

A STRATEGIC CONSIDERATION OF THE COLD WAR HERITAGE
OF THE FORMER RAF UPPER HEYFORD BASE

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79th

Fighter Squadron photograph at Upper Heyford, April 1993, in front of a F-111 prior to the Squadron closedown and closure of USAF Upper Heyford base.



Upper Heyford from 9,000ft, April 1969

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Executive Summary

The former RAF Heyford site is one of many comparable former air bases situated within England as a result of the First, Second and Cold Wars. Fairford, Greenham, Brize Norton, and Upper Heyford were selected for further development post WW2 and turned into United States Air Force (USAF) bases for the Cold War. They shared a task, equipment, design and place in social, military and economic history. Combined with land forces (Army) and maritime capability (Navy), they contributed to the North Atlantic Treaty Organisation (NATO) to provide collective defence against the Soviet Union and her allies.

During the course of the Cold War (1947-1991), over one hundred fixed wing aircraft models were employed by NATO. The F-111, pertinent to Upper Heyford, made a contribution as a nuclear bomber variant and reconnaissance platform, but served in relatively small numbers, 562, within the total NATO air-fleet.

The F-111 role was to carry nuclear bombs into enemy territory as part of the strategy of Mutually Assured Destruction (MAD). This key tenant of the Cold War strategy was replaced by a more balanced approach called “flexible response” and the Upper Heyford site was updated to make it more survivable. The hangers and command and control facilities were hardened in both design and materiel, so that in the event of attack, reciprocation would be possible. The consequent design and layout of Upper Heyford was standard across USAF bases with similar attributes.

Overall, Upper Heyford as an Air Force base and home to the F-111 played its part in the Cold War, but it was neither remarkable nor significant in its achievements within the overall context of an enduring campaign. Its most notable claim is to being the largest air base in the mid 1970s in Europe, but size is not a relative measure of importance or ability and hence is not considered further. Its role within flexible response was noted but not significant; in fact the majority of operations F-111s conducted were from forward bases and not directly from Upper Heyford. While the F-111 achieved many firsts in its history, it never carried out its primary duty of engaging the enemy with its nuclear capability. It therefore achieved the rare status of combat operations without full engagement and for this simple reason is not found in the historiography to the same degree as those that operate in their primary combat role, such as the F-16s, F-18s and the WW2 bombers such as the B-52s.

Hence, it is the unbiased findings of this report that Upper Heyford is worthy but not significant, primarily due to the magnitude of the Cold War and the relative small size of the base and its aircrafts contribution. While it has some specific features, none are the only representation. Indeed, similar facilities exist at RAF Fairford and RAF Brize Norton (both former USAF Stations) and many other former bases within the UK.

The most significant element of the Upper Heyford story is and will remain the people, servicemen and women and their families who stood in harms way and defended the NATO Alliance. They deserve our recognition and thanks, not the empty concrete skeletons of a former era of war that history has not yet decided upon. The Cold War was not won or lost and as such will struggle for its place in history as time moves on. Those who served there will remember Upper Heyford fondly, but others will look on in bewilderment to a war that never was and a set of aircraft that never did.

Premise

Making an assessment of the role and impact of Upper Heyford and its aircraft within both the Cold War and wider air operations, it can only be subjective. There are no natural statistical measurements of use that can define utility, magnitude of role or impact upon a Cold War lasting between 1945-1991.

Much has been written about the Heyford site by various vested parties. Most show a bias towards their own objectives. For example, in one heritage application the term “*global genocide pact*” is used in reference to the doctrine of Mutually Assured Destruction. While emotive, this is hardly balanced or quantifiable in its reference. Hence, this paper endeavours to steer clear of heritage policy and planning factors and considers in isolation the following questions:

- Was RAF (USAF) Upper Heyford of key significance in the Cold War?
- Did it have a vital role in nuclear deterrence and laterally in a ‘*flexible response*’?
- Did the F-111 fighter-bomber make a significant contribution as evidenced by the hardening programme of the 1970s and 1980s?

This paper will look at the Cold War in its entirety in order to get an idea of the scale within which Heyford sits. It will then consider the differing doctrines from Mutual Assured Destruction to Flexible Response to gauge if the grand strategic ideas were relevant to a single airbase and its incumbents.

It will then delve into the specifics of the site by considering both the facility as a whole, the units located within it, and the equipment’s they supported, the aircraft. It will assess if Heyford was actually on the frontline and weather or not it was regularly threatened by Soviet attack.

Finally, the paper will summarise by linking the Cold War policy with the quantifiable factors of the aircraft, people and tactics that contributed to the Cold War posture. In this way, the paper seeks to set an unbiased benchmark of comparison between Heyford and the many other former air stations within the UK that may or may not have played a similar Cold War role.

For further reference there are a series of annexes to amplify the findings and discussion in the main paper.

Introduction

Like so many airbases throughout the United Kingdom, Upper Heyford originated as a First World War RFC aerodrome constructed circa 1916. However, the site was abandoned in 1919, post war until it was redesigned in 1925 with the veritable Handley-Page Hampden Bomber equipping the 16th Operational Training Unit in 1940. The base saw active service during the Second World War and was one of a limited number of bases selected at the onset of the Cold War to be transformed into a purpose-built airbase to house aircraft of the USAF Strategic Air Command (SAC).

Post WW2 RAF Upper Heyford became the model on which airfields of its type were based during the interwar period. The transform into a purpose-built USAF base began in 1950 but no sooner had it started than the Grand Strategy and approach of the USAF changed and meant that Heyford would require new aircraft, such as the F-111E bombers. These aircraft had the ability to respond at any time and under any conditions, day or night, with the primary role of these bombers to carry intermediate range nuclear weapons.

Once developed, the area enclosed by the United States Air Force security fence operated effectively as 'Little America' and comprises about 540ha including both military and residential facilities. The airfield to the north of Camp Road, the public highway which bisects the site, includes nuclear bomb stores, runways, 56 Hardened Aircraft Shelters (HAS), including the Quick Reaction Alert, squadron buildings, Battle Command Centre and Avionics.

Throughout the Cold War, Upper Heyford housed a wide range of aircraft; reconnaissance, bombers and some fighters. By July 1971 Upper Heyford had become the largest by area 'fighter' base in Europe, equipped with the F-111E designed to deliver intermediate range nuclear weapons. The hardening of the base took place from 1979 and the arrangement of the 59 HAS sought to minimise the damage from a first strike and preserve the ability to retaliate as part of the strategy of Flexible Response (successor to Mutually Assured Destruction). Planes from the Quick Reaction

Response at Upper Heyford could have been among the first waves to respond to an attack on NATO.

With the fall of the Berlin Wall in 1989 and the collapse of the Soviet Union in 1991, the need for large numbers of USAF forces in the UK no longer existed and plans were made for significant cuts. The bases at Bentwaters, Woodbridge, Chicksands, Greenham Common, Sculthorpe, Wethersfield and Upper Heyford were closed by the end of 1993. In 2015 it was announced that Molesworth, Mildenhall and Alconbury were to be closed, leaving RAF Lakenheath the only operating USAF airbase in the UK, which will continue to host the 48th Fighter Wing. Lakenheath had originally been very similar to Upper Heyford in design, but did undergo upgrade in 1998 to represent a more varied role and be hardened and dispersed to represent the threats of the 21st century.

Upper Heyford is primarily regarded as a Cold War airbase as it closed in 1994 prior to conversion to Twenty First century warfare structures, such as those that USAF/RAF Fairford undertook; however, the significance of this modernisation programme should not be exaggerated, as the vast majority of the work was in support areas and not the aircraft hangers or systems that supported flying operations.

Detailed Historical Overview of Upper Heyford

World War I

RAF Upper Heyford began life in the days of the Royal Flying Corps in World War I. In 1916, Canadian engineers began laying out a landing field on the plateau above the Cherwell valley, west of Bicester, where airmen could train before going to the front. The airfield opened in 1918 with six hangars and a tarmac apron, as home to three squadrons of the new Royal Air Force and their Sopwith Dolphins and Salamander aircraft. From August 1918, the first two squadrons of the infant Canadian Royal Air Force were also established on the base, though the war ended before they became active. With the end of hostilities, the land was returned to New College, Oxford.

Between the wars

In 1924, the Air Council bought the land back and began building new hangars, stores and accommodation. Many of those buildings survive. The “trident” layout at Upper Heyford became the model for other early airfields, including RAF Bicester. The Oxford University Air Training Squadron moved on to the station in 1927, flying Avro 504s and Bristol Fighters. In 1936, Upper Heyford became part of Number 1 Bomber Group of the new Bomber Command. Its Long Range Development flight of Vickers Wellesleys helped develop the navigation and endurance skills that made long-range bombing missions possible. The station also played a role in research into radar, when one of its planes became the first one ever to be tracked by radio waves, via the BBC transmitter at Daventry in Northamptonshire.

World War II

The outbreak of war saw Upper Heyford return to its original training role. People from all the Commonwealth and allied nations passed through. But it continued to be involved in developing military radio and radar, and senior crews also took part in leaflet drops over occupied Europe. In 1942, Upper Heyford was briefly a base for raids of a thousand bombers on Germany’s industrial Ruhr, and Main Force raids on other targets. In the winter of 1943/4, the construction company John Laing built concrete runways for the station. The station was a target itself, so a decoy “Q” airfield was built on Otmoor to trick the enemy.

Cold War beginnings

The Cold War, unlike a “hot war” of actual battles was a state of tense conflict based on threat and brinkmanship, rather than direct military fighting. Some say it was effectively launched in 1946 by Britain’s wartime prime minister, Winston Churchill, when he made his famous Iron Curtain speech in America. He said: “From Stettin in the Baltic to Trieste in the Adriatic, an iron curtain has descended across the Continent, Warsaw, Berlin, Prague, Vienna, Budapest, Belgrade and Sofia; all these famous cities and the populations around them lie in what I must call the Soviet sphere.”

Mr Churchill said Russia’s desire for “the indefinite expansion of their power and doctrines” must be countered by Anglo-American co-operation, “with all that such co-operation implies in the air, on the sea, all over the globe.” And so began the most important period in the life of RAF Upper Heyford, though at first, only slowly.

