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GREAT BRITAIN AND THE WAR IN THE SOUTH ATLANTIC

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April 1985

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During the amphibious landing at San Carlos Bay in May 1982, a British Army major observed an incongruous sight. Against the backdrop of wheeling Argentine warplanes, heavy British anti-aircraft fire, and the bustling confusion of the landing operation, a shattered photocopier lay on the rocky beach, where it had been literally dropped by an impatient British helicopter crew. Photocopiers play an important role in day-to-day military life and no doubt are standard inventory items for most military units. During the war in the South Atlantic, however, where "a dry clean piece of paper was a bonus in itself" and unit orders were drafted on scraps of cardboard,² photocopiers quickly were relegated to the position of being excess baggage.

The fate of the photocopier illustrates the fact that soldiers, sailors, and airmen must always think, plan, and practice for the unknown. No matter how realistic the conduct of exercises and training, it is impossible to simulate combat. Wars invariably expose deficiencies in peacetime planning. Before World War I, most soldiers planned and practiced for a war of maneuver and the offensive, yet the Western Front rapidly evolved into a static battle of attrition. Prior to 1914, admirals planned and trained to fight massive and decisive fleet actions on the model of Trafalgar and Tsushima; four years of conflict witnessed only one such action--the Battle of Jutland--and it did not prove decisive.

¹This article, which grew out of earlier work in Rand's Resource Management Program, was prepared for the journal *Conflict*. The author would like to thank Rand colleagues Bruce Hoffman, Robert Perry, James Quinlivan, Michael Rich, and Marilyn Yokota for their helpful advice and assistance.

²Major J. Bailey, "Training for War: The Falklands 1982", *Military Review*, September 1983, p. 66.

Before World War II, soldiers in France and Britain practiced the prosecution of static defensive battles on the order of the previous war and fell victim to the *Blitzkrieg*. Sailors still pinned their faith on the battleship as the decisive factor in sea power--a few years of combat experience witnessed the rise of the aircraft carrier as the centerpiece of the battlefleet. Airmen in many nations theorized that heavy bombers could win wars single-handedly, a doctrinal position that outran capabilities until the advent of the atomic bomb in the last year of the war.

Combat continually demonstrates the inherent unpredictability of war and places military professionals in the difficult position of always preparing for the unexpected. Military men must take on chameleon-like qualities--they must constantly adapt to new operational and political realities. The process of adaptation can be seen in peacetime, when nations continually attempt to update and modify their military establishments to support changing political objectives. For example, the United States' concern in the late 1970s over the increasing threat to the flow of oil from the Persian Gulf region has resulted in, among other things, the creation of a new separate military command, new plans, and new forces, such as fast sealift ships, highly mobile "light divisions" and an enlarged airlift fleet.³

New weapons systems--aircraft, warships, and fighting vehicles--continually enter inventories. Escalating costs have led to the extensive modification of weapons systems to maintain fighting effectiveness. Sometimes, as in the case of the F-4G Wild Weasel defense suppression aircraft, systems are modified to perform new roles. Aircraft are fitted with modernized avionics, self-protection systems, additional fuel capacity, new engines, and advanced munitions. New missile and radar systems are installed on old warship hulls. Tanks are provided with improved guns, fire control systems, engines, and armor.

³See C. Bowie, *Concepts of Operations and USAF Planning for Southwest Asia*, Santa Monica: The Rand Corporation, 1983, R-3125-AF, for an overview of U.S. strategy for the Persian Gulf.

Sometimes peacetime "fixes" can be found in innovative tactics and operational concepts. The experience of the Royal Air Force's V-bomber force offers a useful example. The aircraft comprising this nuclear delivery force had been conceived in the late 1940s and built in the early 1950s, when high altitudes appeared to offer safety from defenses. Advances in interceptors and surface-to-air missiles, however, severely reduced the credibility of high-altitude bombers at a time when their planned replacement (the Royal Navy's submarine missile force) would not be ready for another 7-8 years. To preserve the credibility of Britain's independent deterrent, the RAF switched in the space of several months from high altitude to low altitude penetration tactics, which greatly reduced the threat posed by current and projected enemy defensive systems. The solution to this particular problem, then, involved the development of a new operational style and the retraining of aircrew.⁴

Actual combat compresses the adaptive process. Tactics undergo dramatic changes. New equipment is designed and produced extremely quickly. In World War II, for example, the first sonobuoys went from conceptual stage to production in five months, the acoustic mine sweep in four weeks. Modifications are also made quickly. Prior to the Vietnam War, for example, the U.S. Air Force and Navy had come to believe that air-to-air missiles had made the gun obsolete. Many fighters planned and procured in the 1950s and early 1960s, such as the F-86D, F-89, F-101, F-102, F-106, and F-4, were built solely with missile armaments. Combat experience, however, indicated that the gun still had an important place in air combat. Accordingly, the American military establishment adapted quickly. As a quick fix, gun pods were built and carried on U.S. aircraft; as a longer term effort, fighters such as the F-4 were modified to carry an internal gun. All subsequent U.S. fighters, though carrying greatly improved missile armaments, have also been built with internal guns.

