Confucius, Thucydides and lots of others). I do think it's important that one gets the past straight in these things.

Reliability. For example, Mike Alcock's paper said that it was not until the 1980s the first Paper on Reliability was produced. Well, I produced one in 1960; and presented it to the Air Council at a meeting in 1962, together with the costs of unreliability. I had estimated support costs when I was working for the Air Member for Technical Services at the Air Ministry in 1947 so I was fully aware of what the technical costs were. The trouble was that there were so many other things that seemed to matter more to the Air Council. I remember in 1946 going to an Air Council Meeting. I was going with the Air Member for Training to present the costs of flying training and technical training and how these could be reduced by altering the intake dates. I sat all afternoon outside the Council and eventually went away without being heard. The Council were discussing which of seven designs for the new aircrew ranks badges should be adopted. I never got back in there. There are sometimes problems like that.

*Logistics Command***.** The next point concerns various functions of Logistics Command. When I wrote my Report in 1973 ('Repair and Overhaul in the RAF'), the last page said that we should set up a Logistics Command and that AMSO should become the Air Member for Engineering, with his Organisation function moved elsewhere. I

was told I had to rewrite that page. It did not suit the GD Officer who was AMSO at the time; and I don't think that was altered for many years afterwards. If I may say so, the GD Branch should take some responsibility for these things. There was an idea that the engineers and the suppliers were second-rate staffs who didn't matter even if – a main trouble – we seemed to cost far too much. Methods for getting that cost down were repeatedly ignored. We had put up requirements for better maintainability and reliability from CSDE at that time (1960, and at many times since).

Logistic Support. After I left the Royal Air Force and went after a while to Short Brothers, I helped them to get a contract with the United States Air Force for the C-23A light support aircraft. We won that contract on a whole life cost basis. Shorts had not only to provide the aircraft, the spares, the support staff, the technical advice and all the rest of it, we had to have sub-contracts with the suppliers of the engines and the inertial navigation system that they would give such support too. It was a most interesting experience. When, a few years later, Shorts got the contract to supply the Tucano, our Ministry refused to have that sort of logistic support. They wanted to take over all those sub-contracts and organise them. I think they lost out immensely by doing so. I do think it's most important that such contracts are looked at as a whole weapon system, and that the whole thing is set up that way.

Lines of Support. I noted on one of the later slides the suggestion that you should have two lines of support instead of four. You've got to have three lines, because there's what you do on the aircraft, there's what you do immediately you take an item off the aircraft and there's what you do if you have to send it somewhere else for repair. You cannot have less than those three.

Spares Economics. Lastly I'd say that one of the problems is always the Treasury. One has got to convince the Treasury that what you're doing is cheaper than any other way of doing it. When it comes to an economic balance on stock levels, I had great difficulty in Support Command in persuading GD Officers of the need for a careful balance between aircraft waiting for spares, and spares waiting for aircraft. Support Command Depots had huge numbers of spares waiting for aircraft, but we were always being asked, 'Why haven't you got more? Why should we have any aircraft awaiting spares?' It

just would not have been economic. You can work out the way in which spares fail (which is often very randomly) but you've got to accept that there will always be a certain number of aircraft waiting for spares. In fact, that came into Shorts contract with the United States Air Force on their C-23A. We were pinned down to a certain maximum level of aircraft waiting for spares. From that we estimated what our stocks of spares should be. It is very important that one looks at that aspect of spares provisioning.

Air Cdre Derek Waller. I cannot let this Seminar close without responding to Sir Michael Alcock's severe criticism of the Supply Branch, and especially his contention that in the 1980s we were a set of Luddites. I agree that there were too many separate pillars of activity in the support business and that this situation needed to be rectified. However, the problem was not all one-sided and even the engineers and others had their problems, as he well knows from the time that we worked together at HQ Strike Command in the late 1980s. In fact one of the major problems affecting the supply organisation at that time was industrial performance and, even as late as 1990 when I went to work for BAe, Beaverbrook-type performance was still the norm. Indeed, BAe were horrified when I insisted that spares orders over two years old and repair orders over twelve months old were totally unacceptable! One of the problems that I discovered was that the MOD(PE)/NAMMA Tornado contract stated that production was to take priority over spares, and of course at that time the Tornado production line was still open. I hope someone will now check that this has been changed in the Typhoon production contract. To conclude, I hope that Mike Alcock's comments were simply meant to be provocative rather than unnecessarily critical; which is the way they came over.

Markey. I think that we have to recognise that Sir Michael probably had his tongue firmly in his cheek. He had been presented with a splendid opportunity to ride one of his favourite horses, and he rode it. Nevertheless, let me balance my own book. I think he was a great friend of any professional officer; anyone who, to pick up the theme, 'delivered', he would support – and there are many of us here today who have enjoyed working with him.

CLOSING REMARKS

by AVM Peter Markey

My brief required me to sum up. I need take only a moment or two of your time. What we have heard about today is adaptability, constant adaptation, but also continuity. For example, when we were listening to Larry O'Hara speaking about the First World War we heard that even at that early stage configuration control was an issue. We have heard about the adaptability demonstrated in the opening and closing of depots; we have heard about moving with the Front Line; about adapting constantly to what the Front Line needed. All of that continues today, as we can see reflected, very clearly, in our current highly-deployed, seriously-overstretched and, effectively (in terms of manpower) under-resourced air force. Our Service does tend to focus on equipment but we also need to focus on our people and, fortunately, in our Branch we do have excellent people. We always have had good people and this is particularly so today, when our officers, airmen and airwomen are serving, as you have heard, effectively as infantrymen and women – as well as doing their jobs. I suggest to you that the Branch is in very good hands. Anyone who thinks that it was always better in the past is probably getting quite old. That simply was not the case – and I think we can leave it at that.