Until 1946, Upper Heyford remained a training unit for RAF Mosquitos. Later, the 1st Glider and Paratroop Training School arrived with Dakotas, Handley Page Halifax's and Horsa Gliders. A number of those aircraft were involved in the Berlin Airlift, flying in supplies on a massive scale when the Soviets blockaded the city in 1948 and 1949. Until 1950, RAF Upper Heyford was relatively quiet. But then came the period of Mutually Assured Destruction (MAD), which also saw the building of the Berlin Wall in 1961 and the Cuban Missile Crisis.

The first Cold War

On 26 June 1950, permanent United States Air Force (USAF) bases in Britain were approved. America's Strategic Air Command worried about the vulnerability of bases in the east of England, and established four to the west, at Upper Heyford, Brize Norton, Fairford, and Greenham Common. Between 1951 and 1953, Upper Heyford was given new runways, aprons and hard standings, as well as 170 new buildings such as the innovative nose-docking sheds that allowed maintenance of the new generation of US bombers, high off the ground. Those docking sheds are now deemed to be of international significance.

The base kept its British name and was technically under an RAF base commander. With international tensions high into the early 1960s, up to 20 aircraft at each of the four western bases had to be capable of being airborne with 15 minutes of an alert.

Upper Heyford was also used by reconnaissance aircraft that gathered intelligence on Soviet radar and communications, and helped monitor Soviet nuclear tests. In the summer of 1962, they carried out air sampling at very high altitudes over test sites to see what could be learned about the latest Soviet weapons. In March 1965, Upper Heyford became part of United States Air Force Europe (USAFE), and an operating base for the 7514th Combat Support Group. French withdrawal from NATO meant US aircraft could not be based in France, so in 1966 the 66th Tactical Reconnaissance Wing of the 4th Allied Tactical Force arrived in north Oxfordshire. Strategic Air Command also brought in giant B52 bombers – for which the runway had to be widened.

The 1970s: Europe's largest fighter base

In March 1970, the 20th Tactical Fighter Wing became operation at Upper Heyford. It had three squadrons - the 79th Tigers, the 77th gamblers and the 55th Fighting Fifty Fifth, each with 24 aircraft that required 20 million dollars' construction work at the base.

By July 1971, it could be claimed that Upper Heyford was the largest fighter base in Europe. Originally, the pilots flew F-100D Super Sabres, but these were soon replaced by the F-111 Aardvark, the aircraft that became synonymous with the base (the name is pronounced F-one-eleven). Their main role was to target key installations in Eastern Europe, such as nuclear weapons sites and intelligence centres. But they were vulnerable to attack on the ground. The solution, from the late 1970s, was to build the 56 hardened aircraft shelters that now dominate the wider airfield. Each of these steel and concrete structures held a single aircraft, with a special door at the rear to allow gases to escape because they also had blast-proof walls that meant jet engines could be fired up inside them. The doors weigh approximately 85 tons. In the Quick Reaction Alert (QRA) Area nuclear-armed planes could take off within three minutes. Standby crews would sit in their aircraft for long periods, ready to fly.

The second Cold War 1980 – 1993

The Cold War entered a second major phase in the early 1980s, with the Soviet invasion of Afghanistan and the election of the strongly anti-communist Ronald Reagan as US President. The anti-war movement was also strong. Peace camps were set up around RAF Upper Heyford's perimeter fence, like the famous women's camps at Greenham Common. During four days in 1983, anti-nuclear demonstrators tried to blockade the base and 752 were arrested.

In 1984, the role of the F-111s was taken by Cruise Missiles and they switched to hunting down mobile missiles. In April 1986, aircraft belonging to the 20th Tactical Fighter Wing took off from RAF Upper Heyford to take part in Operation El Dorado Canyon – America's "self defence" bombing raid on Libya. They were used as an airborne reserve. The fall of the Berlin Wall on 9 November 1989 came to be seen by many as the beginning of the end of the Cold War. The Soviet threat was fading, and plans were made to wind-down RAF Upper Heyford.

The base remained active, though. Its F-111s were involved in Desert Storm, the first Gulf War, flying 1,798 combat sorties without a loss but based out of European air bases at the time. They

also flew operations over Bosnia. But in May 1993, it was announced that RAF Upper Heyford was to be decommissioned. Shortly after 11 o'clock on 7 December 1993, the last three F-111s took off in to a clear, blue sky. One of the planes bore the name, "68-061 The Last Roll of Me Dice."

Cold War Overview

To understand the role of Upper Heyford in the latter stages on the 20th century, it is necessary to have a wider understanding of the Cold War and why it shaped the Western World for fifty years or more. The Cold War pitted nuclear superpowers, the United States and the Soviet Union, against one another in a war that thankfully never became hot. The Cold war was concurrent to many smaller hot but limited wars, some related, some proxy and some of no consequence.

The last few months of World War II set new hostilities in motion as the Soviets competed with their Allies to be the first to liberate Axis-held territories in both Europe and Asia. At the 1945 Yalta conference, three months before Germany surrendered, Joseph Stalin, the Soviet leader, American president Franklin D. Roosevelt, and British Prime Minister Winston Churchill agreed to a buffer zone between the USSR and Germany. By 1946, Churchill, speaking at a Missouri college, was decrying a Soviet "Iron Curtain" that was turning eastern European nations, including the Soviet sector in eastern Germany, into satellite states, while projecting communist influence around the world. The Cold War was under way as a result of competition for resources and the ability to regenerate post Global War. The Cold War was also predicated on vastly different global politics with Socialism, Communism and Capitalism all facing one another.

Although the United States and Soviet Union never directly attacked one another, hence the term "cold" war, the superpowers engaged in an extremely costly arms race and spent blood and treasure in a series of "proxy" wars in Korea, Vietnam, and Afghanistan. Wars of decolonization included French Algeria, Dutch Indonesia, and French, British, Belgian, and Portuguese sub-Saharan Africa erupted in many regions still trying to throw off Western imperialism. The United States and the Soviet Union regularly used independence movements as opportunities to outdo each other by providing intelligence, arms, and covert assistance to their presumed allies. Both "proxy" and "decolonizing" wars played out in a bipolar¹ world in which the Americans and Soviets each pressed

¹ Bipolar refers to a world with just two super powers, namely American and the USSR.

the rest of the world's nations to take a side or face the consequences of a lack of collective defence. Many did so; others, including India, precariously maintained nonaligned status.

Both the United States and the Soviet Union were permanent members of the United Nations Security Council, but they also took steps to secure their own allies. The North Atlantic Treaty Organization (NATO), founded in 1949, became a mutual security body prepared to respond militarily to possible Soviet incursions. Moscow responded in 1955 to NATO's admission of West Germany by creating the Warsaw Pact, a mutual defence agreement between the Soviet Union and most eastern European nations in the Soviet orbit.

The Soviet Union intervened militarily to crush revolts in Hungary (1956), Czechoslovakia (1968), and Poland (1981) and built the Berlin Wall to prevent East Germans from escaping to the West. The United States stepped up efforts to control client nations in Central America, sometimes intervening militarily to prevent the emergence of any reform movements that were, or seemed to be, inspired by communism. Cuban revolutionary leader Fidel Castro's embrace of the Soviet Union after 1959 was a rare failure of U. S. influence in the Western Hemisphere.

The most significant but least-used weapon of the Cold War was the nuclear bomb. After the Soviets fabricated their own Atomic bomb in 1949, other nations were soon preparing to join the nuclear "club." Since then, Britain, France, China, India, Pakistan, Israel, South Africa, and potentially North Korea have built bombs or are believed to have developed bomb technology, despite international efforts to check nuclear weapons proliferation. In 1951, the United States tested an even more powerful hydrogen, or H-bomb and began expanding its fleet of nuclear-powered submarines. As the arms race intensified, both sides turned to rocket technology to create intercontinental ballistic missile systems; virtually all of these were designed to drop nuclear warheads on enemy targets or fire them from submarines.

Many historians now agree that this bilateral binge of nuclear weapons stockpiling was a major reason why the United States and the Soviet Union managed to avoid going to war with each other. The Cold War weapons build-up that produced what came to be called MAD, (Mutually Assured Destruction) certainly caused anxiety. Americans were urged to build backyard fallout shelters to protect their families from radiation. But the consequences of initial attack was complete retaliation as the time of flight for such missiles mean that an attack could be detected and responded to prior

to initial detonations. This time of fight issue was the factor that allowed retaliation and MAD, hence its simple premise of assured detection and retaliation was a perfect foil to initial assault. Social commentators constantly denude the MAD strategy, but at a time of world instability and huge pressures on the economy, the fact that a war would result in no winners ultimately kept it from happening.

During the Cuban missile crisis in 1962, American President John F. Kennedy and Premier Nikita Khrushchev squared off over Soviet installation of nuclear weapons in Cuba. War was narrowly averted, allegedly, but the likelihood that both nations could suffer deaths and damage of unprecedented magnitude helped to defuse the impasse. In 1963 Kennedy and Khrushchev signed a treaty banning aboveground nuclear testing; by the 1970s, the two nations were negotiating agreements to slow nuclear weapons development. In many ways, with enough nuclear weapons to destroy the planet, there was little need to have more. What changed, was the means of delivery and its guarantee.

After 1950, the U. S. Air Force emerged the biggest initial winner in the internal Pentagon race for resources. The biggest, most expensive improvements in both offensive and defensive weaponry focused on manned and unmanned aircraft and missiles. A design and build programme was initiated to design and fit tactical nuclear weapons² into aircraft systems, submarines and to be launched from ships. Due to speed of response and range, the aircraft systems were initially favoured, but over time, as technology developed, the fragile nature of the aircraft systems would be displaced by an at sea presence on nuclear powered submarines. Hence, when considering Upper Heyford, we can see why the base was initially developed to house the F-111 nuclear aircraft but ultimately closed as the nuclear deterrent moved primarily to sea.

Three major conflicts between 1950 and 1989 demonstrated attempts by the two superpowers (and Communist China) to “win” the Cold War militarily and ideologically. These were the Korean War (1950–53) and Vietnam War (1954–75), in which U. S. troops played a leading role, and the Soviet invasion of Afghanistan (1979–89). None of these conflicts achieved what they had intended but did maintain the Cold War tension and level playing field required for MAD to be credible.

