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Eighth Air Force Depot Maintenance & Logistics Leadership in World War II



Base Repair Depot BAD 1 Site Sign, Source: Aldon Ferguson

David A. Loska

Contemporary histories of the Army Air Forces (AAF) in World War II acknowledge that the deployment of depot maintenance and logistics operations enabled the rapid assembly, development, and reconstitution of bomber and fighter aircraft in the ETO. The resultant tactical agility proved vital to achieving air dominance over the Luftwaffe and defeating the Third Reich. Seldom do these histories capture how the AAF accomplished this feat, however. Rarer still are examinations of the individual contributors to this success. The stories of these maintenance and logistics forerunners beckon resurrection amidst the high-octane output of a hundred thousand cranking engines infused in the icy fog of obscurity.

Origins

In September 1941, following the combined Anglo-American strategy of the Argentia conference, General Henry H. Arnold directed Maj General George H. Brett, a seasoned materiel officer and commander of the Air Corps, to conduct a study of the maintenance of American planes, supply lines, equipment and training supporting Lend-Lease requirements in England and Northern Ireland. This was to be followed by a survey of logistical efforts in Northern Africa. Brett bid farewell to his wife and young son “Rock,” who would many years later grow to become Commander of Allied Air Forces Southern Europe. As Brett boarded his LB-30 Liberator aircraft, he told his son “I want to introduce you to a very special individual.... Captain LeMay. He will lead our formation through uncharted territory to resupply the Middle East.”¹ Curtis LeMay’s mission, though concurrent to Brett’s, was singularly significant to theatre logistics as it would establish the ferrying and supply route into North Africa. He would fly a southerly route, first to Brazil and then across the Atlantic and through western Africa to Cairo and return. Brett traveled onward from Cairo to England but would eventually return to Northern Africa for further surveying; leading to the establishment of a depot at Gura in Eritrea.² Brett’s mission was critical; survey and report a detailed account of theatre maintenance and logistics. Time was unimaginably of the essence.

The U.S.’s early investigatory mission in the U.K., the Special Observers Group, known simply as “SPOBS” led by General James Chaney, were directed to test and observe American equipment in the campaign, study British operational methods and manage the exchange of personnel and the standard and experimental equipment between the British and U.S. militaries. Chaney, who was present during the Battle of Britain a year prior, knew the logistical limitations of Rainbow 5 and the earliest war plans. These plans were built in an environment handicapped by Lend-Lease neutrality, devising an end strength that was roughly only one-fifth of what would be required during the inter-theatre operational



Facility Construction Langford Lodge, Lockheed Overseas Corporation Annual Report 1942-1943. 1943, National Archives

peak. Chaney had for some time considered the establishment of a depot facility for repair of American aircraft at Langford Lodge, an airfield located twenty miles west of Belfast in Northern Ireland.³ SPOBS furnished this opinion to Brett, and after his survey, Brett reported to Arnold and the War Department proposing:

“...The AAF set up mobile repair depots manned by civilians to service American aircraft operated by the RAF in the United Kingdom; the AAF ultimately take over the management of existing British facilities for repair of American built equipment and provide for their expansion as required, using initially civilian personnel; specifically, and as quickly as possible, Langford Lodge be established as a depot for third echelon maintenance; and if American air units should operate from bases in the United Kingdom, the United States assume responsibility for third echelon repair facilities for all U.S.-built planes operated by the RAF and AAF, and for the supply of spare parts.”⁴

Brett’s forethought recommendation for the overall transfer of maintenance responsibilities from the RAF would cause some consternation in the War Department and was summarily rejected by Arnold due to the manpower constraint on the embryonic AAF. Arnold would, however, agree that the Langford Lodge depot be established as quickly as possible for third and what would ultimately become fourth echelon, major overhaul maintenance. During Brett’s survey, he inspected other

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sites for probable depot operations, selecting a site called Warton that had once been rejected for aerodrome construction by the British as an unsuitable marsh, then later earmarked as a site for an RAF satellite base at the outbreak of the war.⁵ Warton, near the sleepy agrarian seaside village of Freckleton, was twenty-five miles north of Liverpool and its location advantageously provided access to shipping docks and England’s Lancastrian industrial base.

The Japanese attack on Pearl Harbor and Adolf Hitler’s subsequent declaration of war against the United States less than a week after Brett’s report was submitted, alloyed the malleable logistics planning efforts of the War Department. Though the absence of logistics preparations for “services” during the early stages of the planning effort would become evident in the coming months of execution, America was no longer in doubt over its mission. On January 26, Arnold notified General Chaney of the plan to base in the UK:

“20 Groups of B-17’s or B-24’s, 12 Groups of B-29’s, 22 Groups of B-29’s or other heavy bombardment planes, 10 Groups of pursuit planes, 10 night fighter squadrons, 10 photo recon squadrons”⁶

The planned number of bomber groups would fluctuate varying through the early months of the war before being stabilized by the Joint Chiefs of Staff in October 1943, reaching their maximum strength in the summer of 1944 at forty-one heavy bomber, eight medium bomber, three light bomber, thirty-three fighter and fourteen troop carrier groups.⁷

Deployment

On January 19, 1942, the War Department activated the 8th Air Force at Savannah Georgia. Also activated was the VIII Air Force Service Command (redesignated from 8th AF Base Command), the logistics arm of the 8th. General Ira C. Eaker arrived in England the following month. After reporting to the U.S. Air Forces in the British Isles (previously SPOBS), Eaker was directed to:

“Make a thorough study of bombing operations being conducted by the RAF Bomber Command and submit to this headquarters recommendations covering the training, equipment, tactical doctrines and methods of employment of units required to conduct an effective air offensive... and... a plan covering the reception and assignment to stations of bombardment and auxiliary service units and the administration and supply of such units”⁸

The lack of preparedness and planning for critical logistical factors was immediately apparent to Eaker. In his view, this complex problem had two options with only one objectionable choice. He could fully construct facilities and develop an independent logistics organization before initiating combat operations, or he could have his forces rely on the British to undertake bombing missions soonest. Ideally, Eaker would have built the required depots, and equip



Eighth Air Force Base Air Depot Locations: Burtonwood, Warton and Langford Lodge, adapted from, Eighth Air Force Installations August 1942, Taken from Craven & Cate, 1948

them for the overhaul of engines, aircraft, instruments, and ordnance. He could complete and prepare them entirely. Optimistically, he could have this done before the year was out. Eaker and his staff estimated that the Warton site, not far from Blackpool, could be developed within nine months. Realistically, construction and preparations for any depot facilities had not even begun. Nor had any effort been made to prepare any basing for the reception of troops. Eaker would “compromise” his ideal vision and have the 8th borrow from their hosts. This was difficult to stomach for a man who’d entered military service at the twilight of World War I and witnessed the air arm going hat-in-hand to the French. However, closing on the enemy earlier would add nourishment to the cheapened sustenance of a hand-to-mouth existence. The immature supply lines would have to be accepted; waiting was just too dangerous. The AAF would develop the operational bases that had been made available to them by the British government. Though the stations would still require a lot of work, they could be available almost immediately and, by Eaker’s estimate, could have three bomber groups begin familiarization training for missions by the early summer.

For this to work, the 8th would also need to share and borrow depot facilities to overhaul aircraft until their own could be constructed. Eaker initiated a search for existing facilities that could be put to immediate use. That April, Eaker and Colonel A.J. Lyon, who had been immersed in

logistics planning with SPOBS, inspected and selected the Burtonwood Repair Depot. Eaker forwarded his decision with Chaney’s strong endorsement, and upon receipt, Arnold immediately put into motion the necessary measures for securing the site for American use.⁹ This act cast the mold that would ultimately forge the trident of 8th Air Force depot logistics lethality; Burtonwood, Warton and Langford Lodge subsequently designated Base Air Depots or “BADs” 1, 2 and 3 respectively.