⁴See A. Brookes, *V-Force: The History of Britain's Airborne Deterrent*, London: Jane's Publishing Company, 1982, p. 134.

Such behavior involves the discovery and identification of problems and the initiation of quick and long-term "fixes." It requires an adaptive mentality in military professionals, who must change tactics and operations to suit unforeseen circumstances. It also requires a highly responsive industrial base, which must adapt and modify equipment to meet the constantly changing needs of those on the "sharp end."

Britain's experience during the South Atlantic War perhaps illustrates this process at its most extreme. Literally overnight, Britain was faced with a war for which it had no plans. Failures in the British intelligence community had led to a total lack of strategic warning. The British government first realized on April 1, 1982, that Argentina was planning on invading; the actual Argentine landings took place the following day. On April 3, Britain announced its intention to send a task force south, even though, as the Chief of Britain's Defence Staff stated: "There were no contingency plans for the operation."⁵ The first units of the British task force sailed on April 5, only four days after the invasion.

Britain's military forces were mainly configured to fight in Europe in conjunction with powerful allies. They were not designed to fight a conflict alone 8000 miles from home with only a small underdeveloped base--Ascension Island--as a staging point. As the commander of the RAF Harriers employed in the campaign noted: "If anybody told me in March of last year that within two months I would be fighting a war from an aircraft carrier 8,000 mi. away from home, frankly I would not have believed him."⁶

The demands of the campaign would require extremely rapid planning, tactical and operational innovation, and a highly responsive industrial base. During the post-World War II era, Britain has constantly been faced with having too many commitments and inadequate resources. Necessity has thus made the British masters at modification and tactical innovation--attempting to "make do" with very limited resources.

⁵Air Marshall S. Menaul, "The Falklands Campaign: A War of Yesterday?", *Strategic Review*, Fall 1982, p. 82.

⁶Wing Commander P. Squire, "Falklands War From the Pilot's Seat," *Astronautics and Aeronautics*, Vol. 21, No. 5, May 1983, p. 99.

Britain's ability to "make do" during the South Atlantic War will form the focal point of this article.

FIELD EXPEDIENTS

Britain's adaptive response to the unforeseen conflict can be seen on the tactical and operational level--that is, the imaginative use of materials at hand in the South Atlantic. Sometimes the "materials at hand" were simply motivated, well-conditioned, and well-trained men. For example, when the heavy lift helicopters being transported on *Atlantic Conveyor* were lost after the ship was destroyed by missile attack, British soldiers relied upon "yomping"--rapid marches--to carry themselves and much of their equipment across the islands. Sometimes adaptation involved such a simple thing as paint. To reduce their visibility, the white bellies of Sea Harriers were painted to match the top-side color of dark sea grey (which led to their Argentine nickname "Black Death"). Similarly, RAF Harriers had their roundels painted out, and Vulcans employed on long range bombing missions had their undersides painted a darker grey.⁷

Simply keeping weapons in service in the unpleasant climate of the South Atlantic required ingenuity. Pipe wrenches, though not on formal British Army equipment lists, were used to screw in artillery shell fuses in the bitter cold. Gun detachment commanders slept with artillery firing boxes in their sleeping bags to keep these units warm and dry.⁸ The high humidity levels, which often reached 100%, forced Sea Harrier maintenance crews onboard the two carriers to adopt new techniques. Wet "black boxes" were dried off by placing them in warm galley ovens. Electrical connections were sealed with aerosol plastic skin borrowed from the sick bay. Clear plastic food wrap was used to keep cockpits and instrument panels dry. And common bathroom sealant was employed to seal external joints and keep interior sections dry.⁹

⁷The Argentines also employed paint--most aircraft of the Argentine Air Force were given yellow stripes for rapid identification.

⁸J. Bailey, "Training For War: The Falklands 1982", *op. cit.*

⁹Lt. Cmdr. Neill Thomas, "Falklands War From the Pilot's Seat: Takeoff Every 20-25 Seconds," *Astronautics and Aeronautics*, May 1983, p. 98.

Weapons were often employed for purposes much different than planned for. For example, the Milan wire-guided missile was procured for the anti-tank role. In the Falklands, British soldiers employed it for other tasks, such as attacking fortifications, silencing anti-aircraft guns, and even firing against aircraft.¹⁰ Royal Navy cannon were used extensively for shore bombardment, a purpose probably not envisioned when the vessels were procured to conduct ASW operations in the North Sea.