² A tactical nuclear weapon (TNW) or non-strategic nuclear weapon is a nuclear weapon which is designed to be used on a battlefield in military situations, mostly with friendly forces in proximity and perhaps even on contested friendly territory.

With the blessing of the United Nations (during a Soviet boycott of the Security Council), the United States assembled a multinational force to repel efforts by Communist North Korea to conquer pro-Western South Korea. Soon, the new Chinese Communist regime came to the aid of North Korea, complicating any chance for a United Nations led victory. This war ended with an armistice that never became a peace treaty. Hostilities continued to break out along the DMZ (demilitarized zone) separating North and South Korea. But, the Vietnam War, while not decisive, did generate new emphasis on weapons design and while aircraft became more agile and increased range, their vulnerability was also identified and the long road to redundancy started.

Vietnam was the longest of these “proxy” contests and, for a time, made Americans question national power and the U. S. role in a world of nations. As Japan withdrew from its Asian conquests at the end of World War II, the French tried to resume colonial control in Indochina. Vietnamese leader Ho Chi Minh, a Communist, sought independence. By the time France withdrew in 1954 after a major defeat at Dien Bien Phu, the United States had assumed the role of protecting the southern sector of politically divided Vietnam from its “red” brethren in North Vietnam.

For 10 years U. S. involvement in South Vietnam drew little public attention and was carried out by relatively small numbers of military advisers and intelligence agents. These Americans were supposed to strengthen South Vietnam’s military and political structures to prevent what President Dwight D. Eisenhower called the “domino effect.” This was the idea that communism had to be contained, ideologically if possible, militarily if necessary, wherever it appeared. The American backed South Vietnamese government headed by Ngo Dinh Diem was corrupt and unpopular. In 1963 America instigated a military coup in which Diem was assassinated. In 1964, an apparent clash between North Vietnamese vessels and a U. S. warship spying in North Vietnam’s Gulf of Tonkin gave President Lyndon B. Johnson a free hand in Vietnam, despite his having no congressional declaration of war.

Militarily, Vietnam was a conflict between a massively armed superpower and guerrilla fighters known as the Vietcong. Aided by regular North Vietnamese troops and outfitted with Chinese and Warsaw Pact–supplied weapons, these fighters used their knowledge of Vietnam’s terrain, jungle climate, and people to fight on, despite U. S. attacks with napalm, a deadly defoliant, and air raids

that dropped 8 million tons of bombs on Vietnam, more than any other country had ever experienced.

Throughout Vietnam, F-111 played their part, a common variant to the Upper Heyford Squadrons, although no aircraft from the base took part directly, former base aircrew were deployed on rotation to active units.

Soviet intervention in a civil war wracked Afghanistan ended ten years later in a failure so profound that it became a factor in the breakup of the Soviet Union soon after. The American government, interpreting the Afghan conflict through a Cold War lens, provided the latest weapons, including Stinger missiles, to local warlords. A decade later, these weapons would reappear as disaffected ethnic and religious groups in Asia and the Middle East mounted both anti-American and anti-Russian attacks.

The Soviet Union started to unravel in 1989, the Berlin Wall came down, and 1991, when its last premier, Mikhail Gorbachev, resigned, some thought, briefly, that a time of peace might be at hand. In fact, the demise of a world order shaped by two superpowers helped intensify existing ethnic, religious, and political rivalries and created new “hot spots” around the globe. As old-style colonialism collapsed, especially after 1960, new wars over boundaries and resources erupted in Africa and other formerly colonized regions where Western control had distorted national development. Tribal massacres in Rwanda and the Darfur region of Sudan were only the bloodiest outcomes of warfare also afflicting Congo, Liberia, and much of West Africa. “Ethnic cleansing” occurred in Europe, as Yugoslavia, once an independent socialist state broke into warring religious and ethnic groups. India and Pakistan clashed over the disputed territory of Kashmir, becoming competing nuclear powers in the process. However, it did generate what politicians would refer to as a peace dividend and bases such as Heyford would be shut, as their intrinsic requirement was seemingly no longer required.

Hence, the Cold War provided the momentum for weapon design, base locations and a Grand Strategic concept of Mutually Assured Destruction (MAD). As such, Heyford sat within a context of world peace that could be shattered at any time. However, Heyford was just one of a plethora of bases in the UK and other NATO countries that contributed to an arms race and MAD that kept the peace due to the horrific consequences of war that could tip into nuclear conflict. The fact that all

the proxy wars ended in failure or ineptitude, maintained the balance and did their bit in preventing nuclear war. Heyford's part in this Cold War is represented in its aircraft, the F-111, its structures and its location in the UK and the West of Europe. But the Cold War was in many ways its *raison d'être*.

The Cold War was predicated on a level of destruction from which neither side could gain an advantage. This was initially articulated in the Mutual Assured Destruction doctrine. However, like all military doctrine, it was a developing concept and it often referred to as morphing into "Flexible Response" by the early 1980s. Flexible Response suggested that the use of nuclear weapons had no winners and as such tried to provide credible means to match non-nuclear escalation. The word "flexible" stressed the value of having "multiple options" available should a crisis arise. Having multiple options theoretically should be better than reference to a single response scenario. Having multiple options was thought to enhance the credibility of the NATO deterrent posture while deterring the opponent. It also allowed for a wider build up of conventional forces that America would use for hard and soft power dominance of the beginning of the 21st Century post Cold War. It also supported an American Defence Industry that craved government money whilst providing employment for up to two million servicemen and women, which in itself acted as a type of social service. Thus, conventional forces were to serve two functions, a deterrent function and the function to fight limited wars.

The basic idea of Flexible Response remained to increase the ability to confine the response to non-nuclear weapons. Heyford's role adapted slightly with more reconnaissance variants of its aircraft but it also marked the beginning of the end of the base as eventually flexible response led to a peace dividend that made Heyford redundant. Ultimately, commentators refer to "Flexible Response" as some sort of magic or wisdom in nuclear doctrine; in fact it was a small shift in posture that allowed a defence industry to grow, the government to employ more people in its military and for its conventional forces to expand and be useful in far more ways than conventional nuclear forces, that were obviously limited in their role.

The Soviet Warsaw Pact view of Upper Heyford

Unlike NATO forces, the Russian State and former USSR has no declassification timeline of 25 years. Hence, at this stage post Cold War we have no facts to base an assessment of the likely strategic

importance of Upper Heyford in the Cold War protagonist's eyes. However, we know to an accuracy of 2% how many nuclear warheads the Soviets held due to Arms Treaties. From this, we can deduce that the list of 106 probable targets at **Annex A** there would be approximately 44 specific weapons per site. If you then factor the target list by a factor of 10 (mildly ridiculous) you are left with a bomb to target ration of 4:1, which remains adequate for the denial of the Heyford facility, remembering that there is never an intent to destroy the facility, only to render it useless for a period of time, more than a month, less than six.

This pseudo statistics simply demonstrate that the USSR would have had ample warheads to target Upper Heyford many times over. However, if the bases F-111s had already taken off towards their targets, the strikes would have been nugatory. All Fighter Bomber crews new that in the event of a nuclear war, if they survived their bombing mission, their home base was 90% likely to have been destroyed in the response and hence the majority had divert runways in more remote locations for their own survival. In reality, it didn't matter where they landed as there would be no second missions.

In 1971, the UK government created a list of 106 cities, towns and military bases across the country that were deemed probable targets for nuclear attack in the event of a hot war with the USSR. The lists are held in the National Record Office (NRO) as minutes from Cabinet Office meetings and minutes from the National Security Council of the time. While the list is not corroborated by the USSR, it is deemed likely by contemporary targeting experts that the list is at least 80% correct.

The list of "probable nuclear targets in the United Kingdom" approved by the Cabinet Office was circulated to defence chiefs marked "top secret" by air commodore Brian Stanbridge on 2 May 1972. "It is not a comprehensive list of all targets likely to be attacked in the event of general war," he wrote. It included 38 towns and cities, 37 UK and US air bases, 25 control, communications and radar facilities and six naval sites.

An annex to his memo quoted an estimate from the joint intelligence committee that the Soviet Union could launch an initial nuclear strike against the UK with 150 land-based missiles, plus an unknown number of submarine-launched missiles. "They are unlikely to be inhibited by the question of overkill," it warned.

Estimates of Soviet nuclear strikes used "similar planning assumptions to those which we ourselves might use," the annex stated. "Thus, it is likely that the enemy would aim to achieve a minimum of 50% damage expectancy with a 90% or more assurance factor."

London was expected to be devastated by two to four bombs of up to five megatons each exploding over the city. Glasgow, Birmingham and Manchester were each said to be in line for one or two "airbursts" of up to five megatons. That's 333 times more powerful than the 15-kiloton US nuclear bomb that flattened the Japanese city of Hiroshima in August 1945, killing 140,000 people.

There were disputes about some of the estimates, with one memo pointing out that Home Office scientific advisers "find it difficult to see why an enemy would wish to deliver a three-megaton attack on Swansea and on Leicester when, in their view, one megaton on each target would be sufficient to cause almost complete destruction of those cities."

Other targets included a NATO radio station at Anthorn in Cumbria and US naval communications installations at Thurso in Caithness and Londonderry in Northern Ireland. Nuclear submarine bases on the Clyde near Glasgow were on the list, along with nuclear airfields such as Upper Heyford, Greenham Common and Machrihanish.

Other high-level memos from 1971 said that the target list was drawn up for military planning purposes and to help "contingency planning particularly in the field of home defence". Home defence meant protect and survive measures such as shelters to help civilians under nuclear attack.

Kristan Stoddart, a nuclear historian from Aberystwyth University, suggests that the UK was a priority target for the Soviet Union in the 1970s because it was the only state in Western Europe that was part of NATO's military structure. France had left in 1966. He said: "For a country the size of Britain there was no civil defence against large-scale nuclear attack, anything else was a myth. The list of 106 probable targets, including Upper Heyford is at **Annex A**.