The first forward echelon of the 8th Air Force departed from Boston on the H.M.T. Andes leaving a trail of depth charges behind. The ship cut through dense fog on the River Mersey before disembarking in Liverpool on the 12th of May.¹⁰ On the 3rd of June, the main body of the 8th departed New York on the Queen Elizabeth. Because of the speed of the vessel, there was no need for the standard trail of depth charges. It would arrive before the second advance echelon that set sail three days prior aboard the USS Munargo. On the 9th of June, the main body of Service Command troops arrived. One of the first Americans to arrive, Glen Lundquist, describes his experience:

“I had been working as an aircraft mechanic in sub-depots in the states. Seven of us volunteered from Chanute Field, Illinois. We trained at Kelly Field Texas. We shipped out in the Queen Elizabeth, landing in Scotland near Glasgow, taken by train to Burtonwood. I was first at Site 4 then to



Queen Elizabeth passes the Statue of Liberty at New York, National Archives



P-38 Lightning Maintenance, Burtonwood Source: Aldon Ferguson



US and British personnel check the instruments on a P-51 Mustang at Burtonwood, 1942, © IWM (FRE 14819)

*Site 1, I was assigned to armament inspection on A Site. I was now doing a job after about three months in the Air Force.*¹¹

The expeditious training of technicians was the norm for the Airmen that would come to make up the depot personnel. Maj. Gen. Hugh J. Knerr, who would come to exercise theatre-wide authority of AAF ETO logistics by assuming the “dual-hatted” position of both deputy commanding general for administration as well as commander of the VIII AFSC under General Carl Spaatz, would later say that it was providing and sustaining trained mechanics that was the most considerable logistics challenge of the war. Knerr would recall, “Early in 1943 there were not enough crews trained or untrained, and those sent over after having been trained in this country fell down.”¹² Knerr would later recall that it was during a flight with General Arnold to Prestwick, that Arnold decided to address the need for trained mechanics by furnishing more personnel to be trained on the in-theatre production lines under control of an experienced technician rather than by increasing the quality of training before deployment. “That process trained men in small jobs, larger and larger so that eventually we had all the trained men we needed.”¹³ Although August 17, 1942 saw the 8th fly their first mission, in the early parts of 1943, it would be made manifest that the combat units had outpaced their logistical tail.

Relationships and Leadership

The composition of personnel at each depot was a criss-crossed patchwork of British and American civilians and military. Nowhere was this more uniquely pronounced than at Langford Lodge. Initially conceived as a depot repair facility, Langford Lodge Air Depot quickly grew into the most extensive design, assembly, test and engineering mission in the theatre. Intending for the depot’s eventual management under the military, the War Department contracted the Lockheed Corporation to run the site initially.



The World Flight crews at Sand Point, Washington, before the start of their round-the-world journey. Staff Sgt. Henry Ogden (Second from left) Source: National Air and Space Museum, Smithsonian Institution (SI 81-8960).

This leveraged the relationships that Lockheed had built during its tenure operating an assembly plant for the British near Liverpool. Civilian and military men and women from Great Britain, Ireland, America, and a small group of workers from Poland, were employed on the two-runway air base off the east shore of Loch Neagh. The local men and women arrived to work via train disembarking at Gortnagallon marshaling yard, while the American civilian and military personnel lived and worked on-station out of “Butler Shed” hangers, pole-barn style rectangular buildings roofed and sided in corrugated metal. Base Manager Henry H. Ogden, who was uniquely qualified to manage complex international aviation materiel and logistics operations, having inaugurated the field himself primarily, led the operation.

In 1924, at age twenty-three, Staff Sergeant Ogden served as assistant supply officer and co-pilot as one of two non-commissioned officers on the eight-man team of U.S. Army Air Service pilots; the first ever to circumnavigate the globe in an aircraft. The group departed Seattle in four Douglas World Cruiser aircraft to open air routes for the Army. The feat required the prepositioning of fuel, replacement engines, and spare parts around the world. The planes could only carry 300 pounds of supplies each so Ogden, responsible for the materiel management of the team, made tough decisions about what to bring along, excluding even precious parachutes and life-preservers.¹⁴

After 175 days, seventy-four stops, one crash and the forced landing of Ogden’s initial aircraft in the Atlantic, flying a total of 27,550 miles of serpentine routes through Indochinese jungle, the deserts of Iraq and Jordan, and dodging icebergs as low visibility drove their cruising altitude terrifyingly close to Atlantic wavetops, the team arrived back in Seattle. Ogden, for his resourcefulness, was awarded the Distinguished Service Medal and later Staff Sergeants Ogden and Alva Harvey were commissioned as Second Lieutenants. Shortly after, Ogden left the service and ventured into entrepreneurial roles in aviation, leading to his employment with Lockheed. Nearly twenty years after his round-the-world expedition, Ogden led the BAD3 team that would rapidly grow to 1,200 diversely qualified



Henry H. Ogden, Base Manager, Base Air Depot 3, Lockheed Overseas Corporation Annual Report 1942-1943. 1943, National Archives

support professionals before the end of his first year, and 7,600 at the war's peak.¹⁵ Again performing the role of pathfinder, this time on an industrial scale.

Sharing a similar culture, and both a common enemy and language, relationships between Americans and British at the depots were overall friendly and cooperative. Nevertheless, there were occasional frictions. During the early period that Burtonwood was still under the control of the British, and was carrying the majority of the workload while the other depots came on line, the hastening expansion of American capabilities stirred conflict with the British shop technicians. Upon his arrival in August of 1943, USAAF Captain K. McGee had trouble making heads-or-tails of the production difficulties in his Metal Manufacturing Department. A surprising 50% of all his parts were discarded after failing inspection. The equipment in his shop was the most apparent problem; sixty of the seventy-five machining tools being used were clearly obsolete. McGee quickly put in requisitions for new machine tools, lathes, milling machines, and grinders. Here too he ran into trouble, a tangle of bureaucratic red-tape, as his orders were rejected from the U.S. citing that the machines were "too heavy" and therefore ill-equipped for work in the ETO. Now, insistent upon remedying the root cause of the failure of his production line, McGee found in one of the corners of his shops three brand new screw machines covered in dust. He learned that they were delivered earlier that Spring, but had not been used or even wired for service because the British Labour unions had complained that the machines were too fast and would put men out of a job. McGee could not understand this objection and, despite the controversy, he ordered them put to use. By the end of Sep-