On behalf of us all, I offer our thanks to a number of people: to the Royal Air Force Museum for hosting us; to Tactical Supply Wing and the Royal Auxiliary Air Force Movements Squadron for mounting their displays; to David Packman for backing the event, and to Larry O'Hara, Trevor Stone and Colin Cummings for putting it all together. Finally, I thank the speakers. A tremendous amount of work and research was put into today's seminar by a lot of people who are actually pretty busy, not least Nick in his present appointment, and I think we owe them all a round of applause.

Thank you very much.

SUPPORT FOR THE RAF IN THE 21st CENTURY – A REBUTTAL

by Air Cdre M J Allisstone
(Director of Supply Policy & Logistics Plans (RAF) 1984-88)

It is a pity that Air Chf Mshl Sir Michael Alcock was unable to be at Hendon to deliver his presentation in person, which meant that it was not possible to debate with him afterwards some of the more important points that he raised. Moreover the Director General of Supply (DGS(RAF)) in the mid-1980s has since died and hence cannot defend the allegations made against him by the air marshal. I was the RAF Supply policy director during much of the period of the Maintenance Executive (Maintex) Study; I normally deputised for DGS(RAF) in his absence and, as such, I was well aware both of progress with the concept and of his views on it. I thus feel it is important to ensure that the record is properly balanced and I cannot allow the more provocative parts of the Alcock presentation to pass unchallenged.

The analogy of separate 'smokestacks' is a good one, and sooty they all were. Few then in the RAF Supply Branch would disagree that there was a desperate need for better information on costs, and for more lateral management if they were to be properly controlled and contained. But Sir Michael went on to accuse the 1980s Supply organisation of worrying about its status and of imposing on its members the views of its leaders. My recollection of those days is that we knew the Maintex Study had a wide consultative remit and we also knew that its Chairman had some fairly immutable ideas about how to tackle it, by no means all of which were based on accurate perceptions of the Supply function, despite our efforts to enlighten him. His style then – and it is still apparent in his presentation – was such that his proposals might well have been bull-dozed through amid claims that they enjoyed the support of the majority of Suppliers, had we not ensured that the counter-arguments were also heard.

Despite its long history and several sub-specialisations, the Supply Branch has never been so big or disparate as to be unable to enjoy a strong sense of identity, and there is nothing wrong with that. This *esprit de corps* was not created artificially by the leadership but we certainly encouraged it as a means of assisting the Supply organisation

to carry out its task – seen by some as mundane and even boring in part – effectively and efficiently, for the greater good of the Service. Supply Branch dinners and cocktail parties had their place in this but they occurred primarily because those who attended enjoyed them. Most people were ready to meet the cost of doing so out of their own pockets, without being pressed to participate – and Sir Michael may remember being an apparently enthusiastic guest, at our expense, on several such occasions.

Turning to the specifics of the air marshal's presentation, the size of the RAF inventory is but one of many ways of gauging the Supply task. There is a very simple answer to his question about why, if the RAF was shrinking, the inventory was growing. It was primarily due to the much increased complexity of modern aircraft and other equipment, whilst many of the older types remained in service, albeit in reduced numbers. Nor should his allegations of 'inefficiency, of hopeless management data, of disconnected management structures', etc be levelled solely at the RAF Supply Branch (which, incidentally, pioneered asset visibility and has since introduced further important improvements such as serial number tracking). Such criticisms could be made in equal measure of his own discipline but the problems were actually endemic right across all three Services at that time. Like many of my colleagues, I entirely accepted that there was an urgent need for change and I believe that our response would have been perceived as more positive, had the Branch not felt so threatened by the overbearing nature of the Maintex proposals. In that respect, the study's principal author was probably his own worst enemy.

It is perhaps small wonder that Sir Michael could not understand why the Supply Branch was worried, if he still thinks that 'spares alone' were involved: there was, and still is, considerably more to it than that. Indeed it was this propensity for sweeping statements about the Supply function, with their overtones about 'status' (which I do not recollect ever having been raised by ourselves) that particularly concerned many of us. It was as if Sir Michael were intent on putting the Suppliers in their place, once and for all, as quartermasters as he seemed to see it. Most of us – including the DGS of the day who was, in my view, quite unjustifiably pilloried in the Alcock presentation – entirely accepted the analysis that ultimately only availability, capability and sustainability really mattered to the RAF as a whole.

But we did not like the dictatorial manner in which solutions to these findings were being presented and we were not prepared to be steam-rollered. I seem to recollect that we said so and that this was not popular with the Maintex Study team.

Thus, if Sir Michael 'never heard [of] much commitment to change' from us, he was probably asking the right questions but in the wrong manner. We had already enthusiastically supported the joint Engineering and Supply approach to bringing the Tornado into service (DTES(RAF)) and we regarded that model as a much more sensible way of going about things than the blatant Engineering 'take-over' scenario put being forward in the Maintex study. This was neither a 'lack of commitment from the Supply Branch' nor 'resistance to change'. It was rather a realistic assessment of what was likely to succeed, given acceptance on our part that DTES(RAF) was a worthwhile experiment in partnership which already offered great potential and which later proved it.

I am not qualified to comment on the success or otherwise of Logistics Command or the Defence Logistics Organisation, as they came into being after I had retired from the RAF. However, it appears to me that all three Services, and especially the RAF, are now relying increasingly for war on a peacetime support concept which lacks the resilience, if not the commitment, which they used to enjoy with a largely uniformed logistic organisation. And, unlike certain elements of the Alcock presentation, that really does worry me.

AIR MOBILITY – A game for 500 or more players.