The physical location – Upper Heyford – Oxfordshire

RAF Upper Heyford is the only base in the world that had an aircraft named after it. The Handley Page Heyford was a twin-engine bi-plane bomber that saw service 1934-1941. Although it had a

short service life, it equipped several squadrons of the RAF as one of the most important British bombers of the mid-1930s, and was the last biplane heavy bomber to serve with the RAF. The aircraft was named after its first operational deployment from RAF Upper Heyford, 1934.



Handley Page Heyford

The base is positioned on a leeward hill / rise, giving a flat 2,800m runway and adjoining taxi-way. The prevailing wind directions were steady and usually easterly. The runway was unimpeded from either direction and navigationally easy to find with the local landmarks of Oxford and Banbury sitting either side of it North South. It was just over 1,000 nautical miles to Moscow, achievable in a F-111, direct, in less than 30 minutes.

In response to what was perceived as a growing worldwide threat, the United States Strategic Air Command decided to house a strong force of American bomber aircraft in Western Europe in order to reduce their notice to effect when required. It was decided to convert four existing airfields in and around Oxfordshire to serve as regular air stations as. Upper Heyford was one of those selected, with the others being Brize Norton, Fairford and Greenham Common. All had existing infrastructure and sat within existing air defence warning radar systems so that in the event of non-nuclear attack, there would be some initial early warning.

The USAF leased the air base from the Ministry Of Defence as part of the North Atlantic Treaty Organization alliance. The first deployments in 1952 were the USAF's Strategic Air Command B-47 bomber aircraft, which arrived at the four bases and stayed until 1965. The 66th Tactical Reconnaissance Wing (TRW) took up residence with the RF-101C "Voodoo" until 1969. By the mid-1970's, the F-100's of the 20th Tactical Fighter Wing (TFW) arrived and were replaced soon after by the F-111E, "Aardvark".

Upper Heyford played a small part in wider NATO nuclear deterrence. It was geographically well placed, along with its sister bases, and housed a credible set of both bomber and reconnaissance

aircraft. The air station housed all the requisite facilities to train, sustain and project the force. While initial facilities required hardening in 1979, the remaining HAS ensured a degree of counter attack ability if required. The “Americanisation” of the base was common in the late 1960s and 1970s in order to make life easier for the American personnel based far from home. It did play incongruously with the local people of Oxfordshire, who were forever fascinated by the presence of “Yanks” in their sleepy village. However, it provided employment for many hundreds of local the local population, who all experienced a small slice of American Pie.

The base was not hidden or secret in any way, and as such was an overt and obvious deterrent base. The aim of MAD was to ensure that any hostility would be met with assured counter measures and hence NATO spent much of its time advertising its strengths in exercises and demonstrations of its power, range and capability to endure.

Upper Heyford played its role with a series of summer festivals in which local people were allowed onto the base. Journalists from joined them across the world that was deliberately allowed to publicise the base capabilities. These overeat demonstrations stopped in 1974, once the degree of hardening of the HAS was deemed to be more classified. Even though the public didn't get too near the actual operational side of the base; the risk was considered too great.

To quantify Upper Heyford’s place in deterrence is difficult. It was undoubtedly a credible airbase, with long runways and hardened facilities to extend the life of its aircraft and personnel. But it was no different from the majority of other USAF bases in Oxfordshire and Scotland, all of which played their part in the overall deterrence effect required by NATO. In thorough investigations, there is no reason to mark our Upper Heyford as more or less significant.

While it deployed a key capability in the F-111, as will be explained later, it never acted in anger with its nuclear capability or indeed fly direct to any battlefield mission. Its layout and orientation was standard for USAF bases of the time and indeed its facilities were relatively “random” as they were compelled to fit within existing RAF buildings from the 1930s. Hence, Upper Heyford, Brize Norton and Greenham Common all show vagaries, but not for operational reasons.

Overall, Upper Heyford’s role in the Cold War changed little. It was one of a series of USAF bases that would respond or initiate a nuclear attack or response. It is hard to quantify its contribution in

a war that never happened, but the fact that it was just one of many such bases, all quite unremarkable, suggests that its role was important but not significant. After many research hours, there is simply nothing that makes Upper Heyford more significant than any other USAF or RAF base of the Cold War era.

As will be discussed in the section on the Aircraft, the location of Upper Heyford suited the Cold War, but as the Berlin Wall fell, its location was too far west to influence the discretionary wars of the Middle East and as such, aircraft were forward mounted and flew out of other air stations, negating Upper Heyford's role.

Looking beyond Upper Heyford, there were comparable USAF air bases at a multitude of locations, such as: Alconbury, Barford St John, Bentwaters, Woodbridge, Burtonwood, Blenheim Crescent, Chelveston, Chicksands, Croughton, Fairford, Feltwell, Greenham Common, Lakenheath, Manston, Little Rissington, Menwith Hill, Mildenhall, Molesworth, Sculthorpe, Shepherds Grove, Upwood, Welford, & Wethersfield. See **Annex D** for full details. These bases all deployed aircraft in either reconnaissance, bomber or fighter roles, some with nuclear capability as discussed earlier. They all have geographic commonalities and provision for extended runways, some degree of hardening and the command and control systems to enable the aircraft. Based mostly to the south of England, they were all in range of Eastern Europe, even though most flight routes went north East from their bases to cut across Scandinavia before routing into the USSR. Scottish bases were not initially considered due to inclement weather, which could have interfered with operations and the extra journey time to target.

Of these twenty-three other bases, research has discovered no compelling reason to rank one above the other in terms of operation impact, base design, personnel or overall contribution to the Cold War. They are deliberately nondescript locations with significant resources poured into them, but with discernable advantage. This should not be a surprise, as a ranking system would no doubt have been reflected in Soviet targeting.

Beyond the UK, the USAF had 16 bases in West Germany thus: Ahlhorn Air Base, Berlin Tempelhof Airport, Bitburg Air Base, Erding Air Base, Frankfurt Air Base, Fürstenfeldbruck Air Base, Giebelstadt Air Base, Hahn Air Base, Leipheim Air Base, Neubiberg Airfield, Ramstein Air Base, Sembach Air Base, Spangdahlem Air Base, Wiesbaden Air Base, Wüschheim Helipad & Zweibrücken Air Base.

These bases augmented USAF strike capability and could respond quicker than UK bases, but were far more vulnerable to special forces attack and high speed missiles that could destroy aircraft on the ground prior to take off. Hence, the UK may have lacked the numbers of aircraft, but they had added protection from being further from the enemy.

Finally, when not concerned with nuclear war, Upper Heyford also had a role in reconnaissance and fighter operations. Its reason for being was nuclear proliferation but it did contribute, especially after the Cold War to conventional operations. However, once the Iron Curtain had fallen, German air bases were better positioned for unrest in the Middle East and hence the eventual closure once the Cold War was declared over. The reconnaissance missions supported by the F-111 are detailed later in the specific section.

Hardened Aircraft Shelters (HAS)

The HAS that are often quoted as “exceptional” are anything but as they were replicated across many USAF bases in the UK and indeed, similar designs are still in use at RAF Lossiemouth and were retired at RAF Leuchars in 2013.



RAF Leuchars (left) and Upper Heyford (right) HAS comparison

HASs are a passive defence measure in that they limit the effect of an attack, as opposed to active defences such as Ground Based Air Defence (GBAD) systems, which aim to prevent or at least degrade enemy attacks. The widespread adoption of hardened aircraft shelters can be traced back to lessons learned from Operation Focus, the 1967 Arab-Israeli Six-Day War when the Israeli Air Force destroyed the unprotected Egyptian Air Force, at the time the largest and most advanced air force in the Arab world, at its airbases.

The Cold War drove the conversion to HAS as both sides looked to improve the survivability of their forces upon attack so that they could have retaliatory or second strike option. Consequently, NATO and the Warsaw Pact built hundreds of HASs across Europe.

In this context hardened aircraft shelters were built to protect aircraft from conventional attacks as well as nuclear, chemical and biological strikes. They were designed to withstand a direct hit by a 500 lb bomb, or a near miss by a 1,000 lb bomb. In theory HASs were also built to protect aircraft in a nuclear strike; however, the effect of such an attack on airfield taxiways, runways, support facilities and personnel would have made any retaliatory mission extremely difficult and rearming almost impossible.

Advantages

- Reduces vulnerability of aircraft to all but the most accurate precision weaponry.
- Combined with active airfield defences increases survivability of defender's aircraft and cost to enemy's forces.
- An alternative option, dispersal of aircraft to many different bases, reduces the efficiency of aircraft at both squadron and air force level.
- Nuclear weapons can be stored in the HAS near the aircraft, in a vault; e.g., the United States Air Force Weapons Storage and Security System (WS3).

Disadvantages

- They are in a fixed known position.
- Hardened shelters are expensive.
- Hardened shelters are usually too small to easily accommodate large aircraft such as strategic transport aircraft and large surveillance aircraft.

- Time taken for construction requires forward planning regarding most likely combat zones. If a conflict flares up quickly aircraft may be afforded no protection; e.g., in both the Gulf War and 2003 Iraq War many coalition aircraft had only sun shelters, not hardened facilities.
- When first developed, the likelihood of a direct hit was minimal. Today, with precision-guided munitions (PGMs) and adequate training, delivering a direct hit on a HAS is trivial. Coalition aircraft destroyed over half of Iraq's HASs during the Gulf War.

Hence, while the proliferation of HAS continued throughout the Cold War, they have become a relic of the era now, as there is no longer any way to defend from precision weapons in the 21st century. What they do show is the propensity to defend well, as beholden to the Cold War mind-set.

The people who served at Upper Heyford

It is impossible to say how many service men and women of differing forces served at Upper Heyford over its lifetime; over half a million is reasonable. The units and squadrons will be discussed in the next section, but what is surprising is that in its lifetime as an active base in service with both American and British Air Forces, there are no significant former base officers of particular note. Only the American Major General Gary A Voellger stands out as remotely significant. His full biography is an **Annex C**, but as a former commander of the 55th Tactical Fighter Squadron, July 1984 - July 1987, and assistant deputy commander for operations, 20th Tactical Fighter Wing, Royal Air Force Upper Heyford, he went on to the rank of Major General and retired in 2001.