Mary Ann Site, Burtonwood, Photo: Lawrence Sutton, Source: Aldon Ferguson

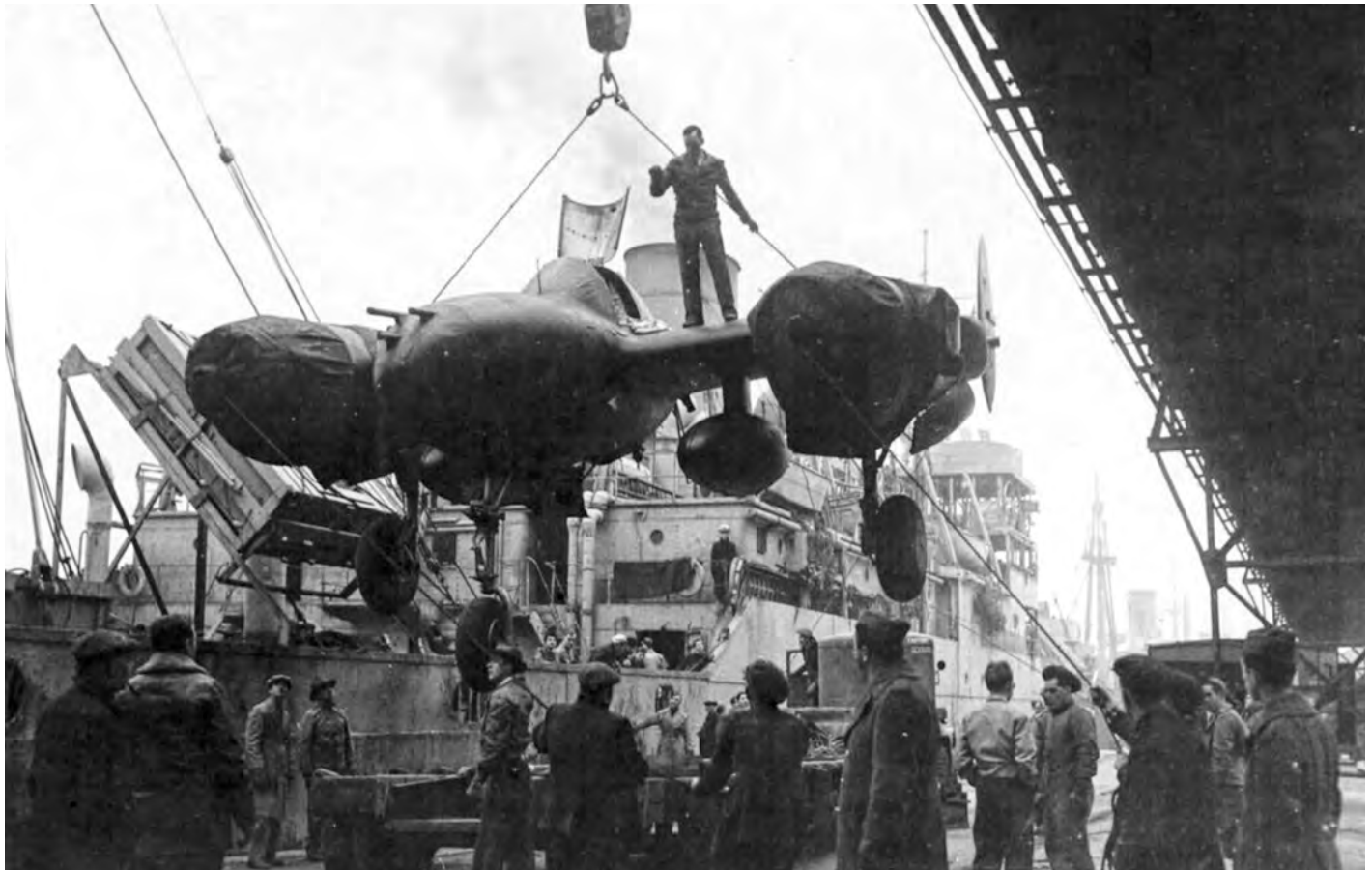
tember, the three screw machines were operational and before the years end 200 total production machines were up and running. With that, the shop that was initially envisioned to address minor battle damage repair was now mass-producing orders of parts over 1,000 items.

Maintenance

The average bomber spent 204 days in the ETO: 19 days engaged in operational missions, 96 days on operational status but not engaged in operations, 21 days in non-operational training, and of those 204 days in the ETO, 68 were committed to repair maintenance and modification.¹⁶



B-17G Undergoing Maintenance, Source: Aldon Ferguson



A Lockheed P-38 is lowered from the USS Delmorte on to a waiting trailer by U.S. Army soldiers and Lockheed Aircraft Corporation workers at Dufferin Docks in Belfast Port. Northern Ireland. Nov. 25 1942. National Archives.

The depots were assigned the modification, battle damage repair, supply, reception, and dispatch of all aircraft. The specialization of each location was both deliberately planned or developed out of necessity. Bomber aircraft, for instance, were flown directly to their combat units after being flown to the depots from the states for modification. Fighter aircraft, however, required shipment. These aircraft were shipped to ports in Liverpool or Glasgow and were transported and assembled at Speke and Renfrew aerodromes, then transported to the depots for modifications before being dispatched to their operational squadrons.¹⁷The processing of radial engines was primarily performed at Burtonwood, while the processing of in-line engines was performed at Warton. Battle damage repair and heavy maintenance were for the most part conducted at Warton and Burtonwood. Langford Lodge was inaccessible to most units, and so only flyable aircraft could be taken there for repair. Langford Lodge, therefore, became specialized in engineering and test and took on a large share of the modification and design program early on in the war.

Knerr in a memo to the War Dept. describes operations as follows.

“...Langford Lodge is essentially a civilian operated aircraft factory functioning under military management, Warton is an engine overhaul and airframe repair activity, and Burtonwood is essentially a supply depot and engine repair

shop. In addition, each is capable of doing some of the work of the others”¹⁸

Moreover, the depots specialized in maintenance by subsystem. Langford Lodge was responsible for the fabrication of modification kits and certain modifications as well as the overhaul of some propulsion components. Warton was responsible for v-type in-line engines and aircraft, instruments, hydraulic and electrical accessories, and armament equipment such as gun turrets and computing gun sights. Burtonwood was responsible for radial type engines and aircraft, propulsion systems and components, radios, and rubber components such as fuel cells, deicer boots, and self-sealing oil tanks.¹⁹

The Base Air Depot Area (BADA) was instated near Burtonwood to establish oversight of the depots. BADA acted as a small headquarters that was sometimes called upon to shift backlogs of workload between the three depot locations. The Bradley-Knerr Commission recommended the establishment of BADA for “centralized control and decentralized operation” of the independent operations of the three depots. This was to ensure that the “...independent operations should be tied together by one management, which by continuous contact with daily problems involved could take immediate action therein without time consuming reference to a headquarters several hundred miles away, and, in the case of Langford Lodge, across the Irish Sea.”²⁰ BADA and its repair and supply network would



50-Calibre Section, Base Air Depot 1, Source: Aldon Ferguson

grow to an end strength of nearly fifty-thousand personnel as set forth by the Bradley-Knerr commission. At the depots, this included roughly fifteen-thousand at Burtonwood, ten-thousand at Warton and over six-thousand civilians with more than a thousand military personnel at Langford Lodge.²¹ Command of BADA was entrusted to Brigadier General Isaac "Ike" Ott, who had previously commanded BAD1.

Ott's tough-as-nails leadership is the stuff of legend. Ott was so demanding that he was outright hated by many depot personnel, especially at Warton where he was particularly overbearing toward the BAD2 base commander.²² During his first visit to Warton since the beginning of his



Personnel of the 322nd Bomb Group inspect a battle-damaged B-26 Marauder, © IWM (FRE 4527)



Burtonwood ramp 1944-1945 Source: Clifford Creaney /Aldon Ferguson

generalship, Ott demanded the expedited relocation of the Internal Supply Section to the partially constructed facilities intended for the unit's future use. Section personnel immediately set to work and over the next twelve hours relocated all of the stock bins, parts, and equipment to the incomplete building during a week of weather that produced gale force winds over 75 mph.²³ This surprising order must have come with some frustration to section personnel. However, depot maintenance production efficiency increased as quickly as the next morning as the hangar space that was previously occupied by parts bins, was now utilized to modify aircraft.²⁴ Two months later, in May 1944 with a "backlog" of B-24s increasing to 166, and with 75 aircraft arriving daily, 55 of which were more B-24s, Ott established a 7-day workweek at BAD1. Perhaps foreseeing the necessity of the decision to prepare for the Allied invasion that was to occur in less than one month.²⁵