On a lighter note, this piece, which was submitted by Colin Cummings, may amuse some members. Written by Wg Cdr M J W Lee circa 1973, it reflects the way the Movements game was played at the time. No doubt the rules will have changed since then..... ***Ed***

Air Mobility is a game of skill played between two teams of military personnel. The first team, called 'The Army' is normally represented by an infantry battalion, whilst the second team, called 'The Air Force' is drawn from any section of the Royal Air Force Movements organisation. The game is played on a four-dimensional board (to be purchased separately) and involves the movement of the first team by the second from one corner ('the departure airfield') to the another corner ('the destination'). Progress across the board is subject to a series of handicaps.

Play is initiated by an external agency called 'The Central Staffs'. The unit to be moved and its destination will be selected at random to achieve maximum surprise and, regardless of the notice actually available, the two teams are to be informed only at the last moment for the move to remain feasible.

Following the signal of 'play', each team endeavours to score points off the other until the destination is reached, the air force runs out of serviceable aircraft or the army runs out of troops. The Army may also resign by adapting its exercise to the Salisbury Plain Training Area.

Points are awarded for each development in the play.

During the basic planning the Army scores 50 points if it can persuade the Air Force to emplane the unit at an airfield anywhere within convenient distance of the unit's camp. The score is doubled should the airfield be devoid of facilities or normally confined to light aircraft. The Air Force likewise may gain 50 points if the Army is forced to leave from Brize Norton or Lyneham, the score being increased by one point for each mile the road journey exceeds the subsequent air move.

The payload quoted by the Army in planning should in no way resemble the freight actually delivered for loading. The manifests should be so worded, however, that no formal reproach is possible subsequently between parenting headquarters. Should the Air Force be

able to identify such a discrepancy it will gain 20 points, or 50 if correspondence reaches brigadier-level.

When allotting aircraft to the airlift, the Air Force gains 20 points for each Hercules it is permitted to task in the full passenger role. A bonus is awarded for flights of over six hours. This score may be doubled if the Hercules is overtaken in flight by a VC10 carrying the Army's freight or a chartered civilian airliner carrying the Air Force servicing crews.

Both Army and Air Force formations may issue conflicting orders at any stage prior to departure. Twenty points will be awarded for any major amendment so timed that the other team's internal administration is held to blame for ignorance of a change in time, day or airfield of departure.

Experienced players will appreciate that the time of arrival of the Army unit at the airfield and the time of departure of the aircraft will bear minimal resemblance to any published information. The Army may claim one point per minute by which the time interval is shortened; the Air Force may claim one point per minute by which the Army have been made to arrive unnecessarily early. Either side may make full use of such phrases as 'all times Alpha' or 'all times Zulu' discreetly hidden as footnotes in an Annex.

The Army will be permitted to load freight onto aircraft but the Air Force may, at their discretion, apply a handicap by insisting on responsibility for supervision. The Army is awarded 50 points for each aircraft fully loaded on time and about which the captain is unable to find a valid reason for demanding reloading or relashing. This eventuality is of course exceptional. The Air Force will normally allocate troops to individual aircraft and so ensure that no chalk is ever coincident with a recognisable sub-unit; they may then claim one point for each soldier separated from his company.

Each soldier is to be briefed at platoon, company and battalion level as to his individual baggage allowance and forbidden articles. This information is to be repeated by the ATLO, Duty Air Movements Officer and the Air Loadmaster. Ten points will be awarded to each soldier who exceeds his baggage allowance by at least 20% and a further ten points can be claimed by any man reaching the aircraft steps openly carrying a Hexamine stove, butane lighter or thunderflash.

In the event of unserviceability of the aircraft en route, the Air Force will be penalised for overnight delays at Gander, Masirah, Ulan Bator or similar locations. Points may be recouped however if the crew can declare the aircraft unserviceable at Nairobi, Hong Kong or Hawaii. The Air Force may seek a bonus if they can persuade the Army to remain in the Movements Lounge all day on the pretext of imminent rectification of the fault and departure. Should the aircraft finally become serviceable, points are to be doubled if insufficient crew duty time remains and a further twelve hours rest for the crew may be justified.

Further opportunities for scoring may occur if an overnight delay takes place and the Army are required to use transit accommodation. The Air Force gains one point for every man allocated to a room in excess of its normal capacity. Twenty points are granted if the unit commander and his batman are allocated to the same room. The Air Force gains a further bonus if, simultaneously, the crew can arrange accommodation at an hotel in the city centre: scoring will increase with the hotel's star rating up to a maximum of 50 for the local Hilton. Most crews will of course gain on this play.

On arrival at the destination both the Army and Air Force have equal opportunities for scoring. A prompt arrival at the destination planned is valued exceptionally highly at 50 points for the Air Force. The Army may reduce this figure by one point for each item of baggage mislaid; this has proved to be an appropriate weighting to achieve parity. The Air Force may nevertheless claim ten points if it can be announced that the unit commander's baggage was off-loaded somewhere en route. The score is twenty if it is in fact true.

On arrival of the last chalk, aggregate points are compared. Should the Air Force win, they may commence the return play with a 200-point bonus. Should the Army win, they may opt to return by sea. In any event the game will prove to be one of a series.

It will be perceived that the game is open to infinite variation. It is a war game that may be played throughout times of peace. It is, however, deserving of a final accolade; it completely defies operational analysis, team management or resolution by digital computer. Can one say fairer than that?