Heavy Argentine air attacks also resulted in hurried field expedients. Ships needed heavier point defenses; accordingly, heavy machine guns were emplaced on most British vessels and reportedly downed several low-flying jets. A Scimitar reconnaissance vehicle, which had not been designed as an anti-aircraft platform, apparently shot down two Argentine jets with its 30mm cannon.¹¹ Indeed, the British employed anything that stood a chance of breaking up enemy air attacks, including Schermuly rocket flares to simulate surface-to-air missiles.¹²

The Rapier missile system had not been designed to operate in conjunction with RN fleet defenses and when the first batteries were established on the hills around San Carlos Bay, it was discovered that Rapier's radar system interfered with naval identification friend or foe (IFF) radio transmissions. Accordingly, the radar system was turned off and Rapier's optical sighting unit used instead. Crews also had to adapt to the unusual situation of firing Rapier missiles at targets flying below the level of the batteries.¹³

¹⁰It does not appear that Milan missiles fired against aircraft actually hit anything, but some air attacks were reportedly broken up. See G. Manners, "Falklands Soldier's Best Friend Was His Milan", *Jane's Defence Weekly*, 7 April 1984, p. 525.

¹¹"UK: Tracked Vehicle's 'Victory,'" *Defense and Foreign Affairs*, Vol. XI, No. 129, Feb. 6, 1982, p. 1.

¹²Major J. Bailey, "Training For War: The Falklands 1982," *British Army Review*, April 1983, p. 65.

¹³"Air Defense Missiles Limited Tactics of Argentine Aircraft," *AWS&T*, July 19, 1982, p. 22.

Other field expedients were more complex. When engaging low-level aircraft, operators of the Seawolf point defense missile found that the guidance flare used for optical tracking blinded them. Engineers with the task force thus modified the guidance software so the missile would fly slightly off the operator's line of sight until the last few seconds prior to interception.¹⁴

Heavy radar-directed gunfire led to a quick electronic counter-measure (ECM) "fix" on both RN and RAF Harriers. Resource constraints had prevented the British from providing these aircraft with a chaff dispensing system; to reduce their vulnerability during combat in the South Atlantic, the Harriers carried chaff bundles in speed brake wells and jammed between munitions and pylons for release over engagement zones. By May 20, the Harriers had been fitted with an internal chaff/flare dispenser unit.¹⁵

The Royal Navy undoubtedly had developed plans for combating Soviet anti-ship missiles, but fighting without land-based airpower against an ally's weapon--the Exocet sea skimmer--had received little consideration. The loss of the *Sheffield* led the RN to adopt new anti-missile tactics--chaff was fired in voluminous quantities at the least hint of threat, helicopters were rigged with radar reflectors to divert missiles, and ships were used as decoys to draw missiles away from high-value targets such as the two carriers.¹⁶ There are unquestionably many other examples--the important point is that combat experience led to many operational and tactical changes.

¹⁴"The Falklands Conflict: Part 2--Missile Operations", *International Defense Review*, Vol. 9, Sept. 1982, p.1154.

¹⁵See below, p. 17.

¹⁶Exact British anti-missile tactics have still not been revealed, though several articles have noted that the firm that made chaff rockets for the Royal Navy went on 24-hour shifts. See "The Falklands Experience: Electronic Warfare," *Navy International*, June 1983, pp. 373-78. The use of decoy ships is well documented. Four reporters with the task force, for example, were regarded as troublemakers by the British naval commander and found themselves covering the war from an Exocet decoy ship! See R. Harris, *Gotcha! The Media, The Government, and the Falklands Crisis*, London: Faber and Faber. 1983, pp. 127-28.

ADAPTATION AT HOME

Adaptive behavior at home was a more complex process and utilized the close partnership that developed between British industry, the services, and the government. This partnership was strengthened by two important factors--money and widespread political support. Government coffers were opened wide for those items that would bring results very rapidly. For example, turning vessels into troop transports required greatly increased amounts of freshwater production gear for the additional personnel. The Inspector of Shipwrights at Devonport learned of a British company that produced such gear, telephoned the firm, and ordered almost 200,000 pounds worth of gear without paperwork or even the spending authority to place such an order!¹⁷ Widespread political support throughout the UK for the government's position made industrial and government employees willing to put in long and often unpaid hours. As one account observed:

In Portsmouth, where the first redundancy [layoff] notices had been issued on the very day of the invasion, one of the workmen was spending Sunday visiting HMS *Victory* with his wife. When he saw others working he just handed his camera to his wife, joined his fellows, and arrived home 36 hours later. In Devonport, forklift truck drivers worked 36- and 48-hour shifts willingly. Outside the Dockyards, industry gave the same response.¹⁸

SHIP MODIFICATIONS

Although Britain had long maintained plans for requisitioning merchant ships to serve as supply vessels for a war in the European theater, the unexpected Falklands crisis required a great deal of ingenuity and modification. Transporting supplies between the Home Isles, the European continent, and the United States, which all possess sophisticated ports, was far different from transporting supplies and men over 8000 miles to islands without available port facilities. Only one staging point--the underdeveloped base of Ascension Island--lay

¹⁷R. Villars, *Merchant Ships at War: The Falklands Experience*, Annapolis: Naval Institute Press, 1984, p. 26-7.