Contrasted in their approach to the demands of leadership was Ike to his trusted cousin Lt Col Walter "Dewey" Ott. Assigned to BAD1 as Chief of Flight Test, "Dewey" Ott was responsible for the test of newly assembled and overhauled aircraft before their delivery to operational bases. Dewey Ott was protective over the pilots in his care. He would often fly the most doubtful of the unproven aircraft himself, earning him the dedication of his crew.²⁶ Dewey's warm and outgoing nature also made him a favorite amongst celebrities traveling into theatre, and he was chosen to shuttle VIPs such as Cagney, Crosby, Rooney, and Hope. Dewey Ott became Bob Hope's preferred pilot during his many visits to the ETO, and the two struck a friendship that endured after the war.²⁷

Nearly as early as its first missions, the problem of battle damage challenged and perplexed maintenance operations within the 8th. However, by the summer of 1943, it had reached a crisis. This prompted General Fredrick Anderson, Commander of VIII Bomber Command, to remark that he was "disturbed over the possibility of the number of crews available exceeding aircraft available in the near future."²⁸ The real danger in materiel support falling be-



Burtonwood Aug 1945 A-20 bone yard between hangars on E Site. Photo: Ray Zimmerman, Source: Aldon Ferguson

hind operational need was heightened as 25%-50% of aircraft coming back from missions into Nazi-held Germany were returning with battle damage. General Eaker complained, "This places a burden on repair establishments which had certainly not been recognized in peacetime planning and for which there was no adequate organization."²⁹ The cannibalization of parts from non-operational "hangar-queen" aircraft became invaluable to the reconstitution of mission-ready aircraft. However, due to the inadequate provisioning of spares at the onset of war, the practice began to get out of hand. New assemblies such as landing gear, turrets and starters, arriving from the U.S. were stripped of their sub-components and their carcasses sent to the depots with a repairable tag. This led General Miller, Commanding General VIII AFSC to intervene into the cannibalization problem borne out of necessity, "...the practice violates existing regulations and must be curbed." To address the battle damage problem, the spring of '43 Bradley-Knerr commission recommended the establishment of a network of sub-depots to extend repair capabilities and supply closer to the operational bases. These sub-depots were activated and would later become further decentralized into advanced depots.³⁰ As some bomber formations were singled out during missions, the need for battle damage repair fluctuated greatly between the bases and depots. The network of sub-depots and advanced depots absorbed the 3rd and 4th echelon overhaul repair through roving work parties between stations.

The weaving repair network and its evolving terminology of *air depot*, *sub-depot*, *advanced depot*, *mobile depot* and *service centre* developed to such a complex state that by July of 1942 General Spaatz wrote in a letter to Arnold "This constant changing of terms leads to too much confusion."³¹

One innovation that by the end of 1943 General Eaker would recall as "One of the principal technical achievements of the Eighth Air Force during the year..."³² was the development of the Mobile Repair Unit. In autumn of 1942, weighing the need for mission-ready aircraft and the man-



Mobile Repair Units, Source: Lockheed Overseas Corporation Annual Report 1942-1943. 1943 National Archives

hours required to produce them, coupled with the sheer difficulty in disassembling large aircraft for transport to repair bases, the 8th decided to devise a means to deliver repair capabilities to the aircraft. This would restore the aircraft to a safe-for-flight condition for travel to a depot for further reconstitution. The Lockheed Overseas Corporation designed and fabricated the first of the units, and with a successful design, was awarded a contract for the construction of 50 units in February of 1943. The units consisted of two semi-trailers outfitted with tooling and repair facilities and one or two trucks or jeeps to ferry personnel and supplies. Initially, one of the trailers was designed to house its 16-19 specialist personnel, but it became clear that the personnel would be better off finding lodging in local amenities and the trailer was adapted to hold more repair equipment and parts.

In another clever attempt to overcome the challenge of access to repair capabilities, engineers and mechanics at Langford Lodge experimented with the conversion of a WACO Glider into a mobile aircraft repair shop, known as the "Mechanikite."

The BADs serviced the myriad network of fighting and support bases in the U.K. through the dedication of Truck Transport Battalions and Companies comprised of segregated Black American troops. Later organized under the 8th Air Force's Combat Support Wing, these transport units navigated England's harrowing carriageways packed with bombs, ammunition, and supplies. Ashamedly failed by the myopic policies of leaders who were dealt complex problems resulting from old prejudices, the AAF as an occupying force instituted segregation in a land where beforehand it could not be found. This led to infamous firestorms of conflict such as that at Bamber Bridge near Warton. It also led to a formalized lack of human decency. After round the clock, arduous distribution missions between bases, often through rain and fog, many of the truck transport servicemen were not afforded a bed or a warm meal at the stations they serviced; instead, they found rest only on the cold bench seat of their utility truck.³³ In the



"Mechanikite," Source: The Papers of Maj Gen Hugh J. Knerr, Clark Special Collections Branch, McDermott Library, USAFA

same selfless and proud legacy of the segregated military units serving the U.S. during WWII, the truck transport units of the 8th Air Force's Combat Support Wing diluted the logistical veins of the 8th as the lifeblood of ETO lethality.

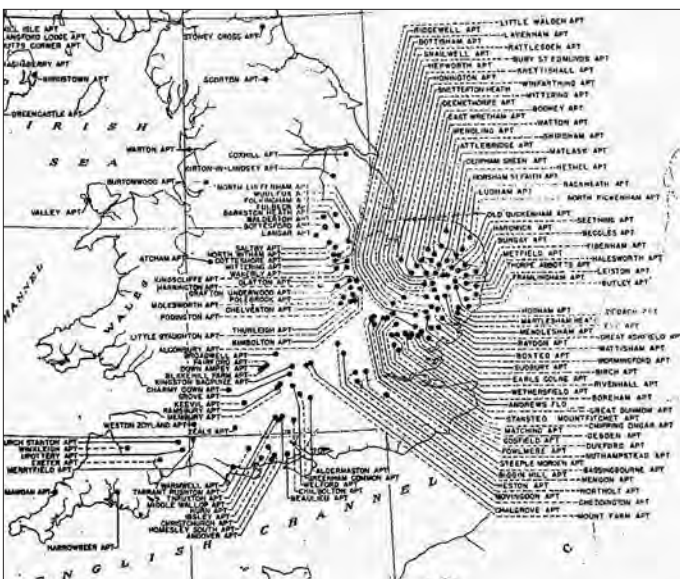
One of the most unique stories to actualize from the battle damage crisis was that of 1st Lieutenant Edward Hall. As an engineer and Officer in Charge over the repair of battle-damaged aircraft at BAD2, Hall invented a method and the special tooling required for substituting press-fitted hollow steel tubes in place of drive bolts, enabling faster repair of aircraft and requiring less personnel. The timeliness and magnitude of this development, earned Hall the Legion of Merit. This was one of only a few such medals base historical records document were pinned, one other presented to General Ike Ott in early 1944, near the close of the war.³⁴ Hall's depot successes, background in mechanical and chemical engineering, and a knack for the



Truck Transport units of the 8th Air Force's Combat Support Wing, Source: The Papers of Maj Gen Hugh J. Knerr, Clark Special Collections Branch, McDermott Library, USAFA.

technical, led to his introduction into missile technology near the end of the war. Hall was assigned to acquire intelligence on the propulsion work of the Nazi's through the V-2 rocket parts that had either exploded or were retrieved through networks of spies.³⁵ At the war's end, he also led efforts to research underground Nazi missile production facilities for the Air Force. It was during this time that Hall developed a fascination for rocket and missile technology that defined the rest of his military career. In 1957, Colonel Hall, recognizing the limitations of liquid fuel missile propulsion, developed and promoted a solid-fuel rocket technology that led to the development of the intercontinental ballistic missile (ICBM) under Chief of Staff Gen Curtis LeMay. In 1960, for his work on solid-fuel, Colonel Hall was awarded his second Legion of Merit and would subsequently become known as the Father of the Minuteman ICBM program.³⁶