FEEDBACK

Spares in the Far East – A Personal Recollection

Air Cdre Probert's reference to the paucity of spares during the Burma campaign reminded me of my own experience in the same area after the war. It had an ironic twist

I was posted from Ceylon in February 1947 to No 52 Sqn at Mingaladon, near Rangoon, to take charge of the squadron's Instrument Section. A large number of Dakotas were being used on communication flights around the Bay of Bengal and internally to Akyab and Meiktila. The aircraft were kept in a spotless condition by a small army of Japanese prisoners of war and, on our part, the engineers' task of daily maintenance was not made easy by the steady attrition of personnel during post-war demobilisation. The Instrument Section came under particular pressure to keep the autopilots serviceable, for although the aircraft were flown by two pilots, the Sperry autopilot was extensively used and was a desirable, but not vital, component for aircraft serviceability. Spares for the Sperry gyroscope units were particularly difficult to obtain. Regular weekly demands through the normal stores procedures resulted in 'no spares available' inscribed on the returned demand forms. In sheer desperation I decided, against all regulations, to dismantle the gyroscopic units, clean, reassemble and calibrate them. This work should have been carried out in clinical, dust-free conditions at a maintenance unit or at the manufacturers. With hardly a window intact, the shrapnel-scarred hangar at Mingaladon was certainly not 'clinical'. But we made the best of it and I managed to keep the autopilots going. Calibration of the artificial horizon gyro units was another problem, as we lacked the correct feeler gauge to adjust the pendulous vanes on the erecting mechanism. I used the thickness of the local newspaper to achieve satisfactory results. (In the 1940s, autopilot gyroscopes were air driven.) In July 1947 Aung San and most of the Burmese Cabinet were assassinated. A few weeks later, preparations were made to move the squadron to Singapore. I was invited to inspect an RAF stores unit in Rangoon to see if there were any useful items to salvage. To my astonishment I found somebody putting a hammer through the gyroscopic units that I had been demanding for months.

One of No 52 Sqn's Valettas (VX526) being escorted by Hornets, somewhere over Malaya, circa 1952. (MAP)

Six years later I was again posted to No 52 Sqn, this time as a medium-range transport pilot. The squadron was still in Singapore, although its Dakotas had been replaced by Valettas, equipped with a Smith's Electric autopilot which, in the main, had good serviceability. My log book records a flight from Singapore in June 1954 where the autopilot failed during the first hour of flight. No spare components were available in North Borneo, the Philippines, Okinawa or at Iwakuni (Japan) or on the return flight through Hong Kong and Saigon. I arrived back in Singapore quite exhausted, having flown manually as a single pilot for 40 of the 41 hours total flight-time.

Flt Lt M J Rogers (Retd)
Banstead

ERRATUM

On page 64 of Journal 34 there was a reference to 'Uttlemore', near Oxford. It should have read Littlemore.

BOOK REVIEWS

From Fury to Phantom – An RAF Pilot's Story 1936-1970 by Gp Capt Richard 'Dickie' Haine OBE DFC. Pen & Sword; 2005. £19.99.

Gp Capt Haine's book is indeed 'a pilot's story' and his love of the air is writ large upon almost every page of this very straightforward memoir. He traces his flying career, from the silver winged biplanes of his training days and of No 25 Sqn at Hawkinge in 1936, to a final appointment as OC RAF Lindholme in the mid-1960s. That he devotes only a dozen pages or so of the book to his staff appointments gives a very fair indication that this is not a volume for those who thirst after the nuances of RAF policy in the thirty-four years of the group captain's service!

Although circumstances saw Haine specialise in the night fighter role throughout WW II, he was at heart a single-seat man, as he makes clear repeatedly. His descriptions of the early days of AI radar and, especially, of his time as a Flight Commander on Beaufighters and in command of a Mosquito squadron are especially interesting. In parts, however, his narrative is clearly drawn straight from the pages of his logbooks and there are a number of lengthy passages throughout this readable book that bear that unmistakable stamp. He was self-evidently not a man to sit behind a desk when he might be in the air or chalking up new types!

In many ways, the early post-war years offer the greatest interest in these memoirs. Gp Capt Haine's account of seventeen very busy months at CFE, on the Air Fighting Development Squadron, provides a glimpse of the work involved in the early jet age and its pace. Equally, his description of a little over two years commanding a wing of Venoms at RAF Habbaniyah makes good reading. His time as OC Turnhouse took me back to my own schooldays. In 1957 I spent some time there, in an Officers Mess packed with the 'boltholed' crews of No 151 Sqn from Leuchars, all but the General List officers dressed in serge battledress. I stroked the flanks of the Caledonian Sector Commander's 'runabout' Hunter F4 that features in this tale. And I flew in rehearsals for the carefully stage-managed Battle of Britain air race involving Chipmunk, Anson, Vampire, Meteor, Javelin and Hunter that was 1950s hooliganising at its very best! The group captain describes the Royal Air Force which many of us joined – but

certainly not the Service from which those of my generation retired.

For the pernickety, there are a number of untidy errors of detail to be pounced upon and I confess to finding the lack of synchronisation between chapter titles and their content confusing. But this memoir has much to commend it, painting a picture of a Service much more romantic, more dashing and, let it be said, less self-consciously 'efficient' than it became, perforce, in the days of the Cold War and since. It does not pretend to be a weighty tome and it is all the better for its honesty.

AVM Sandy Hunter

Armageddon: The Battle for Germany 1944-45 by Max Hastings. Pan Macmillan; 2004. £15.00 hardback; £9.99 softback.

The 60th anniversary commemorations marking the end of the Second World War in Europe have been accompanied by much new historical writing, some of it reflecting the fact that while the earlier years of the war have always received ample attention from the historians the closing months have been less than fully described. In particular perhaps the interrelationship and interdependence of the great campaigns have all too rarely been closely analysed. Now at last the imbalance is being redressed, and Max Hastings' *Armageddon,* tackling the Battle for Germany as a whole, makes a memorable contribution.