Despite much time and energy, no further senior officers have been identified as having spent significant time at Heyford. In itself this is not exceptional, but it does denude the base of an alternative and engaging social history story.



Half a Century of Flying marked by the Heyford Observer, 13 May 1967.

What is not recorded in any detail is the rank and file that served at Upper Heyford in its USAF tenure. The air crew, the maintainers, the air trafficers and weapons experts, the communicators, medics, teachers and chefs all played their part in assuring MAD and latterly Flexible response. Their story contains the truly unique and telling tale of warfare in the later stages of the 20th century; it should be told somehow.

The United States Air Force at Upper Heyford

Headquarters, 20th Tactical Fighter Wing relocated from RAF Wethersfield to RAF Upper Heyford on 1 June 1970. For the first time since it left Virginia in 1952, all three of its flying squadrons were united on one base. Less than three months later, the wing began converting to a new aircraft, the General Dynamics F-111E. On 12 September 1970, the first two F-111Es arrived at RAF Upper Heyford. The last of the 20th's F-100s transferred to the Air National Guard on 12 February 1971 and in November of that year the wing's F-111s were declared operationally ready.

The 20th TFW participated in F-111 NATO and US unilateral operations Shabaz, Display Determination, Cold Fire, Ocean Safari, Datex, Priory, Reforger, Dawn Patrol, Highwood, Hammer, and others from January 1972 to October 1993.

The wing gained a fourth flying squadron on 1 July 1983, with the activation of the 42d Electronic Combat Squadron. On February 1984, the first Grumman (General Dynamics) EF-111A Ravens of that squadron arrived at Upper Heyford. Parental responsibility over the 42d by the 20th TFW was short-lived, however, and on 1 June 1985, operational control of the squadron shifted to the 66th Electronic Combat Wing at Sembach Air Base, West Germany.

In March 1986, the 66th Electronic Combat Wing detached the 42d Squadron to the 20th to take part in Operation Eldorado Canyon, the raid on Libya. On 14 April 1986, 5 EF-111As and 20 F-111Es took off from RAF Upper Heyford as part of the attack force. They were used as an airborne reserve for the F-111Fs of the 48th Tactical Fighter Wing, RAF Lakenheath. Three EF-111s (two were spares and turned back) formed up with the 48th's F-111Fs and provided electronic defence during the attack on Tripoli. Air refuelling support was supplied by KC-135s from the European Tanker Task Force based at RAF Mildenhall. USAFE initiated the Project Power Hunter intelligence network in December 1987. The wing first tested the Durandal runway-buster bombs during Exercise Red Flag, in January and February 1988. All three fighter squadrons deployed to Incirlik Air Base, Turkey for Weapons Training Deployment on Konya Range from March to May 1989.

The 20th deployed aircraft and personnel to Southwest Asia and Turkey, providing tactical and electronic combat operations against Iraq from 17 January 1991 – 28 February 1991. It won the 1991 Gunsmoke tactical gunnery competition in the F-111 category. The wing was relieved of electronic combat mission on 1 July 1992.

Operation Desert Storm

The 20th had aircraft deployed to Incirlik Air Base, Turkey for a weapons training deployment in August 1990, when Iraq invaded Kuwait and Desert Shield started. As the start of the air campaign neared, the wing reinforced its presence as all US aircraft at Incirlik were incorporated into the provisional 7440th Composite Wing, for the duration of the war. The wing also deployed four 42d ECS EF-111As and 80 personnel to Taif, Saudi Arabia, to support Operation Desert Storm. On 25 January 1991, the wing was once again up to four flying squadrons when the 42d Electronic Combat Squadron was reassigned to the 20th from the 66th Electronic Combat Wing.

On 16 January 1991, a 42d ECS EF-111A, operating from Taif, was credited with the first aerial kill of the war. It was attacked by an Iraqi Mirage fighter while flying a night mission near the Saudi-Iraq border. To defeat the Iraqi fighter, the EF-111A descended to minimum altitude on its Terrain Following Radar. The Mirage slammed into the ground while trying to follow the EF-111A. On 17 January 1991, 20th TFW aircraft launched combat missions from both Turkey and Saudi Arabia and continued flying combat missions until the cease-fire.

The F-111s flying from Turkey flew night missions throughout the war, using the TFR to penetrate the dense antiaircraft artillery environment at altitudes around 200 feet (61 m) for the first few nights. Crews who flew those first few terrifying nights said that the illumination from the AAA was so bright that they didn't need the TFR to avoid the ground. After the missile threat was suppressed, crews flew their attacks at altitudes around 20,000 feet (6,100 m), above the range of most Iraqi AAA systems.

During the war, the F-111s attacked a range of targets, including power plants, petroleum refineries, airfields, nuclear-biological-chemical processing and storage facilities, and electronics sites throughout northern Iraq, using 500 and 2,000 pound conventional bombs, and CBU-87/89 cluster bombs. Wing EF-111As flew both day and night missions, providing direct and stand-off jamming for all coalition air forces. The skill and conspicuous bravery of wing aircrews was recognized in the award of numerous Silver Stars, Distinguished Flying Crosses, and Air Medals.

By the end of the conflict Saudi-based EF-111As had flown 219 combat missions, totalling 1,155 flying hours. The wing's 6 EF-111As based in Turkey flew 252 combat missions, totalling 704 hours, while the 23 F-111Es at Incirlik flew 456 combat missions, totalling 1,327 combat hours. When Desert Storm ended, the wing had deployed 458 personnel, flown 1,798 combat sorties without a loss, and dropped 4,714 tons of ordnance.

After the Cold War

The 20th Tactical Fighter Wing, along with the associated 55th, 77th, and 79th Tactical Fighter Squadrons were re-designated the 20th Fighter Wing and 55th, 77th, and 79th Fighter Squadrons on 1 October 1991.

20th Fighter Wing aircrews participated in Green Flag '92 from 27 February – 13 April. This gave most of the wing's aircrew the opportunity to deliver GBU-12 laser-guided bombs in a near-combat environment. On 31 March 1992, the 20th Operations Group was formed, inheriting the lineage of the 20th Fighter Group and having the fighting squadrons assigned to it. In May 1992, the 55th Fighter Squadron deployed to Aviano, Italy for Dragon Hammer '92. The last EF-111A departed RAF Upper Heyford in August 1992.

The wing celebrated the 75th anniversary of the 55th Fighter Squadron 7–9 August 1992. Then, from 4–7 February, additional celebrations were held for the 79th Fighter Squadron and in early March for the 77th Fighter Squadron.

The wing team deployed to Green Flag '93 at Nellis AFB, Nevada from 2 March – 2 April 1993. The first day-night Green Flag incorporated night low level operations and live weapons delivery. The 79th Fighter Squadron inactivated on 23 April 1993, with the last aircraft departing RAF Upper Heyford on 10 May.

On 4 June 1993, the 77th Fighter Squadron participated in Excalibur '93 taking first place by beating all other USAFE units, including F-15Es and F-16s. The 55th Fighter Squadron participated in the Aalborg Airshow, Denmark, from 4–7 June 1993.

On 9 July 1993, the 77th Fighter Squadron inactivated. The last aircraft departed in August. The 55th Fighter Squadron deployed 6 aircraft to Incirlik Air Base, Turkey, for Dynamic Guard '93, from 20 September – 8 October 1993. This was the last operational deployment for the 20th Fighter Wing while at RAF Upper Heyford.

The last of the fighter squadrons, the 55th, inactivated on 15 October 1993. On 19 October 1993, F-111D 68–120 went to the Imperial War Museum at RAF Duxford where it is now on display alongside Happy Jack's Go Buggy, a 79th Fighter Squadron P-38 (68–120 is painted as "The Chief" – it was the wing's alternate flagship). The last of the wing's three aircraft departed RAF Upper Heyford on 7 December 1993. The flagship of the 55th Fighter Squadron, F-111E s/n 68-0055 nicknamed "Heartbreaker" departed first. It went to Robins Air Force Base, Georgia, where it is now on display. The next aircraft, F-111E s/n 68-61 "The Last Roll of The Dice", departed for the Davis-Monthan Air Force Base "boneyard" (now FV0198). Finally, F-111E s/n 68-20 "The Chief" flew to Hill Air Force Base, Utah where it is now on display at the Hill Aerospace Museum.

In its last years at Upper Heyford, the F-111 finally showed that it was a mature system. The 20th's F-111Es had their best maintenance statistics in 13 years in 1992, and the best maintenance statistics in F-111 history in 1993. The fully mission capable rate surged to 88.8%, while cost per

flying hour dropped from \$1,136 to just over \$700. Also the wing scored an Excellent on its Nuclear Surety Inspections for 1991 and 1993.

On 15 December 1993, the flight line at RAF Upper Heyford was closed. It moved without personnel and equipment from the UK to South Carolina on 1 January 1994, inheriting the personnel and equipment of the 363d Fighter Wing.

Fighter and bomber aircraft development leading to the F-111

The United States' first operational turbojet fighter was the straight-wing F-80 Shooting Star, deliveries of which started in 1945, just too late to see service in the Second World War. It had a maximum speed of about 950 km/h, little better than the last of the propeller-driven fighters, and survived long enough to become heavily involved in the early days of the Korean War. It was, however, quickly succeeded by the F-84 Thunderjet, which served at Upper Heyford, also with a straight wing, but with a much higher performance. Some 3,600 of these were built, many of which were exported to NATO countries in the early 1950s.

Design of the first swept-wing interceptor, the F-86 Sabre, began in 1945, with the first prototype flying in 1946 and service deliveries starting in 1948 – a rate of progress that would have been inconceivable thirty years later. The F-86 was the most successful fighter of its day and, with a maximum speed of just over 1,000 km/h and armed with a mixture of guns and rockets, it proved superior to the Soviet MiG-15, which it met in combat in the skies over Korea. The F-86 also became widely used in NATO, being produced in Canada and Italy as well as the United States. Even the UK, which was suffering a delay in production of British-designed fighter aircraft, was forced to operate a number in the early 1950s. Also widely used at this time was the F-84F, which had been created by fitting swept wings to the F-84 Thunderjet, in place of the earlier straight wings; some 2,713 were built, again, many of them for NATO countries.