Leadership and coordination of the daily operations and production planning within the functional departments of the depots were primarily conducted by the Maintenance Division, under the direction of the Maintenance Division Chief. To coordinate depot operations, Production Control sections within each maintenance department collected and reported production data to the centralized Statistical Control office, who further collected status and production data to generate reports.³⁷ These offices were located in rooms surrounded by blackboards covered in statistical data. At Warton for example, 2 officers and 16 enlisted men staffed Statistical Control. Data compiling aircraft arrivals, backlogs, man-hours both available and used, modification programs, parts manufacturing, and assembly and overhaul statistics was organized and reported. This data culminated in the depot's report to HQ BADA of their statistics covering final delivery and output. Lt Col Billy Arnold, Chief of the Maintenance Division, was uniquely experienced at leading both of the mainland depot operations having transferred from Warton to Burtonwood February 15, 1944.³⁸ Arnold's Maintenance Divi-



Army Air Forces Stations During World War II, adapted from: United Kingdom and Iceland Bases, Taken From: Anderson, 1985



Colonel I W Ott (Centre) Lt Col Billy Arnold (Far Left). Source: Aldon Ferguson

sion Weekly Activity Reports to HQ BADA never missed an opportunity to highlight record-breaking production metrics and output. Arnold's unique origin and technical background made him unusually adept to the rigors and undaunting pace of depot operations. Before joining the Army a week after the attacks at Pearl Harbor, Arnold was employed by the Chrysler Corporation.³⁹ Years earlier, Arnold studied for a baccalaureate in mechanical engineering at the University of Illinois before taking up car racing. Between the years 1930 and 1932, Arnold led almost every lap he raced at the Indianapolis 500. In 1930 at age 24, Arnold became the first to win the Indy 500 in under 5 hours and the first to finish at a greater than 100 mph average speed without relief help. He also led all but the first two laps of the race, 198 out of 200 or 99% of the total laps, a record and metric that has yet to be surpassed even to the day of this writing.⁴⁰

Modification

The U.S. learned the importance of keeping an agile modification program in order to seize and retain the air offensive early in the war, even prior to the Battle of Britain. In a SPOBS report dated 13 June 1941, Lyon wrote:

"The lessons of the past year have demonstrated that aircraft must be constantly modified and changed during its life to meet the requirements of modified tactics and specialized operations. The RAF has recognized the necessity of modifications and changes in their planning and maintenance organizations. It is recommended that plans for Base Repair Units and Maintenance include provision for a technical staff and manufacturing facilities adequate to undertake modification of aircraft and its components op-

*erated by American Forces in the United Kingdom"*⁴¹

During the Battle of Britain, modifications were the mechanized lethality of the RAF combat squadron. RAF mechanic B. Edwards of St Albans, having arrived at Burtonwood the previous spring, would later recall, "Most of the work I was employed on at this time was in fact embodiment of various mods."⁴² During the fall of 1940, the highest priority modification was to equip the Merlin engines of the Spitfire with Constant Speed Units and Propellers. The parts were manufactured by Rotol (a joint venture of Rolls-Royce and Bristol), 125 miles to the south in Gloucester. This system increased the Spitfire's maneuverability at all altitudes, maintaining the advantage over Luftwaffe bombers. Modifications during the early days of the war included installing armor plating and nose and fuselage guns on Hampden, Buffalo and Oxford aircraft. Though the distance of Burtonwood from England's south coast or the RAF's East Anglian operational bases was far enough to limit air attacks, it did not eliminate them entirely. On September 6, 1940, during the early period that Burtonwood was still managed by the RAF, two JU88's flew far enough inland to perform a low-level incendiary bombing mission over the airfield. However, after dropping several bombs, no damage to aircraft or airfield resulted. The newly invented Identification Friend or Foe (IFF) system was installed on nearly all model aircraft during this time, and was fixed with an explosive device in the rear fuselage in case the aircraft was to come down in enemy territory. "The aircraft went out to squadrons practically as quickly as the mods were embodied," Edwards remembered.

Of the 68 days in maintenance the average bomber aircraft spent in the ETO, an average 12 days were consumed by modification.⁴³ Early AAF policy categorized modifica-



Billy Arnold, Source: Indianapolis Motor Speedway Museum

tions between those that were necessitated by military or combat requirements, those needed to correct original design errors, and those required to divert aircraft to tactical use other than initially intended.⁴⁴

As operations were strained to adapt to emerging tactical needs, much of the engineering and design modification workload fell to the Lockheed Overseas Corporation based at Langford Lodge⁴⁵ When originally conceived, the Engineering Department at Langford Lodge was only staffed to handle “Shop Contact Engineer” workload, defined as that which would “...develop repair design, approve material substitution, justify a necessary departure from aircraft specifications, and to prepare unsatisfactory reports and very minor modifications.”⁴⁶

The fall of 1942 saw the introduction of the design, engineering and modification workload at Langford Lodge, transferring the primary responsibility of this work from the British engineers at Burtonwood. Lockheed relied on whatever design capabilities their small staff could muster, and recruited whatever engineering help they could find locally. This amounted to only two Polish, one British and one Irish engineer.⁴⁷ Lockheed filed emergency requisitions to its Burbank office for engineering personnel to meet the growing requirements as the mission of the base transitioned from that of a repair depot to the center for the manufacture and design of modifications.

The difficulties in adopting a standard policy for modification programs was a result of the shifting nature of the program. This was, in effect, responsive to the shifting natures of tactical demand and of enemy attack. Communicating technical plans, specifications, and prototypes between depots based in America and England created a tug-of-war on resources and communication. In July of 1943, Maj General Henry Miller, who was then Commander of the VIII AFSC wrote to General Eaker:



B-24 for Carpetbagger Project 1944 Mary Ann Site, Photo: Col D Ott, Source: Aldon Ferguson

“With the shortage of trained personnel in this theater and...the requirements for the sustained air effort, the Materiel Command must realize its responsibilities insofar as it pertains to modification of aircraft...As you know, we have been struggling with the P-47 which has taken 4-months to get into combat ...Recommend the modification centers in the United States must be stepped up to ensure the arrival of aircraft ready for combat. Modifications in this theater are being accomplished at the expense of maintenance and supply, and we cannot hope to continue to rob Peter to pay Paul indefinitely.”⁴⁸

The balance was ultimately between the comparative value of man-hours at home and abroad; civilian versus military labor between that of the Air Service Command Maintenance Division in the U.S. and VIII AFSC in England. It was General Clements McMullen, Chief of the Maintenance Division of the Air Service Command who ultimately suggested to Arnold on July 19, 1943, that a heavy bomber in the completely modified form be sent back monthly from the UK to guide the modification program at home.⁴⁹ This practice was adopted by VIII AFSC and reduced the discontinuity between modification programs at home and abroad.

Modifications ranged from the complex to the simple, from those directed by headquarters to those originating from the technicians that employed them; from the mods that failed to those that succeeded.