¹⁸Villars, *ibid*, p. 29.

roughly midway between the United Kingdom and the captured territories.

Nonetheless, government records of British vessels proved a useful starting point; on April 4, an Order in Council was promulgated by the Queen stating the government's intention to requisition civil vessels. These were referred to as STUFTs (Ships Taken Up From Trade), which led to obvious puns. The Order in Council required some rapid financial and legal planning; passenger vessel owners, for example, wanted compensation for cancelled tours, while there were some disagreements over the insured costs of vessels. These rather knotty questions, however, were worked out quite rapidly.

The ships had to be surveyed to ascertain their suitability and what modifications would be required. These surveys were often done on the move. In the case of the liner *Uganda*, which was converted into a hospital ship, the survey team was airlifted to the vessel in the Mediterranean; as the vessel steamed toward the dockyard in Gibraltar, the surveying team did its work.

Some fifty civilian vessels in all served in the South Atlantic, ranging in size from trawlers to ocean liners. Seventeen of the vessels were fitted with helicopter decks, each of which had to be able to withstand the weight of a fully loaded helicopter making a crash landing. The liners *Canberra* and *Uganda* were the first to be fitted with helicopter decks--both within one week. Final structural touches were completed as the ships steamed south.

The speed at which the platforms were installed can be seen in the rapid work done on the *Queen Elizabeth II* (QEII). The two landing platforms were constructed on the swimming pool decks, which were ringed by expensive aluminum side screens. A surveyor pointed out the screens to be removed, an engineer marked them, and right behind the two men a dockyard worker moved in to cut the marked obstructions with an acetylene torch!¹⁹ The ships fitted with helicopter landing platforms, of course, also required the installation of various landing aids.

¹⁹R. Villars, *Merchant Ships at War*, op. cit., p. 22. Villars' excellent book on the Falklands operations contains a great deal of detail on the conversion and employment of merchant ships during the Falklands operation.

Almost all the vessels taken up from trade were fitted with military communications and satellite navigation gear. Equipment for refueling at sea was fitted to all ships. Since most of the vessels carried more personnel, additional freshwater production equipment was often required (reverse osmosis water purification gear was used extensively with great success). Billeting space had to be created for the additional people. Car ferries designed for operations in the English Channel had their bows welded shut to prevent disasters in the rough seas of the South Atlantic.

Nine vessels, including the two big liners *Canberra* and *QEII*, carried troops and associated equipment. Modifications included the addition of helicopter platforms, communication and navigation gear, underway refueling apparatus, and extra billeting space. Some of the effects of carrying troops were unforeseen; on the *QEII*, for example, when the troops ran in place during exercise periods, the resultant vibrations caused much of the deck caulking to fall out. Cunard, *QEII*'s owner, was also upset by the discovery of numerous bullet holes in the deck railing inflicted during live weapons training.²⁰

Fifteen tankers were requisitioned to supply the task force and the hastily developed base at Ascension. Most of these vessels were fitted with extra communications and navigation equipment, as well as gear for refueling at sea. One of the tankers was loaded with fresh water for the task force. Two vessels designed for oil drilling operations in the North Sea were sent to act as repair ships; they were pressed into service with such speed that one vessel still had a diver in its decompression chamber when the ship arrived at the conversion dockyard. Five trawlers were fitted with minesweeping gear, manned by RN crews, and sent to the South Atlantic, where they cleared sea mines after the surrender at Port Stanley.

Undoubtedly the most difficult modifications involved four vessels-- *Atlantic Conveyor*, *Atlantic Causeway*, *Contender Bezant*, and *Astronomer*--which were modified to transport Harriers and helicopters to

²⁰An extensive account of the *QEII*'s service can be found in W. Flayhart and R. Warwick, "The Liner She's A Lady", *United States Naval Institute Proceedings* Vol. 110, Nov. 1984, pp. 53-64.

the South Atlantic (although only the ill-fated *Atlantic Conveyor* actually carried Harriers). There had been no previous British plans to convert these ships, but the need for more fixed and rotary winged platforms was overriding. The vessels selected for such duty were container ships, which featured large flat decks. Nonetheless, the conversions required a considerable amount of work.

On the *Atlantic Conveyor*, for example, the first to be requisitioned for this purpose, the deck was found to be strong enough to support aircraft, but the proposed landing and takeoff pad area for the Harriers and helicopters had to be strengthened through the addition of doubler plates. The "flight deck" was cleared of obstructions, such as ventilator fans, guard rails, and lockers, resurfaced with non-skid paint, and painted with flight deck markings. Landing lights and glidepath indicators were fitted. Limited protection from the sea was created by stacking containers on both sides of the parking area. Aviation fuel was stored in newly installed tanks and pumped with surplus warship equipment. Liquid oxygen supplies were also added. Aircraft maintenance facilities were installed in the deck containers. A ballast tank was filled with fresh water to enable the crews to wash down the Harriers to reduce corrosion. The ship's firefighting equipment was upgraded to cope with possible jet fuel fires. Additional communication equipment was installed. Space was created for the additional 100 naval and flight personnel.