Meanwhile, intense efforts were being made to exceed the speed of sound, which was eventually achieved in October 1947. Thereafter numerous fighters were able to exceed Mach 1 in a dive, but in 1949 a programme was started to develop the first operational fighter capable of exceeding the speed of sound in level flight.

During the late 1940s the pace of these and many other development programmes both in the USA and the UK was as rapid as peacetime conditions allowed, but when the Korean War broke out, and in particular when the MiG-15 was encountered, all military programmes, especially those involving new technology, were greatly accelerated. The F-100 Supersabre programme was one of those affected; the first flight took place in May 1953, and production aircraft, which had a maximum speed of 1,390 km/h, began to reach squadrons in October of that year. Unfortunately, as happened in many of the programmes rushed through in the early 1950s, the aircraft hit snags and had to be grounded in November 1954 to enable major modifications to be carried out. By the time production ended, however, 2,294 had been produced and the type had been sold to several NATO air forces. It started to leave service in the mid-1960s, but remained with the US air force long enough to take part in the Vietnam War.

In the early 1950s there was rising concern in the USA that the Soviets were developing long-range bombers, which would be capable of reaching the continental United States. This led to a requirement for a high-performance interceptor, and the resulting F-102 Delta Dagger became the only delta-winged fighter to operate with the USAF and the first to be designed as a 'weapon system', where the aircraft became relatively less important than the avionics that controlled it. Work started in 1952 and the first prototype flew in October 1953, when it exhibited very disappointing flying characteristics, leading to a total redesign. The revised design proved satisfactory and was placed in production, with 875 single-seat fighters and 63 two-seat trainers being delivered within twenty-one months.

The F-102 design was modernized to produce its replacement, the F-106 Delta Dart, which entered service in 1959, but only after further and lengthy development problems. Once these were solved the F-106 served as the continental USA's only manned interceptor, the last squadron standing down in 1991, exactly thirty years after production had ceased.

The General Dynamics F-111 started life as the TFX (Tactical Fighter, Experimental) programme in an effort to produce a long-range, high-performance attack aircraft which would meet the needs of the US navy, Marine Corps and air force, and which would also, it was hoped, obtain large overseas orders. The key design feature of the F-111 was its swing wing, and the programme started in 1960, with the first flight in 1964 and initial service delivery in 1967. From the start, however, the programme was beset by problems, which ranged from excessive aerodynamic drag, through ever-

escalating weight and cost, to inter-service rivalry. The problems were eventually overcome, and the F-111 fighter and the FB-111 strategic-bomber version became very successful and capable aircraft, although they were only ever purchased by the air force. The FB-111 was also due to have been ordered by the British air force in place of the abandoned TSR-2, but this order was cancelled and the only overseas order was for twenty-four from Australia. Hence, the F-111 was the natural evolution to gain speed and altitude performance with the range to deliver tactical nuclear payload. Its genesis in the F-80 shooting star is obvious as is its swept wing design.

The Aircraft of Upper Heyford

During USAF use of Upper Heyford, many types of aircraft were deployed on employed at the base. Of note were the five main aircraft that made up the bulk of tasking and active duty squadron airframes. They consisted of two variants of the F-84, the F-100 and then two variants of the F-111 as shown below.

- Republic F-84G Thunderjet (1948–1955)
- Republic F-84F Thunderstreak (1955 - 1957)
- North American F-100D Super Sabre (1957–1971)
- General Dynamics F-111 Aardvark (1970–1993)
- General Dynamics-Grumman EF-111 Raven (1984–1992)

As the base was primarily considered a tactical nuclear bomber base this next section will concentrate on the F-111 and its two initial variants that are synonymous with Upper Heyford. While it was based at other locations temporarily, its main home was Upper Heyford

The impact of the F111 within the overall Cold War can only be a subjective assessment. Amongst NATO it was one of approximately 55 aircraft types employed as a recce or bomber configuration during the bulk of the Cold War. It was an aircraft of limited manufacture, 562 built; see **Annex E**, and limited role due to its bold design and mixed ability. Post 1980, the vast majority of airframes were employed in one specific role, while the F-111 was adequate at both recce and bombing, it was a master of neither. For recce the AWACS was superior, for strategic (nuclear) bombing, it was not a far ranging and capable as the UK equivalent, the Avro Vulcan Bomber. The full history of the F-111 and all its variants is at **Annex F**.

EF-111A "Raven"

Nicknamed the "Raven," the EF-111A is the newest aircraft to join the 29th Tactical Fighter Wing and the first of its kind in NATO. The first "Raven" arrived at RAF Upper Heyford in February 1984 and will be flown by members of the newly formed 42nd Electronic Combat Squadron.

Equipped with a variety of radars and high-powered jamming transmitters, the "Raven" is designed to provide electronic countermeasures support of tactical air forces. It can detect, sort and identify different enemy radars observing an attack force and using its jamming transmitters, make the threat radars ineffective, preventing interception by hostile air defenses.

In a typical mission, several orbiting EF-111As could use their vast jamming power to create an electronic barrier to mask the movement of friendly aircraft from hostile radar detectors, enabling them to refuel and regroup undetected.



(above) 29th Tactical Fighter Wing aircrew accepts first EF-111A "Raven." (left) "NATO Raven One" (below) EF-111A in flight.
(U.S. Air Force photos)



A page from the Heyford Air Show programme 9 June 1984.

Conclusion

RAF Upper Heyford, during the Cold War, made a noteworthy contribution to the defence of NATO Countries with its comprehensive range of aircraft, flight crews, maintenance teams and command and control centres. It was a busy, active base that housed over 8,000 service men and women and their dependants at any one time.

It had hardened shelters built, deployed niche aircraft and trained with new technology at the heart of deterrence. However, it was not remarkable in itself as it formed but one cog of a number of similar air bases across Western Europe, which together provided the collective defence of Mutually Assured Destruction and latterly Flexible Response.

Whilst it was home to many different aircraft, the F-111 Aardvark and Raven were two key equipment's of the Cold War. They were recognisable and specific to their Electronic Warfare role and nuclear delivery capability. But, they were not unique or significant when compared to the thousands of other aircraft with similar missions, stationed across Europe, in an effort to maintain a stable status quo and prevent mutual destruction. The F-111 had had a difficult design and birth, the son of a compromise between Air Force and navy projects. While it eventually delivered a key capability, it should not be forgotten that for over 75% of its service life, it was not a guaranteed asset due to its poor serviceability.

In the context of its level of significance during the Cold War it is impossible to quantify. Its buildings, structures and what it achieved were not remarkable at all; in fact they were replicated many times over. The timing of the base has allowed much of the former Cold War attributes to remain, but they are not what achieved an end to war with the USSR, that is vested in the people, pilots, families and commanders that fought the systems, deployed overseas, put themselves in harms way and ultimately kept the peace in Western Europe.

Ultimately, what undermines Upper Heyford's importance is the failure of its systems. While nuclear war was averted, the hardening of the hangers, the development of the F-111 and the overall utility of air delivered nuclear bombs was eventually replaced by an at sea deterrent that could not be struck first and could not be interdicted. While Upper Heyford had held the line for

some time, ultimately, technology moved on and its capabilities were forgotten as relics of a war that never was.

While the base and its associated equipment is important, the true debt of gratitude should be placed at the people who made it happen. The physical site will somehow always be associated with these remarkable people, but it was the human being that won, not the concrete, aluminium or paper that makes up an air station. Any commemoration or celebration should be focused on the people, not the site; lest we forget.

ANNEX A - PROBABLE UK NUCLEAR TARGETS IN 1972

A redacted list from the National Archives

Towns and cities: Glasgow, Birmingham, Liverpool, Cardiff, Manchester, Southampton, Leeds, Newcastle/Gateshead, Bristol, Sheffield, Swansea, Hull, Teeside, Coventry, Wolverhampton, Leicester, Stoke-on-Trent, Belfast, Huddersfield, Sunderland, Gillingham, Rochester, Chatham, & Maidstone.

Centres of government: Central London, Cheltenham, Edinburgh, Nottingham, Catterick, York, Preston, Cambridge, Dover, Reading, Salcombe, Brecon, Kidderminster, & Armagh.

Royal Air Force bases: Scampton, Waddington, Honington, Wittering, Marham, Coningsby, Lossimouth, Finningley, Bedford, Kinloss, Manston, Wattisham, Cottesmore, Wyton, St Mawgan, Machrihanish, Leeming, Valley, Brawdy, Coltishall, Yeovilton, Leuchars, & Binbrook.

United States Air Force bases: Alconbury, Bentwaters, Woodbridge, Wethersfield, Lakenheath, **Upper Heyford**, Fairford, Boscombe Down, Pershore, Greenham Common, Mildenhall, Sculthorpe, Cranwell, & Lyneham.

Early Warning radar stations: Flyingdales, Boulmer, Patrington, Bawdsey, Neatished, Buchan, Saxa Vord, Staxton Wold, Feltwell, & Orford Ness.

Military command and control centres: Northwood, Plymouth, Pitreavie, Fort Southwick, High Wycombe, Ruislip, Bawtry, & West Drayton.

Naval communications centres: Rugby, Criggion, Anthorn, Inskip, New Waltham, Londonderry, & Thurso.

Naval bases: Faslane, Coulport, Holy Loch, Rosyth, Portsmouth, & Devonport.

ANNEX B – SELECTED PHOTOGRAPHS OF RAF UPPER HEYFORD

EF-111A tail number 66-0049 of the 42nd Electronic Combat Squadron, 20th Tactical Fighter Wing (USAF) RAF Heyford, 1984.



Ef-111 “Raven” of Upper Heyford. The 42nd Electronic Combat Squadron, assigned 66th Electronic Combat Wing (USAF) attached to the 20th Tactical Fighter Wing (USAF) RAF Heyford.



1972 NATO USAF Silver Anniversary Air Show, Upper Heyford.



ANNEX C – BIOGRAPHY OF MAJOR GENERAL VOELLGER – MOST SENIOR RANKING FORMER COMMANDER AT UPPER HEYFORD

Note Heyford relevant items in **Bold**

Major General Gary A Voellgers last mobilised appointment was the NATO force commander, Headquarters NATO Airborne Early Warning Force, Mons, Belgium. He was responsible for the operational support of both the Supreme Allied Commander Europe and the Supreme Allied Commander Atlantic through the provision of airborne surveillance and control platforms. In this capacity, the commander ensured the NATO Airborne Early Warning Force was organized, trained, supported and ready to implement major NATO command's directives.