In June of 1944, 2d Lt Bill Clearwater departed Warton on a routine test flight of a P-51D. Observers from the airfield watched as the Mustang’s wing detached and the aircraft began to dive vertically toward the earth from 3,000 feet. Test pilots could not determine the cause of the failure and concluded it was a one-off occurrence.⁵⁰ In the same month, 2d Lt Burtie Orth crashed in another P-51D accident after witnesses on the ground reported having seen his right wing detach during straight and level flight shortly after climb out. The wreckage of Orth’s P-51D was taken back to Warton. The P-51 experts of Hangar 5 found that on both crashed Mustangs, the brake lines had bent around the undercarriage shock absorbers leading them to



P-51 Mustang in 5 Hangar at BAD2 Warton, Source: BAD-2 Association

believe that the landing gear, having been wholly twisted around, had dropped from their stowed position during flight. The Hangar 5 technicians devised a test by placing a P-51D on jacks and exhausting the pilot's checklist, but to no avail. Leaving the aircraft in a condition of cruise flight with the gear up and undercarriage lever in neutral, they went to take a coffee break. On their way out, one of them noticed something curious, one of the wheels was resting on the wheel door, causing it to drop down slightly. It was later discovered that, due to the addition of features to the P-51B and C models, such as an extra machine gun in each wing, the undercarriage uplocks on the earlier models had been removed as a weight saving measure. This relied on the hydraulic pressure alone to hold up the landing gear, and any surge would allow them to bounce freely in the carriage. This condition would cause enough fatigue to induce structural failure. The findings were quickly reported and the uplocks of earlier models were retrofitted to all P-51D aircraft and incorporated on newly manufactured Mustangs.

Other modifications originated from the creativity of depot technicians, desiring merely to prove they *could*. The Experimental Department at Burtonwood led an effort to modify a CG-4A Waco Glider by installing two engines to determine if it was possible to produce kits to convert them into self-propelled aircraft. Although the project was discarded midstream, the department's enlisted technicians had already committed a great effort and begged for the opportunity to prove that it worked.⁵¹ They were allowed to complete the conversion of one glider, and upon test, the Waco Glider took flight under its own power. In another instance of depot ingenuity, Warton's P-51 technicians petitioned base commander Colonel John G. Moore to allow them to use their free time to rebuild a P-51B that was damaged during shipment and "written-off" by engineers. To their surprise, Moore approved their request but only to fly the aircraft as a "station-hack," solely for local flying. After sourcing sections from five other aircraft, removing the oxygen system and command radio to modify the



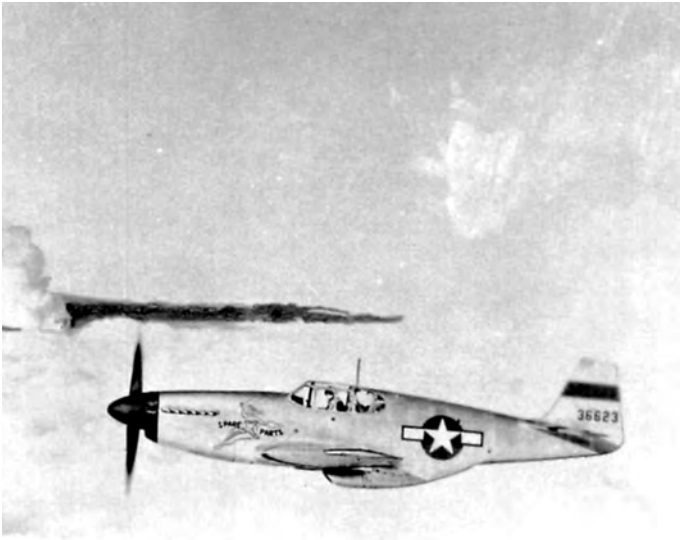
CG-4A converted to powered aircraft Burtonwood, 1945, Photo: Dick McClune Source: Aldon Ferguson

fighter with a rear seat, the aircraft was designated "*Spare Parts*" before it was test flown successfully. *Spare Parts'* primary missions were "whiskey-runs" to Glasgow, and the aircraft provided a morale-boosting opportunity for the ground crew to climb into the back seat through the detachable rear window and experience flight in their own modified Mustang.

Sorrow

American bases in England benefited from a high degree of security as compared with the AAF in other theatres during the war, primarily due to the infrequency of Luftwaffe bombing attacks. Further, as compared to their non-combat personnel peers in other theatres of the war, the USSTAF accounted for only 13% of the total overseas non-combat crew losses. That is also an even smaller percent as compared with their combat crew peers in the same theatre, accounting for 60% of all AAF battle casualties. In fact, AAF ground crew in England were not subject to enemy fire until they began to move into France in June 1944.⁵²

There were exceptional safety incidents, however. The testing of aircraft was inherently hazardous and occasionally resulted in the accidental death of aircrew. Deaths to the ground crew were rare, but did occur infrequently. Langford Lodge reported only one death during its first year due to a loss at sea from a man falling overboard during transit. Because of the threat of German U-Boats, the ship's crew could not attempt a rescue and, "threw him a raft with a flare on it, and kept going,"⁵³ Lockheed later counted the loss as "non-industrial."⁵⁴ Warton boasted a generally flawless safety record up to the second half of 1943, despite an accidental wing clipping of a P-51 by an alert crew vehicle. Nevertheless, the first months of 1944 would not be so kind.⁵⁵ The month of April was particularly bad in terms of safety for Warton. On the evening of the 16th, a night-shift electrician accidentally blasted all eight guns of a P-47 Thunderbolt, disintegrating part of the



BAD2's own P-51 Spare Parts, pictured on a flight over North Wales, Source: BAD-2 Association

hangar roof. The following day technicians accidentally fired the top turret guns of a B-24, spraying the entire area with 50-caliber bullets and shells. Fortunately, in these two incidents no one was hurt, but that same day a civilian contractor named Frederick Cooke was killed while riding in the back of a lorry after being struck by the propeller of a taxiing P-51. Later that year Private Edward Farow died of his injuries while on night shift after walking into the spinning propeller of a P-38. Considering the austerity of the depot conditions, the lack of training and experience, and the sheer number of personnel, casualties to the ground crew were quite rare and allowed for largely uninterrupted progress of industrial depot practices.

And yet, despite the relative safety of these industrial sites, it was at the depots that on the 23rd of August 1944, the Allies would suffer the single most significant loss of the war.

Early that morning in Freckleton, teachers prepared their lessons as students at Holy Trinity School listened attentively. Patrons of the adjacent *Sad Sack Cafe*, a popular restaurant for locals and for Airmen looking for a better alternative to the mess hall, enjoyed an early meal.

1st Lt. John Bloemendal of BAD2 took off in the B-24 named *Classy Chassis II* for a post-maintenance check ride. Lieutenant Peter Manassero, commanded a second B-24. While airborne, the two pilots discussed a rapidly developing storm formation that Manassero later called "a very impressive sight and looked like a thunderhead."⁵⁶ To calm the children after the sudden dark and stormy shift in weather, school teachers at Holy Trinity had the young children place their heads on their desks and read them fables. General Ott at BADA headquarters, aware of the developing storm, telephoned BAD2 ordering the immediate grounding of aircraft and the suspension of flight operations.⁵⁷ At 500 feet in altitude, Bloemendal and Manassero approached for landing. With zero visibility, both decided to abort. Manassero was successful, but the turbulence and downdrafts of the thunderstorm grabbed hold of *Classy Chassis II* and sent it cartwheeling down



Ground personnel clear rubble from a school in Freckleton that was destroyed in crash by a B-24 Liberator (serial number 42-50291) nicknamed "Classy Chassis" of the 486th Bomb Group., 1944 © IWM (FRE 11566)

narrow Lytham Road. The wreckage demolished homes and the *Sad Sack Cafe*, and the impact immediately killed its patrons and Bloemendal. The momentum of the crash carried the wreckage farther still, slamming the B-24's nose turret into the infant's wing of the school, creating a 2,793-gallon tidal wave of flames. The flames rolled down the narrow street as the small schoolhouse of Holy Trinity Church became enveloped in violent flashing tongues of yellow and red. One of the few survivors later recalled watching his teacher Ms. Louisa Hulme engulfed in flames as the air was sucked from his lungs. Hulme and teacher Jennie Hall along with 38 young children, fell victim to the firestorm. Three of those children during previous months had been moved from London to Freckleton during Operation Rivulet to protect them from V-1 and V-2 rocket bombings. Foreseeing her own demise, Hulme expressed to hospital workers her desire to be buried with her students.