At the same time as the conversion work was going on, various military stores were being loaded into the ship. Yet with all the required modifications, the *Atlantic Conveyor* sailed only 11 days after her arrival at the port of Plymouth!²¹ Experience gained from converting the *Atlantic Conveyor* led to more sophisticated modifications on the other three aircraft ferries; these vessels possessed covered hangars, improved aviation fuel farms and pumping systems, and self-defense weapons. Conversion times dropped to around a week for each of these vessels.²²

²¹Villars, *op. cit.*, pp. 75-82.

²²Villars, *ibid.*, pp. 82-87.

All the converted vessels played a critical role in the campaign to retake the Falklands. Troops, helicopters, Harriers, Rapier batteries, ammunition, fuel, and the wide variety of supplies required by the British expeditionary force would have been available in much smaller quantities without the use of these converted vessels. The overall speed with which the ships were requisitioned, surveyed, converted, and loaded illustrates the power and responsiveness of a modern industrial state when provided with decisive leadership²³ and backed by widespread popular support.

AIRCRAFT MODIFICATIONS

Modifying aircraft is technically more difficult than modifying ships, since flying machines are more sensitive to center of gravity changes and the drag effects of newly-installed external protruberances. Mistakes can have rather dramatic consequences. Nonetheless, focusing money and the efforts of industry and indigenous military engineering establishments enabled the British to modify many aircraft to permit them to serve in the Falklands campaign. These included Vulcan heavy bombers, Victor tankers, Nimrod maritime patrol aircraft, Hercules transports, Harrier tactical aircraft, and helicopters.

At the time of the Argentine invasion, the RAF was in the process of phasing out its Vulcan bomber force. For many years the backbone of Britain's independent deterrent, the Vulcans had been dedicated to NATO as a nuclear asset since the 1969 introduction of the Royal Navy's Polaris submarines. Indeed, a number of Vulcans were already in residence at several aviation museums throughout the world! Although the delta-winged Vulcans had an aerial refueling system,²⁴ the probes and internal plumbing had not been used for fifteen years. RAF engineers at Waddington, the last remaining Vulcan base, quickly replaced valves and piping to bring the internal plumbing up to standard.

²³Some may disagree with the Thatcher government's decision to respond with force, but almost all would agree that her government did provide decisive leadership during the crisis.

²⁴The RAF employs a probe and drogue refueling system, unlike USAF's boom-receptacle system.

Since the Vulcans had been configured for nuclear missions, old conventional bomb racks had to be rescued from storage depots and inserted into the aircrafts' bomb bays. Electrical and mechanical bomb release systems were also altered. To improve navigational accuracy, new inertial navigation systems (INS) were installed; the INS units came from the RAF's collection of mothballed VC-10s.²⁵ Finally, electronic jamming pods in the British inventory--ALQ-101s--were removed from RAF Buccaneers and placed on rapidly manufactured pylons attached to wing hardpoints.²⁶

Crews for the Vulcan began training for refueling operations and conventional bombing missions on April 14--twelve days after the Argentine invasion. On April 29, two of the modified Vulcans deployed to Ascension Island. The first of the five Vulcan missions--codenamed Black Buck--took place on May 1, the second on May 4.

These attacks, each performed by a single Vulcan, succeeded in cratering the runway at Port Stanley, but did not succeed in putting it out of action. However, the attacks did have the significant effect of causing the Argentine government to hold its only radar-equipped fighters on homeland alert in case of heavy British bomber strikes against the mainland.²⁷ This ended whatever hopes Argentina had to dispute Britain's marginal air superiority over the combat zone.²⁸

²⁵The VC-10s had been purchased from British Airways to replace the Victor tanker force; the increased fatigue on the Victor force caused by the demands of the Falklands campaign has resulted in the speedier introduction of the VC-10 into RAF service.

²⁶The hardpoints had been installed during the days when the Vulcans were slated to receive the U.S.-developed Skybolt air-launched missile. The unilateral cancellation of the Skybolt program led directly to Britain's procurement of its current SLBM force. See C. Bowie and A. Platt, *British Nuclear Policymaking*, Santa Monica: The Rand Corporation, 1983, R-3085-AF, for further information.

²⁷J. Ethell and M. Price, *Air War South Atlantic*.

²⁸After the Vulcan attacks, the task force's inability to deflect all incoming Argentine air formations was caused by inadequate numbers of Sea Harriers, the range and loiter constraints of these aircraft, and the lack of airborne early warning rather than by Argentine efforts to gain air superiority.