When, twenty-five years ago, I reviewed one of Hastings' earliest books, *Bomber Command,* I described it as eminently readable, based on considerable research, and conveying remarkably well the courage and dedication of the aircrews who flew over Germany. He had shown what it was really like to be involved in the Bomber Offensive and also illustrated how it felt to be on the receiving end. Now he has brought these particular talents to bear on almost the entire final year of the European war, and much of this book concentrates on describing the conflict in all its aspects from the personal standpoints of many of those involved in the actual fighting and the countless others whose lives were directly affected.

The soldiery include not just men of the Red Army, the United States Army and the British and Commonwealth Forces but those too of other European nations who also fought, and Hastings brings out many features and contrasts in their behaviour. Their standards of

discipline, the way their morale was maintained in the face of differing circumstances, their varying attitudes to casualties and to prisoners of war, the conflicts of loyalties that many of them faced, their differing behaviour towards the civilian populations in territories being occupied and fought through: such issues are vividly described and discussed in relation to the bitter and massive campaigns of 1944-45. Hastings spares his readers nothing in his determination to convey the sheer horror and widespread effects of so much that took place.

In the process he provides the essential framework of events and has no qualms about criticising those who had to make the more important military and political decisions. He brings out too some of the broader issues that confronted the Allied leaders, most notably the relationship between the dictates of fighting the war, the importance of bringing it to an end as soon as possible, and the differing ambitions of the main Allied nations once the war was over. All in all Hastings offers us much food for thought as he looks over a unique year in 20th Century history.

RAF readers, however, may be a shade surprised that the air aspects of the story receive strictly limited coverage. Apart from occasional very brief references elsewhere, only one chapter, about 8% of the book, is devoted to the Anglo-American bomber offensive against Germany which many will think made a major contribution to *Armageddon.* Nevertheless Hastings finds room at the centre of his discussion to maintain his long-held and controversial view that the later stages of Bomber Command's war were misdirected and that Portal should have dismissed Harris at the end of 1944. On the other hand he admits to having modified his earlier opinions on the degree of damage to the German economy caused by bombing in 1942-44 in the light of Richard Overy's more recent analyses. Hastings admires too the balanced approach of the German historian Gotz Bergander to the debates surrounding the destruction of Dresden and the British bombing as a whole. In effect, he echoes Bergander when recognising how much easier it is to pass critical judgements in the relative tranquillity of the 21st Century than it was amid the ghastly circumstances of 1945: 'for all its follies and bloody misjudgements, the strategic air offensive was a military operation designed to hasten the collapse of Germany's ability to make war.'

In sum this 660-page volume is a *tour de force*, the product of

immense research and the weaving together of hundreds of personal recollections of every conceivable kind. It paints a word picture of the fates of a hundred million people involved in the climax of a war whose nature one hopes will never be paralleled. While far distant from a pleasant read it deserves to be read by future as well as by present generations. I personally should have welcomed a bibliography and serially numbered endnotes, and occasionally there are errors; for example the *Tirpitz* was hardly a mere pocket battleship! But these are trivial criticisms. Let Churchill – as so often – have the final word, as Hastings quotes him. At Yalta on 6 February 1945 he said to his daughter: 'I do not suppose that at any moment of history has the agony of the world been so great or widespread. Tonight the sun goes down on more suffering than ever before in the world.'

Air Cdre Henry Probert

2nd Tactical Air Force, Vol 2 – Breakout to Bodenplatte by Christopher Shores and Chris Thomas. Classic Publications; 2005. £29.99.

I reviewed the first volume in this (what will eventually be a) trilogy, in Journal 33 and this second helping maintains the high standards set by the first. Since I waxed lyrical about Vol 1, and the comments I made are equally applicable to Vol 2, I will keep this short. Like its predecessor, Vol 2 is a lavishly illustrated A4 hardback; there are more maps, more excellent profile paintings of individual aeroplanes and many more photographs, most of them fresh and all of them informatively captioned and very well reproduced on coated paper. As before, the main content is provided in diary form, the narrative account of each day's events being amplified by accompanying tables presenting the salient details of claims and losses. At appropriate intervals there are lengthier passages, summarising the progress of the campaign and discussing changes in policy, deployment and tactics, and further inserts focusing on specific incidents and particularly significant operations.

A word of caution – if you pick up one of the publisher's flyers relating to Vol 2, do not be misled by the advertised 384 pages. Vol 2 is actually the same size as Vol 1, which is to say that it has 192 pages but, presumably because Vol 3 is to contain a consolidated index to

the whole work, the pages are being numbered in a coherent series, so Vol 2's run from 193 to 384. The flyer also says that the price is £35, which it isn't; both books are published at £29.99. Not cheap, of course, but one does have to pay for quality and this series has plenty of that. Recommended.

CGJ

With a Smile and a Wave – The Life of Captain Aiden Liddell VC MC by Peter Daybell. Pen & Sword; 2005. £19.99.

Only two pilots are specifically named on the recently unveiled memorial at St Omer to some 4,700 members of the British Air Services who died on active service in France and in Belgium during World War I: Major Mick Mannock and the subject of this biography, Captain Aidan Liddell. Both were awarded the Victoria Cross.

The author, Wg Cdr Peter Daybell – the 1998 winner of the Society's 'Two Air Forces Award', while studying for an MA in War Studies at King's College, London – came across Aidan Liddell's personal papers in the Public Record Office. The idea of a book germinated: he has written a fine biography, full of fascinating detail and well illustrated. It will appeal to readers at several levels: descriptions of pre-Great War Edwardian English 'society', both at public school (Stoneyhurst College) and at Balliol College, Oxford; life in the trenches as a subaltern in the first awful winter; and then, the culmination of the book, having returned to England to train as an RFC pilot, the story of Aidan Liddell's first and last week of operational flying.