Three days later BAD2 Officers and Enlisted Airmen served as pallbearers during the funeral procession, lowering caskets into the communal grave they had earlier dug in the shape of a "T," placing a memorial headstone at the top of the grave, completing the form of a cross. The body of schoolteacher Ms. Hall was lowered into one of the arms of the cross, and Ms. Hulme later laid along its vertical frame. The small caskets of the children were each laid within the grave's outstretched arms as if to embrace and comfort the heavily burdened mourners and to beckon the stranger come, see the proof in the scars of the hands and feet and to know better the cost. General Arnold in Washington, so saddened by the news of the tragedy, requested that General Ott represent him at the funeral. The gravity and burden of command so profoundly fell on this exacting prefect of air war production. This island was not estranged to suffering, but this was too much for anyone to bear. Only five days prior, representatives from the ETO had flown back to the U.S. to meet with the War Department to initiate logistical redeployment plans in preparation for the defeat of Nazi Germany.⁵⁸ Ott was already preparing for the



Funeral procession for the children who died in the Freckleton Air Disaster, Source: BAE Systems

flow of equipment and the end of the war. The conclusion of it all was in sight, the timing of this tragedy made the suffering all the more desperate and unnecessary. And yet, they could not by sheer strength of will cause a more expedient completion to the war. As Ott stood unwaveringly beside his men, watching the tiny caskets lowered into their grave, the olive drab of their Class-A uniforms flickered at the cold but resolute Lancastrian wind.

Resolve

During the spring and summer of 1944, plans and personnel were ever more committed to the successful completion of the war.

In a subtle but remarkable gesture expressing their commitment, depot personnel of BAD2 organized a unique war bond drive intending to raise enough money to pur-



Dedication ceremony of three P-51's during a war bond drive at Base Air Depot 2, Lancashire, England. P-51C's "Mazie R" 42-103601 and "Pride of the Yanks" 42-103502. P-51D "Too Bad" 44-13335. June 3 1944. National Archives



Maj Gen Hugh J Knerr shakes hands with a member of BAD 2 during a war bond drive where three North American P-51's were dedicated. note the nickname "Mazie R" England, June 3 1944. National Archives

chase two P-51 Mustangs for employment against axis powers, at the cost of \$114,000.⁵⁹ One aircraft would be named "*Too Bad*" commemorating the depot, and the other would be designated by an enlisted man chosen through a raffle. The chance of naming the P-51 increased through each purchase of a \$25 bond. To the astonishment of depot leadership, the personnel raised enough money to purchase *three* P-51 Mustangs. The men who named them, Pfc Stanley Ruggles and Pvt Stanley Silverman, in a Memorial Day ceremony overseen by Maj Gen Knerr, Brig Gen Ott, and Col Moore, unveiled the aircraft and their names, "*Mazie R*" and "*Pride of the Yanks*."

Advanced echelons of 9th Air Force personnel, composed of a considerable number of men previously assigned

to the 8th, forward deployed to the European continent during the cross-channel landings at D-Day. Most of their supplies transferred through the 9th AF's BAD4 at Baverstock, near a railway at Dinton, Wiltshire. By June 10, more than 6,000 men and 1,000 vehicles from the 9th AF had landed in France, virtually all of them on OMAHA Beach.⁶⁰ Among the units ashore by that time were engineer battalions, airdrome squadrons, truck companies, signal units, and other service organizations that would prepare the way for the later arrival of the combat groups. By June 20, more than 18,000 men and 4,000 vehicles had left England for the continent. Plans were to establish a depot in France as early as July 1944. In December of that year, Brig Gen Ike Ott was transferred to establish and



B-17 Flying Fortresses, one of the 306th Bomb Group and a B-24 Liberator at a repair depot in France. A censor has obscured the faces of the personnel in the foreground, and the aircraft in the background. Passed by the censor 1 Mar 1945, © IWM (FRE 4374)



Burtonwood, 2nd Air Depot Group, Winter, 1942 Photo: Chris Vandiver, Source: Aldon Ferguson

command the Continental Air Depot Area (CADA) in Compiègne, France, which was two months later re-designated as the *Central Air Depot Area*. Further advancing the depot maintenance and logistics capabilities from England to the continent, empowered the AAF to lower the strategic mountains, raise the valleys, and close with tactical agility against the Axis enemy, ultimately leading to victory.

Legacy

The stories of these depot-maintenance and logistics leaders recall the earliest warriors of democracy, where the ancient Athenian navy operated complex shipyards enabling

rapid deployment and reconstitution of trireme warships. These drydock ship-sheds were the depots of their day, equipping the Athenians to defy the odds when outnumbered, achieving victory at the Battle of Salamis, the first great naval battle in recorded history.⁶¹ Together, all social classes fought onboard the technologically advanced warships, creating the social bonds that historians say were the turning point in establishing the world's first democracy.⁶² Inextricably linked to these forerunners of freedom, the depot leaders of the 8th Air Force and the Allies fought together to preserve the ancient democratic liberties of the world, strengthening a foundation for independence, and contributing a legacy of leadership for generations to follow. ■

NOTES

1. Cox, Douglas A. "Airpower Leadership on the Front Line. Lt Gen George H. Brett and Combat Command." *Air University Press*, (September 2006): p. 22.
2. Craven, Wesley F., and James L. Cate. "Crisis in the Middle East." In *The Army Air Forces In World War II Volume 2: Europe - Torch To Pointblank August 1942 To December 1943*, (Chicago: University of Chicago Press, 1948), p. 6.
- 3 Craven, Wesley F., and James L. Cate. "Establishment of the Eighth Air Force in the United Kingdom." In *The Army Air Forces In World War II Volume 1: Plans And Early Operations January 1939 To August 1942*, (Chicago: University of Chicago Press, 1948), pp. 634-35.
4. *Ibid.*

5. Holmes, Harry. *The World's Greatest Air Depot: The US 8th Air Force at Warton 1942-1945*. Shrewsbury: Airline Publishing, 1998.
6. Historical Section, ETOUSA. "Chapter 4, Sec I. Strength and Flow." In *VIII Air Force Service Command History - 1942-44*, 4, 1946. *The National Archives (NA)*
7. Historical Section, ETOUSA. "Chapter 4, Sec I. Strength and Flow." In *VIII Air Force Service Command History - 1942-44*, 9, 1946. *NA*
8. Historical Section, ETOUSA. "Chapter 1, Mission." In *VIII Air Force Service Command History - 1942-44*, 39-41. 1946. *NA*
9. Craven and Cate. "Establishment of the Eighth Air Force in the United Kingdom." In *The Army Air Forces In World War II*

Volume 1: Plans And Early Operations, pp. 634-635.

10. Historical Section, ETOUSA. "Chapter 2, Organization." In *VIII Air Force Service Command History - 1942-44*, 30-32. 1946. NA

11. Ferguson, Aldon P. *Eighth Air Force Base Air Depot "Burtonwood."* Airfield Publications, 1986.

12. Headquarters U.S. Air Force. Secretary General, The Air Board. *Notes on Interview with Major General Hugh J. Knerr.* By Alfred Goldberg. 1947. Air Force Historical Research Agency (AFHRA)

13. *Ibid*

14. "First Flight Around the World." Smithsonian National Air and Space Museum | First Flight Around the World | Pioneers of Flight. Accessed April 04, 2019. <https://pioneersofflight.si.edu/content/first-flight-around-world>.