At the same time, the RAF was preparing Vulcans for defense suppression missions by equipping them with radar-homing missiles for use against the major Argentine radar station at Port Stanley. Martel missiles in the British inventory were initially installed on hastily-built pylons and test-fired on May 5. RAF preference for the newly available U.S.-supplied Shrike radar-homing missile led to a "modified modication" and pylons carrying two Shrikes each were fitted to two Vulcans. These "Wild Weasel" Vulcans deployed to Ascension on May 27 and carried out two raids on May 30 and June 2; the attacks, however, did not succeed in knocking out the targeted radar installation. A final "Black Buck" conventional bombing mission was flown on June 11 against the Port Stanley airstrip.²⁹

Each of the Vulcan sorties required the support of 10 Victor tankers, which refueled each other and the bomber on these missions. The complexity of the tanking operation required some hasty planning at Strike Command Headquarters in the UK and attempts to beef up the Victor tanker force. The RAF possessed a number of mothballed VC-10s purchased from British Airways to replace the Victors in later years. However, it was quickly determined that these aircraft could not be converted quickly; moreover, the RAF had few qualified VC-10 crews. Attention thus switched to turning available Vulcans and Hercules into tankers. Extra fuel tanks were installed in the bomb bays of six Vulcans. Hose drum units containing the refueling drogue were fitted in newly manufactured plywood boxes attached to the rear of the converted aircraft. These Vulcan tankers were created in under six weeks.³⁰

RAF C-130 Hercules were also converted into tankers by the firm Marshalls of Cambridge. The Ministry of Defense ordered the conversion on April 30 and a C-130 arrived at the company's premises on May 1. A hose drum unit was installed in the rear area of the cargo bay. Internal piping, fuel pumps, cooling vents, tanker lighting, and control panels were also added. The first dry refuelings were attempted on June

²⁹Detailed information on the Black Buck modifications can be found in "The Five Black Bucks: The Story of Vulcan Operations in the South Atlantic," *Air International*, Dec. 1982, pp. 291-98.

³⁰"The Five Black Bucks...", *ibid.*, p. 298.

11; buffeting troubles led to the installation of small strakes on the bottom of the cargo ramp. On June 20, the first wet refueling took place--only six weeks after the initial placement of the MoD order,³¹ although too late to see combat service.

Hercules also underwent other modifications to enable them to operate over the long distances between the forward base of Ascension and the task force. In five days, RAF engineers installed two auxiliary fuel tanks originally produced for another RAF cargo aircraft in the forward cabins of several Hercules. This provided another 3-4 hours of endurance. A four tank set-up was also created for ultra-long-range flights.

Refueling probes taken from Vulcans not slated for service (and in at least one case, from a Vulcan in a museum!) were installed by Marshalls of Cambridge on a trial C-130. Necessary internal plumbing was also added. The first addition of a probe and associated "kit" on a C-130 took only ten days; altogether six Hercules were fitted with refueling gear by the end of the conflict. The newly installed probes and plumbing greatly added to the flexibility of the C-130 force, which conducted over 40 supply missions to the British task force in the South Atlantic prior to the Argentine surrender at Port Stanley on June 15.³²

Other large RAF aircraft also underwent modifications. At least two Victor tankers were fitted with cameras, mapping radar, and other gear for reconnaissance missions; the first of these took place some three weeks after the invasion.³³ Nimrods, the RAF's sophisticated maritime patrol platforms, were needed to bolster Britain's surveillance and ASW capabilities. On April 14, British Aerospace was tasked to

³¹"Hercules in the RAF...The Falklands and Beyond", *Air International*, Feb. 1983, pp. 71-2.

³²"Hercules in the RAF...", *ibid*, pp. 73-4. The long-range missions delivered high priority cargo and messages to the British task force. For example, after the commander of 2 Para was killed during the assault on Goose Green, a new commander was airlifted to the task force by an enhanced range C-130.

³³Ethell and Price, *Air War South Atlantic*, *op.cit.*, p. 25 and 34-5. The Victor reconnaissance gear had been procured in the 1960s, though it appears the radar mapping gear was removed from specially fitted strategic reconnaissance Vulcans. See A. Brookes, *V-Force....*, *op.cit.*, pp. 147-8.

install air refueling probes and plumbing on the Nimrods. Probes from unused Vulcans, internal piping, and small rear fuselage strakes were fitted rapidly for the first flight on April 27. By May 9, the first probe-equipped Nimrod was operating from Ascension; twelve more probe conversions were completed by the end of the conflict.