Much of the book covers Liddell's period as an Argyll and Sutherland Highlander and the unremitting five months he spent in the trenches near Armentières (including winning the Military Cross). Using Liddell's diaries and letters to and from his parents, the author surrounds close family detail with broader sources. For example, he uses apposite quotes from Cecil Lewis' *Sagittarius Rising* and John Terraine's *General Jack's Diary* to give solidity and atmosphere to the unfolding story. But Liddell's own understated words shine through: after unrelenting rain, mud and cold for several weeks, he gets a short break to a nearby HQ for a shower and a few hours rest. He returns to find that, in his absence, someone has stolen all his kit, his waterproof sheets, haversack, water bottle, cigarettes, everything. The next day, it

pours with rain. Cold, wet, hungry and thoroughly fed up, he writes a disconsolate letter home: 'November 16th, Dear Mother – Still in the trenches…getting rather tired of this underground existence.'

Just after Christmas 1914 (and there is a detailed description of that first Christmas in the trenches and of the 'fraternisation' that occurred) and the New Year, with the rudimentary trenches collapsing from the constant downpours and having been up to his knees in water and mud for several weeks, and after five months without a break, he gets a single week's leave at home. On his return to the front line, he comes down with the 'flu and is invalided back to hospital in England. Not that he realised it at the time, but Captain Aidan Liddell's service with the 93rd Sutherland Highlanders was over.

Having learned to fly at his own initiative before the war, he gets only 2½ months of flying training at Shoreham and at Dover before joining No 7 Sqn at St Omer. After just two days of local flying experience, he and his observer survive their first operational recce sortie. Two days later, he and Roland Peck set off in their RE5 on a four-hour deep recce mission. Attacked by an enemy two-seater, Liddell is grievously wounded. With half his flying controls shot away and weakening from loss of blood from a shattered leg, he somehow regains control and determines to fly back to Allied lines. Aided by his observer, he crash lands on a Belgian airfield thus saving the life of his companion. Surrounded by putative helpers, he has the presence of mind to refuse to be moved until trained medical help arrives, and fixes his own tourniquet. When he is eventually lifted out of the smashed cockpit and placed on a stretcher, a photographer captures his '…smile and a wave' with a picture which soon dominates the British newspapers. After an initial recovery, Liddell's shattered leg has to be amputated, septicaemia sets in, and he dies shortly after hearing the news that he has been awarded the Victoria Cross.

Unusually, Liddell's body is returned to England and he is buried with full panoply and much publicity in Basingstoke cemetery. 'The extraordinary media attention that had marked first his courageous deed and then his Victoria Cross was replayed again with his illness and death, and finally with the funeral.'

The book is a construct that never palls, that moves inexorably to its sad climax, and that keeps the reader's interest throughout. In Peter Daybell's own words, he tells the story of 'a thoughtful, self-effacing,

immensely likeable and modest young man.' And he has done it very well.

AVM Nigel Baldwin

Airfields & Airmen by Mike O'Connor. Pen & Sword (in the *Battleground Europe* series); one volume per year since 2001. £9.95.

Perhaps because of the scale on which it was fought (which meant that practically every family was touched in some way) many of us, four and even five generations after the event, still feel that we have a personal stake in the Great War. Whatever the reason, there can be no denying that there is an insatiable interest in the events of 1914-18 and that the relative accessibility of the battlefields of Flanders and Picardy attracts a constant flow of visitors. There has always been a market for guide books to assist these pilgrims and in recent years Pen & Sword have established a sound reputation within this field with its *Battleground Europe* series of handy paperbacks devoted to major campaigns and many others in the same format dealing with individual engagements within each of these battles. Only recently, however, has there been any attempt to do this for those with a particular interest in the air war. Having given up his day job as a Concorde captain, Mike O'Connor has set about filling this gap and he has done (is doing) it extremely well.

Each book in the series runs to 192 profusely illustrated pages. Although each of the four volumes that have appeared thus far has taken its name from a battle (Ypres, Somme, Cambrai and Arras), they actually deal with activity that took place in that general area over the whole period of the war, rather than focusing on a particular ground action. The content of each book is similar, taking the form of a series of tours, linking war cemeteries and long-disused aerodromes. The cemeteries are the key in that each one provides the basis for one or more essays describing the exploits of some of the airmen (of both sides) who rest there. Some of the names are familiar, many are not; but in every case, the biographical information provided and the details of the actions in which they fought and died, sheds much incidental light on the social structure of the early air services and on the way in which aerial combat was conducted as it underwent its remarkable transformation in both scale and sophistication in the course of a mere four years.

By its nature, the narrative is presented in easily digestible bite-size chunks, rarely more than two or three pages long, amply supported by photographs of places, people and aeroplanes, well over a hundred in each book, and a remarkable collection they make. There are, for instance, sketch maps and/or ninety-year old photographs showing the layouts of specific aerodromes and in many cases these are contrasted with a recent, often air-to-ground, annotated photograph of the same site. The text is supported by an excellent index and the books are a mine of absorbing information, much of it new – to me, at least. Who knew, for instance, that in 1916-17 the Germans ran a fighter pilot school at Famars (near Aulnoy) which operated a flight of captured allied aircraft including a couple of Pups, a brace of SPADS, four Nieuports and an FE8? They did, and there is a picture of them all lined up to prove it. Then again, are you aware of the Indians who flew with the RFC/RAF, like 'Laddie' Roy who became a nine-victory ace flying SE5as with No 40 Sqn before being killed in action, or Lt Shri Krishna Chunda Welnikar who flew Dolphins with No 23 Sqn? Their stories, and those of scores of other individuals, can be found between the covers of these friendly little books.

If you are considering paying your respects at the last resting place of a WW I aviator and wish to extend your visit, you will need one or more of these volumes. Alternatively, if you simply wish to gain an overall impression of the 'texture' of life in the air services of 1914-18 this series is ideal browsing material. O'Connor's writing is authoritative, but very easily assimilated, and his books are full of fascinating vignettes. The next one will have a strong RNAS flavour as it will deal with activity on the Channel coast. I have it on my wants list.