15. Lockheed. *Lockheed Overseas Corporation Annual Report 1942-1943.* 1943 NA

16. Historical Section, ETOUSA. "Chapter 1, Mission." In *VIII Air Force Service Command History - 1942-44*, 2-23. 1946. NA

17. Holmes, Harry. *The World's Greatest Air Depot: The US 8th Air Force at Warton 1942-1945.* (Shrewsbury: Airlife Publishing, 1998).

18. Historical Section, ETOUSA. "Chapter 2, Organization." In *VIII Air Force Service Command History - 1942-44*, 90. 1946. NA

19. Historical Section, ETOUSA. "Chapter 5, Materiel and Supplies." In *VIII Air Force Service Command History - 1942-44*, 142. 1946. NA

20. Historical Section, ETOUSA. "Chapter 2, Organization." In *VIII Air Force Service Command History - 1942-44*, 93. 1946. NA

21. Bradley, Follet, & Knerr, Hugh. *The Bradley Plan for the United Kingdom.* 1943. AFHRA

22. Aldon Ferguson (RAF Burtonwood historian) interview with the author, February 2018.

23. The United Kingdom. Air Ministry. Meteorological Office. *Monthly Weather Report of the Meteorological Office, March 1944.* 3rd ed. Vol. 61.

24. The United States. U.S.A.A.F. Commanding Officer BAD #2. *Historical Report Base Air Depot #2 March 1944.* AFHRA

25. The United States. U.S.A.A.F. Office of the Chief Maintenance Division 1st Base Air Depot. *Weekly Activity Report (For Week Ending 12 May, 1944).* 1944. AFHRA

26. Aldon Ferguson (RAF Burtonwood historian) interview with the author, August 2018.

27. Magnolia Presbyterian Church, and Hartman Funeral Home. *Funeral service Obituary, Walter Wesley Ott.* 2006.

28. Historical Section, ETOUSA. "Chapter 5, Materiel and Supplies." In *VIII Air Force Service Command History - 1942-44*, 126-133. 1946. NA

29. *Ibid*

30. Bradley, Folett., & Knerr, Hugh. *Report of investigation made by Colonel Hugh J. Knerr of Air Service Command activities in the United Kingdom and African Theatres April 25 - June 17, 1943.* 1943. AFHRA

31. Historical Section, ETOUSA. "Chapter 2, Organization." In *VIII Air Force Service Command History - 1942-44*, 68-90. 1946. NA

32. Historical Section, ETOUSA. "Chapter 5, Materiel and Supplies." In *VIII Air Force Service Command History - 1942-44*, 126-133. 1946. NA

33. Historical Section, ETOUSA. "Chapter 4, Sec II. Special Personnel Groups." In *VIII Air Force Service Command History - 1942-44*, 1. 1946. NA

34. The United States. U.S.A.A.F. Headquarters ETOUSA. *Citation, Award of Legion of Merit, 22 Sep 1943, First Lieutenant Edward N. Hall. by Command of Lt Gen Devers.* 1943 AFHRA

35. "Colonel Edward N. Hall Inducted 1999." Air Force Space Command | Air Force Space and Missile Pioneers. Accessed April 04, 2019. <https://www.afspc.af.mil/About-Us/Heritage/spaceandmissilepioneers/>.

36. Maugh, Thomas H., II. "Edward N. Hall, 91; Rocket Pioneer Seen as the Father of Minuteman ICBM." *Los Angeles Times*, January 18, 2006.

37. The United States. U.S.A.A.F. Commanding Officer BAD #2. *History of BAD #2.* 1944. AFHRA

38. The United States. U.S.A.A.F. Commanding Officer BAD #2. *Historical Report Base Air Depot #2 February 1944.* 1944. AFHRA

39. Oklahoma City, Associated Press. "Billy Arnold, 1930 "500" Winner, Dies." *Indianapolis Star*, November 11, 1976.

40. "Billy Arnold." The People of IMS | Indianapolis 500 Drivers. Accessed April 04, 2019. <https://www.indianapolismotor-speedway.com/history/people-of-ims/indianapolis-500-drivers/bill-y-arnold>.

41. Historical Section, ETOUSA. "Chapter 1, Mission." In *VIII Air Force Service Command History - 1942-44*, 39-41. 1946. NA

42. Ferguson, Aldon P. *Eighth Air Force Base Air Depot "Burtonwood."* Airfield Publications, 1986.

43. Historical Section, ETOUSA. "Chapter 1, Mission." In *VIII Air Force Service Command History - 1942-44*, 2-23. 1946. NA

44. Historical Section, ETOUSA. "Chapter 5, Materiel and Supplies." In *VIII Air Force Service Command History - 1942-44*, 158. 1946. NA

45. Lockheed. *Lockheed Overseas Corporation Annual Report 1942-1943.* 1943 NA

46. *Ibid*

47. *Ibid*

48. Historical Section, ETOUSA. "Chapter 1, Mission." In *VIII Air Force Service Command History - 1942-44*, 2-23. 1946. NA

49. *Ibid*

50. Holmes, Harry. *The World's Greatest Air Depot: The US 8th Air Force at Warton 1942-1945.* (Shrewsbury: Airlife Publishing, 1998).

51. Aldon Ferguson (RAF Burtonwood historian) interview with the author, August 2018.

52. Historical Section, ETOUSA. "Chapter 4, Sec I. Strength and Flow." In *VIII Air Force Service Command History - 1942-44*, 10. 1946.

53. Eastwood, Doug. *HUT 203 The Wartime Log Book of Doug Eastwood, an American Civilian Aircraft Mechanic in Northern Ireland, During the Second World War, 1942 - 1944.* Station 597 Publications.

54. Lockheed. *Lockheed Overseas Corporation Annual Report 1942-1943.* 1943 NA

55. The United States. U.S.A.A.F. Commanding Officer BAD #2. *Historical Report Base Air Depot #2 14 February 1944.* AFHRA

56. The United States. U.S.A.A.F. Commanding Officer BAD #2. *Historical Report Base Air Depot #2 September 1944. 8 October 1944.* AFHRA

57. Hedtke, James R. *The Freckleton, England, Air Disaster: The B-24 Crash That Killed 38 Preschoolers and 23 Adults, August 23, 1944.* (Jefferson, NC: McFarland & Company, Publishers, 2014).

58. "1st Base Air Depot - AAF 590 Historical Report." *AAF Historical Office*, August 1944. AFHRA

59. The United States. U.S.A.A.F. Commanding Officer BAD #2. *Historical Report Base Air Depot #2, May 1944. 9 June 1944.* AFHRA

60. Craven and Cate. "Logistics Mobility." In *The Army Air Forces In World War II Volume 3: ARGUMENT to V-E Day*, pp. 577-87. (Chicago: University of Chicago Press, 1948).

61. Britannica, The Editors of Encyclopædia. "Battle of Salamis." Encyclopædia Britannica. December 21, 2015. Accessed April 04, 2019. <https://www.britannica.com/event/Battle-of-Salamis>.

62. Rankov, Boris. "Lessons of History: The Good Ship Democracy: The Building of a Trireme." *The Independent*. October 23, 2011. Accessed April 04, 2019. <https://www.independent.co.uk/news/uk/lessons-of-history-the-good-ship-democracy-the-building-of-a-trireme-warship-fleet-had-a-deep-effect-1491503.html>.