Commissioned through the Air Force Reserve Officer Training Corps program, the general started his Air Force career as a personnel officer and subsequently completed both undergraduate navigator and pilot training. He served at all levels in the U.S. Air Force, from squadron through Headquarters U.S. Air Force. His assignments covered most of the United States and were supplemented by multiple tours in Europe and Asia. The general qualified on the **F-111**, **F-117**, F-4, E-3 airborne warning and control system aircraft, KC-135 tanker, C-21, and the C-141 and C-17 airlifters. A combat veteran, he participated in the war in Southeast Asia, the 1990 incursion in Panama and the 1991 Gulf War. During operations Desert Shield and Desert Storm, he commanded the 552nd Air Control Wing where he led the largest and most successful deployment in AWACS history when 1,200 E-3 aircrew members, maintainers and support personnel implemented the most complex command, control and communications architecture ever used in war. The general also commanded the 92nd Air Refuelling Wing, where he built the largest of Air Mobility Command's core tanker wings, and the 437th Airlift Wing, where he helped prove the outstanding military utility of the C-17 during the Bosnia airlift. During his tenure as AMC's director of operations, he reinstalled a focus on combat readiness, greatly enhancing the command's ability to execute worldwide expeditionary air force missions. He also introduced processes and procedures that led to the most significant improvement of business practices in the command's history.

ASSIGNMENTS:

1. September 1967 - January 1969, personnel officer, 379th Combat Support Group, Wurtsmith Air Force Base, Mich.
2. January 1969 - October 1969, student, undergraduate navigator training, Mather Air Force Base, Calif.
3. January 1970 - June 1970, weapons systems officer, 46th Tactical Fighter Squadron, MacDill Air Force Base, Fla.
4. July 1970 - January 1972, weapons system officer, 91st Tactical Fighter Squadron, Royal Air Force Bentwaters, England.
5. January 1972 - December 1972, student, undergraduate pilot training, Laredo Air Force Base, Texas.
6. January 1973 - May 1973, **F-111 transition training**, Nellis Air Force Base, Nev.
7. June 1973 - April 1974, F-111 pilot, 428th Tactical Fighter Squadron, Takhli Royal Air Force Base, Thailand.
8. May 1974 - July 1979, **F-111 instructor pilot**, flight commander and standardization and evaluation flight examiner, 523rd Tactical Fighter Squadron and 27th Tactical Fighter Wing, Cannon Air Force Base, N.M.
9. August 1979 - June 1980, student, Air Command and Staff College, Maxwell Air Force Base, Ala.
10. July 1980 - June 1984, air operations staff officer, politico-military affairs officer and assistant deputy director for Joint National Security Council Matters, Headquarters U.S. Air Force, Washington, D.C.
11. July 1984 - July 1987, **commander, 55th Tactical Fighter Squadron and assistant**

deputy commander for operations, 20th Tactical Fighter Wing, Royal Air Force Upper Heyford, England.

12. August 1987 - June 1988, student, Air War College, Maxwell Air Force Base, Ala.

13. June 1988 - January 1989, deputy commander for operations, 4450th Tactical Group, Nellis Air Force Base, Nev.

14. February 1989 - May 1990, vice commander, 4450th Tactical Group, (redesignated the 37th Tactical Fighter Wing in June 1989), Nellis Air Force Base, Nev.

15. May 1990 - May 1992, commander, 552nd Air Control Wing, Tinker Air Force Base, Okla.

16. July 1992 - July 1993, commander, College of Aerospace Doctrine, Research and Education, Air University, Maxwell Air Force Base, Ala.

17. August 1993 - June 1994, commander, 43rd Air Refueling Wing, Malmstrom Air Force Base, Mont.

18. July 1994 - August 1995, commander, 92nd Air Refueling Wing, Fairchild Air Force Base, Wash.

19. August 1995 - July 1996, commander, 437th Airlift Wing, Charleston Air Force Base, S.C.

20. July 1996 - September 1998, director of operations, Headquarters Air Mobility Command, Scott Air Force Base, Ill.

21. September 1998 - present, NATO force commander, Headquarters NATO Airborne Early Warning Force, Mons, Belgium

ANNEX D – USAF BASES IN THE UNITED KINGDOM

Alconbury (USAFE)

7560th Air Base Group (ABG) (1953–1959)

10th Tactical Reconnaissance Wing /Tactical Fighter Wing (1959–1994)

423d Air Base Group (1995– 1999)

Barford St John

Detachment 1, 2130th Communications Squadron (AFCS) (1960-1992)

422d ABG (1993–1997)

Bentwaters/RAF Woodbridge (USAFE) *

79th Fighter Squadron (FS) (1952–1970) (RAF Woodbridge)

81st Tactical Fighter Wing (TFW) (1951–1993)

(RAF Bentwaters to 1958, Bentwaters/Woodbridge to 1993)

Burtonwood (Air Materiel Command) *

59th Air Depot Wing (1948–1965)

Blenheim Crescent (EOARDS/USAFE)

422d Air Base Group (2007–2010)

Chelveston (SAC/USAFE) *

SAC Reflex Base (1952–1959)

42d Tactical Reconnaissance Squadron/10th Tactical Reconnaissance Wing (1959–1962)

Chicksands (USAFSS) *

10th Radio Sq (1950–1951)

7534th Air Base Squadron (ABS) (1951–58)

6950th Radio/Security Gp (1958–1978)

7274th Air Base Group (1978–1993)

Croughton (USAFE)

1969th Communications Squadron (CS) (1950–1955)
1230th Airways and Air Communications
Service Squadron (AACS) (1955–1961)
2130th Communications Squadron (1961–1971, 1983–1986)
2130th Communications Group (1971–1980, 1986–1993)
2168th Communications Squadron (1980–1983)
630th Communications Squadron (1993–1994)
603d Communications Squadron (1994–1996)
422d Air Base Squadron (1996–2005)
422d Air Base Group (2005–2009)

Fairford (SAC/USAFE)

7507th Air Base Group (1950–1952)
3919th Air Base Group (1952–1964)
7020th Air Base Group (1979–1989)
11th Strategic Group (1984–1992)
420th Air Base Group (2004– 2017)

Feltwell (USSC)

5th SSS/21st SW

Greenham Common (SAC/USAFE) *

7501st Air Base Squadron (1951–1953)
3909th Air Base / Combat Support Group (1953–1964)
7551st Combat Support Group (CSG) (1964–1968)
OLA, 20th TFW (1976–1979)
501 TMW (1982–1991)

Lakenheath (SAC/USAFE)

7460th BCS (1948–1949)
7504th ABG (1949–1953)
3913th ABS (1953–1955)
3910th ABG (1955–1960)

99th ADS (1959–1960)

48th TFW (1960–2-15)

Manston (USAFE) *

123d FBG (1951–52)

406th FIW (1952–1958)

RAF Little Rissington (USAFE) *

870th Contingency Hospital (1981–93)

20th TFW (1981–93) accommodation for RAF Upper Heyford

Menwith Hill

Mildenhall (SAC/USAFE/AMC)

7511th ABG (1950–1955)

3913th ABG (1955–1959)

7513th ABG (1959–1966)

513th MAW (1966 – 2011)

100th ARW (1992 – 2014)

Molesworth (SAC/USAFE)

582d Air Resupply Group (1951–1956)

482d Troop Carrier Sq (1956–1957)

303d TMW (1986–1989)

423d ABG (1989–2013)

Sculthorpe (SAC) *

47th BW (1952–1962)

Shepherds Grove (USAFE) *

116th/78th FBS (1951–1958)

Upper Heyford (SAC/USAFE) *

7509th ABS (1950–1951)

7509th ABG (1951–1952)

3918th ABG (1952–1958)

3918th CSG (1958–1964)

3918th SW (1964–1966)

66th TFW (1966–1970)

20th TFW (1970–1993)

Upwood (USAFE)

10th TRW/TFW/ABW (1959–1994)

423d ABG (1995–)

Welford (USAFE)

420th ABG (2005– 2012)

Wethersfield (USAFE) *

20th TFW (1951–1970)

* - Inactive Operating Base

AFCC - Air Force Communications Command

AFSS - Air Force Space Command

USAFSS - Air Force Security Service

ANNEX E - GENERAL DYNAMICS F-111 AARDVARK PRODUCTION

<i>Manufacturer:</i>	<i>General Dynamics Corp., New York, New York, USA (In 1970, headquarters relocated to St. Louis, Missouri, USA)</i>
<i>Designation:</i>	<i>F-111</i>
<i>Names:</i>	<i>Aardvark (RAAF, became official in 1996); Raven (EF-111A)</i>
<i>First official flight:</i>	<i>(F-111A) 21/12/1964</i>
<i>Factory production period:</i>	<i>1963 - 1976</i>
<i>Primary service period:</i>	<i>1967 - 1996</i>
<i>Last official flight:</i>	<i>(EF-111A) 02/05/1998</i>

F-111 PRODUCTION

F-111A

Twin engined, swing-wing, tactical fighter-bomber.

First 17 were pre-production aircraft, 4 to RAAF in 1982.

Produced 1963 - 1967

General Dynamics Fort Worth, Texas (CF)

63-9766 / 63-9782	A1-01 / A1-17	
65-5701 / 65-5710	A1-19 / A1-28	
66-0011 / 66-0058	A1-29 / A1-76	
67-0032 / 67-0114	A1-77 / A1-159	Total: 158
<i>7 additional airframes cancelled.</i>		

F-111B

As F-111A, USN version, minor changes, shorter nose.