CGJ

Hit and Run - Daring Air Attacks in World War II by Robert Jackson. Pen and Sword; 2005. £19.99.

This book consists of fifteen chapters, each of which deals with an example, or examples, of hair-raising operations carried out by both Allied and German airmen. I will pick out some for discussion here. The focus of the chapter dealing with the battle for France is on the attempts of the AASF to stem the *Luftwaffe*-supported German advance with its ten squadrons of hopelessly inadequate Fairey Battles

and a couple equipped with Blenheims. The loss rate was horrendous and, in spite of the great courage and determination of their crews, their tactical successes were minimal. The chapter makes pretty dismal reading as a result. One key feature of several of the missions described in this book is the low-level daylight operation. For examples, the Blenheim attack on Bremen in July 1941 during which Wg Cdr Hughie Edwards of No 105 Sqn won his VC and the August 1943 raid on the Ploesti oilfields by USAAF B-24s. Both are described in graphic accounts and the latter conjures up the awe-inspiring picture of a huge aircraft like the B-24 hurtling for miles through enemy airspace at altitudes around 200ft! The RAF laid on a daylight low-level attack on the U-boat engine factories at Augsburg in August 1942 which was carried out by Lancasters of Nos 44 and 97 Sqns. The losses were high and the results poor. The RAF did not repeat such an operation again until 1944 when Allied air supremacy had been established over Europe. Before the advent of the P-51B in late 1943 daylight operations at respectable altitudes saw bombers unescorted for long periods of their journeys due to lack of range in the available escort fighters. For example on 17 August 1943 the USAAF attacked Regensburg and Schweinfurt with heavy losses in largely unescorted daylight missions and the enormous battles which resulted are well recorded here, including a lengthy verbatim account from an American observer flying on the Regensburg mission.

Carrier-based operations receive their share of attention, as in the 1942 Doolittle raid on Tokyo by B-25s flown from the USS *Hornet* – another low-level affair which was only made possible by modifications made to the B-25B so as to allow it to take off from the carrier's 500ft flight deck with a 2000 lb bomb load and sufficient fuel to reach China after the attack. The FAA is represented by its Swordfish attack on the Italian fleet at Taranto in November 1940 from the carrier HMS *Illustrious.* Other actions include the elimination of Admiral Yamamoto by USAAF P-38s and the capabilities of the Mosquito are demonstrated by its daylight attacks on the Gestapo HQ in Oslo and Berlin's radio station in 1942 and on Amiens prison in 1944. Of course the Mosquito was well suited to this kind of mission with its high speed and consequent lack of need for fighter cover.

The *Luftwaffe* gets attention in the attacks launched by the Bf 109s and Bf 110s of *Erpr.Gr* 210 (the author has *EGr* 210) against radar stations and Fighter Command airfields during the Battle of Britain and in the fighter-bomber attacks by Bf 109s and later Fw 190s on Britain which followed. In a chapter on intruder operations both British and German examples are given, including night intruder missions by Hurricane II units and later by Mosquitos equipped with AI radar.

Now, how is one to assess a book like this? First by considering the reader for whom it is intended and that is clearly not the serious student of the history of aerial warfare in WWII. Here, he or she will not find the things that are so necessary to the historian's trade, namely the methodical citing of sources and their locations, nor even a bibliography. The general reader, for whom I reckon the book *is* intended, won't be worried about that and will find interesting well-written accounts of the experiences of both Allied and German airmen who undertook extremely hazardous operations and, in some cases, paid a very high price indeed for little effect on the enemy. In catering for such a reader the author has done a sound job here. What about the price? I have a rather parsimonious attitude to book prices and £20 represents a critical point for me. I will pay that, and more, for a book which I would expect to re-read from time to time or to have as a work of reference. If I'd read a review like this one I wouldn't be reaching for my credit card but I would certainly consider putting in a request for the book in question at my local library – on whose shelves *this* book should certainly see some action.

Dr Tony Mansell

The RAF Air Sea Rescue Service 1918-1986 by Jon Sutherland and Diane Canwell. Pen & Sword; 2005. £19.99.

In their introduction to this 244-page hardback, the authors state that it was their intention to record the 'history of the RAF marine craft, their exploits, crews and personalities…' They evidently had a problem maintaining their aim, however, because, in describing wartime rescue activities, they have been increasingly diverted into dealing with the contribution made by aeroplanes and this has considerably softened the focus with respect to marine craft. Furthermore, the account of the post-war era reverts primarily to the

activities of the boats with aeroplanes, and particularly helicopters, being afforded little more than the occasional mention in passing, so there is a problem with consistency and with balance. Having set out to tell the story of the boats and their crews, the end result is a partial history of air-sea rescue.

It would have been helpful if the writers, who were naturally immersed in their subject, could have taken a step back to see it from the perspective of less web-footed readers. While the Marine Craft Section, later the Marine Branch, was undeniably an integral element of the RAF, it was, by its very nature, 'different' and its equipment, roles and operating environment spawned its own set of terms and acronyms. For those unfamiliar with this aspect of RAF activity, and those not otherwise accustomed to messing about in boats, this book needed a glossary to decode and differentiate between HSLs, MCUs, MCTSs, ASRCUs, RSLs, RTTLs and so on, and I never did succeed in finding out the difference between a launch, a tender and a pinnace. 'Google' offers numerous definitions, but they all more or less boil down to 'small boats that are used to ferry people and things between the shore and larger boats.' What, specifically, did these terms mean within the RAF – and why does pinnace sometimes have a capital letter and sometimes not?