AIM-9L Sidewinders were fitted to several Nimrods and cleared for operational use by May 31.³⁴ How a Nimrod would actually fare in air-to-air combat with a fighter remains to be seen, but one senior British civil servant noted that the primary reason for the Sidewinder fitting was to comfort the crews, who flew solo sorties "a long way from home."³⁵ Finally, additional new weapons were rapidly cleared for use in the Nimrod's capacious weapons bay--these included iron bombs, BL-755 cluster bombs, the Stingray ASW torpedo (which was still in trials at the time of the war), and U.S.-supplied Harpoon anti-shipping missiles.³⁶

When the two Royal Navy carriers sailed south on April 5, they carried two squadrons totaling 20 Sea Harriers between them. Worries over possible attrition rates led to immediate British attempts to increase the size of their carrier-based fighter force. Britain had 12 remaining Sea Harriers in the UK; on April 17, 8 of these aircraft flew to Ascension (refueling from Victor tankers) and then transferred to the hastily converted container ship *Atlantic Conveyor*. These aircraft flew from this vessel on May 18 to the two carriers. Some modifications were made to these naval aircraft. Larger drop tanks were rapidly cleared for use on the Sea Harriers. Further, a new pylon capable of carrying two Sidewinders was manufactured (as opposed to the old one which carried a single missile), although it did not enter service before the end of the conflict.³⁷

³⁴"Nimrod Capabilities Enhanced", *Air International*, April 1983, pp. 172-176.

³⁵Personal communication to the author. Consideration had also been given to placing Sidewinders on Vulcans.

³⁶"Nimrod Capabilities Enhanced," *op.cit.*, pp. 175-6.

³⁷G. Swanborough, "Harriers for the Task Force", *United States Naval Institute Proceedings*, Nov. 1983, pp. 114-16.

The size of the task force's air component still did not inspire confidence and a decision was taken soon after the invasion to prepare Royal Air Force Harrrier GR.3s for operations in the South Atlantic. RAF Harriers differed substantially from Sea Harriers--they did not possess the latter's radar suite, navalized INS, non-corrosive materials, or the ability to carry the wide range of munitions available to the Sea Harrier. RAF No.1 squadron, which is normally tasked for "fire brigade" operations in the NATO theater, was selected for deployment on April 14, although the two Germany-based Harrier squadrons undoubtedly contributed aircREW and personnel.

Drainage holes were drilled in the Harrier GR.3s and some panels were sealed up to assist in resisting salt water corrosion. A new plug-in point for external power was also added. The aircraft's avionics suite was modified. An I-band transponder was added to integrate the RAF Harriers into the carriers' air traffic control system. Moreover, the firm of Ferranti developed a trolley-mounted reference system to assist the aircrafts' INS in on-deck alignment when operating from a moving platform. The latter was rushed into service so rapidly that the final software for the reference system was transmitted by satellite to HMS *Hermes*.³⁸

The GR.3s were cleared for several new types of munitions. First, the outboard pylons were wired and modified to handle Sidewinder AIM-9Ls. Other types of munitions made available included 2-inch naval rockets and 1,000 lb. laser-guided bombs (LGBs).

No.1 squadron aircREW flew to the RN station of Yeovilton to practice ski-jump take-offs. On April 22-23, RAF and RN Harrier pilots reportedly engaged in dissimilar air combat maneuvering over the English Channel with French Mirages and Super Entendards to prepare them for combat with Argentina's similar aircraft.³⁹ On April 29, RAF Harrier pilots test fired Sidewinders from their aircraft for the first time.

³⁸See R. Braybook, "Harriers Over the South Atlantic," *Air Progress*, Feb. 1983, pp. 38-44.

³⁹See Swanborough, "Harriers for the Task Force," *op.cit.*, p. 116, and "Mock Combat Preceded British Deployment," *AWS&T*, 14 June 1982, p. 24.

On May 3, approximately 15 Harrier GR.3s flew south to Ascension with 8 Sea Harriers. Six of the GR.3s joined the Sea Harriers on-board the *Atlantic Conveyer*; to reduce corrosion, they were wrapped in large plastic bags produced for this purpose by a dry-cleaning firm in the UK. These GR.3s joined the task force in the middle of May.

In the early part of June, four more Harriers flew directly to the task force from Ascension utilizing aerial refueling. This proved to be the first time that the pilots of these Harriers had ever seen, much less landed on, an aircraft carrier. Sea Harrier losses proved less than feared and hence the GR.3s were not required for air defense duties. However, they did carry out approximately 150 air-to-ground missions during the conflict.

Finally, as noted earlier, both RAF and RN Harriers during the conflict stuffed chaff bundles in the speed brake wells and between bombs and pylons to reduce the threat posed by radar-directed guns and missiles. A chaff/flare dispenser provided by the United States was made available by May 12 and apparently installed in both types of Harrier by May 20.⁴⁰

The need for airborne early warning had been widely recognized even before the task force sailed; the loss of the *Sheffield* in early May forcefully illustrated the requirement. RAF Shackletons performing this role for UK air defense were unable to provide much help in the South Atlantic and a desperate search was launched for an AEW system. The RN's last large fixed-wing capable carrier, retired in 1978, had carried a number of Gannet AEW aircraft and attempts were made to locate these aircraft. Some surprises turned up--it was discovered that a small British firm had 100 Gannet engines in storage for use as power generators, while a scrap merchant in Reigate had an unused mothballed Gannet in packing cases in his yard. Eventually, nine Gannets in varying states of disrepair were tracked down, but by this time, the MoD decided that it needed an AEW platform capable of operating from the RN's two small carriers.⁴¹ This focused British efforts on a helicopter

⁴⁰Swanborough, "Harriers for the Task Force," *op.cit.*, p. 116.