I did not find the narrative particularly easy to read; there is a tendency to jump about in time and place, and the content is somewhat uneven. For instance, a chapter (more of an annex really) entitled 'Bases and Operations 1918-86' lists 110 numbered wartime marine craft units; a few of these are afforded a very brief 'history' but most have to make do with a solitary location and no dates at all. Another chapter provides details of 'ASR Aircraft 1918-86' and the inclusion of types like the Southampton and Cloud suggests that the authors have assumed that anything that floated was automatically assigned to rescue duties, but if one includes the Stranraer on this basis, why not the Scapa? Then again, why include the Martin Mariner, which never became operational with the RAF, but gets more space than the Warwick, while omitting the Hudson, Lancaster, Shackleton and any mention of helicopters?

For the wartime element of the book, one suspects that the writers have drawn heavily on the Air Historical Branch Narrative of the 1950s for much of their basic information. One cannot be certain,

however, as there is no formal attribution, indeed there is no bibliography at all. Whatever sources were used, however, it is clear that the writers do not have a firm grasp on general RAF history, or even on that of WW II. For instance: Trenchard went to France in November 1914 (not August 1915) and he became CAS in March (not January) 1919; the wartime USAAF is referred to as the USAF throughout; Operation TORCH was mounted in 1942 (not 1943); Operation HUSKY was the invasion of Sicily (not Italy); the He 111 was not a seaplane; the first RAF helicopter rescue was in 1953 (not 1960) and the statement that 'No 269 (Metropolitan) Squadron, which was based in the Azores, was reformed in January 1944 and covered rescue operations in the Bay of Biscay' is difficult to reconcile with the facts. There are, in addition, numerous misspellings of the names of people and places, eg Standford (for Stanford) Tuck, Port Suiz (for Suez), Helensborough (for Helensburgh), Flt Lt Kinkhead (for Kinkead); Mesirah (for Masirah) and Fenara (for Fanara). There are many more and they may well be typos, rather than errors, because the last two are certainly spelled correctly on occasion, but either way, there is far too much of this sort of thing to inspire much confidence.

One's confidence is also undermined by the scrambling of previously well-documented accounts of some of the incidents that are described. For example, Lt Ray Veitch was flying a Mustang (not a Thunderbolt) of No 260 Sqn RAF (not SAAF) prior to the first of his three dunkings in the Adriatic in April 1945 (not 1944). Similarly, a first-hand account of a ditching, reported to have occurred in 1957, is described as 'a Black Hunter III squadron had lost its 'tail end Charlie'' (*sic*). I would guess that this probably refers to a Hunter (XF448) of No 74 Sqn, Number Three in a tail chase, which dived into the sea (hardly a 'ditching') in August 1958 and inclusion of this story points up the risks involved in failing to verify the facts of half-century-old 'war stories'.

This book is not all bad as it does provide some insight into the way in which the RAF's marine craft element evolved and offers some first hand impressions of life aboard and it may well be enjoyed by ex-motor boat crewmen, but it contains far too many flaws to represent a comprehensive history of either the Marine Branch or of air-sea rescue.

CGJ

ROYAL AIR FORCE HISTORICAL SOCIETY

The Royal Air Force has been in existence for over 80 years; the study of its history is deepening, and continues to be the subject of published works of consequence. Fresh attention is being given to the strategic assumptions under which military air power was first created and which largely determined policy and operations in both World Wars, the inter-war period, and in the era of Cold War tension. Material dealing with post-war history is now becoming available under the 30-year rule. These studies are important to academic historians and to the present and future members of the RAF.

The RAF Historical Society was formed in 1986 to provide a focus for interest in the history of the RAF. It does so by providing a setting for lectures and seminars in which those interested in the history of the Service have the opportunity to meet those who participated in the evolution and implementation of policy. The Society believes that these events make an important contribution to the permanent record.

The Society normally holds three lectures or seminars a year in London, with occasional events in other parts of the country. Transcripts of lectures and seminars are published in the Journal of the RAF Historical Society, which is distributed free of charge to members. Individual membership is open to all with an interest in RAF history, whether or not they were in the Service. Although the Society has the approval of the Air Force Board, it is entirely self-financing.

Membership of the Society costs £18 per annum and further details may be obtained from the Membership Secretary, Dr Jack Dunham, Silverhill House, Coombe, Wotton-under-Edge, Gloucestershire. GLI2 7ND. (Tel 01453 843362)

THE TWO AIR FORCES AWARD

In 1996 the Royal Air Force Historical Society established, in collaboration with its American sister organisation, the Air Force Historical Foundation, the *Two Air Forces Award*, which was to be presented annually on each side of the Atlantic in recognition of outstanding academic work by a serving officer or airman. The RAF winners have been:

1996 Sqn Ldr P C Emmett PhD MSc BSc CEng MIEE
1997 Wg Cdr M P Brzezicki MPhil MIL
1998 Wg Cdr P J Daybell MBE MA BA
1999 Sqn Ldr S P Harpum MSc BSc MILT
2000 Sqn Ldr A W Riches MA
2001 Sqn Ldr C H Goss MA
2002 Sqn Ldr S I Richards BSc
2003 Wg Cdr T M Webster MB BS MRCGP MRAeS
2004 Sqn Ldr S Gardner MA MPhil

THE AIR LEAGUE GOLD MEDAL

On 11 February 1998 the Air League presented the Royal Air Force Historical Society with a Gold Medal in recognition of the Society's achievements in recording aspects of the evolution of British air power and thus realising one of the aims of the League. The Executive Committee decided that the medal should be awarded periodically to a nominal holder (it actually resides at the Royal Air Force Club, where it is on display) who was to be an individual who had made a particularly significant contribution to the conduct of the Society's affairs. Holders to date have been:

Air Marshal Sir Frederick Sowrey KCB CBE AFC
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