⁴¹The search for Gannets is discussed in D. Wettern, "Falkland Chickens Clucking Home to Roost," *Pacific Defence Reporter*, Vol. 9, August 1982, pp.22-3.

platform. The Westland Sea King was selected for modification. A Thorn-EMI Searchwater radar unit used for development work on the RAF's Nimrod AEW aircraft (which were not yet operational) was installed in the space of eight and a half weeks. Though the conversion was done at an impressive speed, the war was over before the AEW helicopters were finished with trials. Nonetheless, two newly created AEW Sea Kings sailed with HMS *Illustrious* to provide vital early warning services when this carrier went south to relieve the HMS *Invincible* in early August 1982.⁴²

Modifying the aircraft, of course, often entailed new roles and led to rapid aircrew retraining. For example, fitting probes on the RAF's large aircraft meant that aircrew had to learn or re-train in aerial refueling procedures. In the case of the RAF's Harriers, the pilots had previously flown from land bases in ground-attack missions; the addition of air-to-air missile armament and the initial lack of land base required these pilots to learn the use of all-aspect Sidewinders and operate from "ski-jump" carriers.⁴³ The British have long stressed the importance of highly trained military professionals for the creation of an effective fighting force. Their faith was amply rewarded during the conflict.

The aircraft conversions and crew training played a vital role in the overall success of the British campaign. Though some of the conversions, such as the Vulcan and C-130 tankers and the helicopter AEW platform, were readied too late to see action, the other efforts yielded impressive benefits. The rapid fitting of probes and extra tanks on C-130s enabled these aircraft to supply the task force with critical cargo. Adding probes to the Victors, Nimrods, and Vulcans permitted the "cascading" tanker operations and the long range reconnaissance, ASW, and bombing missions. Finally, the Harrier conversions greatly added to British combat power in the South Atlantic.

⁴²See A. Vicary, *Naval Wings: Royal Navy Carrier-Borne Aircraft Since 1916*, Cambridge: Patrick Stephens, 1984, p. 99.

⁴³After the beachhead was established at San Carlos Bay, the British built a small forward operating strip nearby for the Harriers.

SOME CONCLUDING THOUGHTS

The preceding sections have not covered the full extent of the adaptative process in the Falklands. When conducting amphibious landings, for example, all doctrinal statements stress the criticality of possessing local air superiority. The commander of the British task force, however, had to plan an amphibious landing at San Carlos Bay without air superiority. Logistical marvels became second nature. Ascension Island, for example, was transformed from a sleepy way station into a vital logistics base, with added fuel farms, pumping stations, air traffic control systems, port facilities, personnel billeting, and air defenses.⁴⁴

Yet the essential point remains unchanged. War inevitably yields the unexpected and military professionals must always prepare for the unknown. Coping with the unexpected creates great strains--standard procedures must be abandoned, doctrine changed on the spot, equipment modified, and so on--but it is precisely this ability to adapt to the unexpected that provides united Western democracies with hidden strength.

First, in their military establishments, the democracies place a great deal of stress on the role of education and the ability to think independently. This stress is expensive, given the costs of tuition and the associated "opportunity costs."⁴⁵ However, possessing educated officers and enlisted men assists the ability of our fighting forces to adapt rapidly to new tactical, operational, and political realities.

Second, the economic system of the Western democracies also provides a hidden strength. Not only have our economic systems developed industrial power of unprecedented magnitude, but the nature of the system encourages that crucial quality of adaptability. Conducting business in a competitive economy places a great deal of importance on the ability to adapt rapidly--the ups and downs of the various computer

⁴⁴ See "The Ascension Island Base" in *A Job of Work: Defence Looks at the Falklands Conflict*, November 1982, pp. 70-71, for more information.

⁴⁵ Sending officers to graduate school, for example, reduces the amount of time that they can spend training with their units.

firms being only one case in point. Again, wars yield the unknown and a nation's industry must be able to respond rapidly.

The British effort during the Falklands perhaps illustrates this process of adaptation at its most extreme--no "strategic" warning of impending conflict, no contingency plans, and an ill-suited force structure. Still, Britain's perennially troubled economy has forced the British services to "make do" with materials at hand for many decades. The Falklands conflict compressed the adaptive process greatly and in so doing, revealed a hidden strength of a united democracy--its ability to focus its hard-won intellectual and industrial power to cope with the unexpected.