Produced 1964 - 1965, 1968

Grumman Bethpage, Long Is., New York

BuNo.151970 / 151974	A2-01 / A2-05	
BuNo.152714, 152715	A2-06, A2-07	Total: 007
<i>30 additional airframes cancelled.</i>		

FB-111A

*As F-111A, strategic bomber version, engine upgrade,
F-111B wings, minor changes. F-111A s/n: 63-9783
completed as the prototype.*

Produced 1967 - 1971

General Dynamics Fort Worth, Texas (CF)

63-9783	A1-18	
67-0159 / 67-0163	B1-01 / B1-05	
67-7192 / 67-7196	B1-06 / B1-10	
68-0239 / 68-0292	B1-11 / B1-64	
69-6503 / 69-6514	B1-65 / B1-76	Total: 077
<i>369 additional airframes cancelled.</i>		

F-111C

*As F-111A, strike version for RAAF, underwing
bomb pylons.*

Produced 1968 - 1969

General Dynamics Fort Worth, Texas (CF)

67-0125 / 67-0148		
<i>All delivered to RAAF as:</i>	D1-01 / D1-24	Total: 024
A8-125 / A8-148		

F-111D

As F-111A, engine / avionics upgrade.

Produced 1969 - 1973

General Dynamics Fort Worth, Texas (CF)

68-0085 / 68-0180	A6-01 / A6-96	Total: 096
<i>684 additional airframes cancelled.</i>		

F-111E

As F-111A, modified air intakes, minor changes.

Produced 1969 - 1971

General Dynamics Fort Worth, Texas (CF)

67-0115 / 67-0124	A1-160 / A1-169 (E-01 / E-94)	
68-0001 / 68-0084	A1-170 / A1-253 (E-11 / E-94)	Total: 094

F-111F

As F-111D, engine upgrade, simplified avionics.

Produced 1970 - 1976

General Dynamics Fort Worth, Texas (CF)

70-2362 / 70-2419	E2-01 / E2-58 (F1-01 / F1-58)	
71-0883 / 71-0894	E2-59 / E2-70 (F1-59 / F1-70)	
72-1441 / 72-1452	E2-71 / E2-82 (F1-71 / F1-82)	
73-0707 / 73-0718	E2-83 / E2-94 (F1-83 / F1-94)	
74-0177 / 74-0188	E2-95 / E2-106 (F1-95 / F1-106)	Total: 106
<i>24 additional airframes cancelled.</i>		

FB-111H - 1977, proposed strategic bomber version, cancelled.

F-111K - 1967, proposed strike / reconn. version for RAF. 46 on order cancelled.

TF-111K - 1967, proposed trainers for RAF, 4 on order cancelled.

Two already under construction to USAF as YF-111A,
both scrapped before delivery.

Grand Total: 562

F-111 CONVERSIONS

USAF

EF-111A	42	<i>Raven</i> F-111A, 1977-1998, conversions for electronic warfare missions. Conversions by Grumman Aerospace Corp., New York.
GF-111A	1+	F-111A, ground instructional conversions.
RF-111A	1	F-111A(63-9776), 1967-1968, prototype tactical reconn. conversion. Additional conversions as RF-111D cancelled.
<i>FB-111B</i>	155	<i>F-111A / F-111D, 1979, proposed strategic bomber, conversions cancelled.</i>
F-111G	36	FB-111A, 1989-1993, conversions as tactical bombers, 15 to Australia in 1994.

ANNEX F – F-111 HISTORY

The **General Dynamics F-111 Aardvark** was a low-altitude strike plane born out of a shotgun wedding between competing Air Force and Navy requirements—with Defence Secretary McNamara as the minister. Despite its troubled adolescence, it grew into a capable high-tech night bomber that lasted decades in service, noted for its sleekly elegant profile.

Troubled Conception

In the early 1960s, the Air Force came to realize that new, radar-guided surface-to-air missiles such as the Soviet SA-2 could reach its slow, high-altitude bombers. In response, it devised a new concept: a smaller long-range supersonic bomber that could skim close to the ground, below radar systems. At the same time, the U.S. Navy was looking for a fast, long-range carrier-based interceptor armed with air-to-air missiles that could take out Soviet bombers from a distance.

Newly appointed Defence Secretary Robert McNamara was convinced that a single aircraft could satisfy both requirements, thereby saving on development costs. The Army and Navy were less keen on compromising their visions, but were forced to cooperate on the so-called TFX program. A contract was awarded to General Dynamics in 1962. Because the design was smaller than Air Force strategic bombers, and the service eschewed the “attack” designation used by the Navy, it was designated with an “F” for fighter.

Revolutionary Design

The F-111 was built around two powerful yet fuel-efficient TF30 turbofan engines with new afterburner technology. A capacious fuselage could accommodate bomb loads of up to 31,000 pounds and fuel for missions up 2,500 miles long, with external tanks adding another 1,000 miles. The large plane weighed twenty tons empty—or more than twice that loaded.

The designers of the F-111 faced a challenge: they needed a plane that could fly at very high speeds, but still take off or land on a short runway. Using smaller wings would create less drag, allowing the aircraft to fly faster—but also create less lift, requiring the aircraft achieve higher speeds before it take off, in turn necessitating a longer runway. For example, the other supersonic

fighter-bomber of the era, the F-105 Thunderchief, had very small wings—and required airstrips over a mile long for take-off, limiting which airfields it could operate from.

The F-111's designers adopted the new technology of variable-geometry, or "swing" wings. These permitted the wings to swing out during take-off to generate maximum lift, and then would tuck inward mid-flight to achieve higher speeds. The F-111 was the first of several major designs that used the technology.

The two-man crew sat side by side in a cockpit pod. If they needed to escape, a rocket boosted the pod upward, which then floated to the ground on a parachute, just like a space capsule.

A key innovation was the F-111's revolutionary new terrain-following radar, which mapped the ground directly in front of the plane and then automatically adjusted the flight path to avoid collision. This allowed F-111s to fly as low as two hundred feet above the surface and make precise adjustments at high speed without crashing—even when flying at night, or in bad weather conditions. The F-111's talent for hunting in darkness, nose close to the ground, was what earned it the appellation "Aardvark."

Early F-111s did show promise, capable of flying over the speed of sound at Mach 1.2 at low-altitude, or more than double that (Mach 2.5) at high altitude—all the while requiring only a 2,000 foot runway to land. It was the first tactical aircraft to cross from the United States to Europe without mid-air refuelling.

However, the F-111's design was biased in favour of the Air Force's specifications. The carrier-based interceptor version, the F-111B, performed abominably in trials, struggling to exceed Mach 1. The expensive forced compromise that was the naval version was finally scrapped, leaving everyone millions of dollars poorer. Many of the more promising design elements of the F-111B made it over to the F-14 Tomcat, however.

Deployment in Asia

The Air Force F-111s didn't have an auspicious debut in combat. After a detachment of six F-111As was deployed to Vietnam in 1968, three of them crashed in just fifty-five missions, all of them accidents linked to defective wing stabilizers. The Air Force was forced to withdraw the F-111 and correct the flaw at a cost of \$100 million.

It wasn't until the Linebacker raids in 1972 that the F-Aardvark finally demonstrated its potential. Skimming beneath North Vietnam's extensive radar network at night, F-111s blasted North Vietnamese airfields and air defence batteries, weakening the resistance to incoming B-52 raids. Aardvarks didn't require the fighter escort, electronic warfare support, or mid-air refuelling that other bombers required, and could operate in inclement weather. Only six F-111s were lost in combat over the course 4,000 missions during the war, one of the lowest loss rates of the war.

F-111s ended up participating in the last combat operation undertaken by the U.S. military in South East Asia, when the Cambodian Khmer Rouge seized the container ship S.S. Mayaguez in May 1975. Two Aardvarks diverted from a training flight were the first to locate the Mayaguez. Later, an F-111 sank a Khmer Rouge patrol boat escorting the seized ship.

Variants

563 F-111s of all variants were built. After the F-111A, the F-111D and E models upgraded the Aardvark's electronics and engine inlets, and increased the thrust of the engines. Another variant, the FB-111, was designed as a strategic bomber with improved engines, stretched two feet longer to accommodate additional fuel. Seventy-five of these served in Strategic Air Command units. The F-111C was sold exclusively to Australia. It incorporated a mixture of design elements of the FB-111 and F-111E.

The definitive F-111F sported engines with thirty-five percent more thrust, an upgraded radar and a Pave Tack infrared targeting pod that allowed crew to identify targets on the ground and hit them with precision-guided munitions.

Starting in the mid-1970s, forty-two F-111As were converted into unarmed EF-111A Raven electronic jamming platforms at a cost \$1.5 billion. The EF-111's key system was an ALQ-99E jamming pod that emitted radiation that scrambled radars in the vicinity, permitting entire formations of aircraft to pass in its wake undetected. When active, the jammer's current literally caused the hairs on the crew's heads to stand as it crackled through the plane. Thus, the Raven was known as the "Spark Vark" to its pilots. The EF-111 is distinguishable by the receiver pod on the tail fin.

El Dorado Canyon Raid

The F-111 would return to the stage of world history in 1986, after the bombing of the La Belle nightclub perpetrated by Libyan agents in Berlin killed two U.S. servicemen. Reagan ordered an attack on Libyan dictator Muammar el-Qaddafi's personal compound near Tripoli codenamed Operation El Dorado Canyon. It was an early attempt to assassinate a head of state by air attack.

An array of twenty-five SAM sites defended Tripoli. A squadron of eighteen F-111Fs carried out the main attack, joined by four EF-111 Ravens to electronically scramble the defence radars. A separate Navy strike hit targets near Benghazi.

Because the United States couldn't get approval from mainland European countries for the raid, the Aardvarks took off from the UK and had to circumnavigate Spain, increasing total flight time to thirteen hours. In all, they would need to be refueled six times on the roundtrip. It was the longest fighter mission in history.

As a feat of logistics, the raid was impressive—but unfortunately, both F-111's performance and the conception of the operation as a whole left something to be desired. One F-111 was shot down, probably by a SAM, and its crew was lost. Four were unable to release weapons because of avionics failures, and one F-111 had to land in Spain because of an overheating engine. Seven missed their target, with several of the bombs landing in civilian areas, nearly hitting the French embassy.

Aardvarks and Ravens Over Iraq

On January 17, 1991, the opening night of Operation Desert Storm, Aardvarks zipped across the desert at a low altitude, targeting Iraqi air defences and key military installations with laser-guided bombs. Meanwhile, EF-111 Ravens accompanied strike packages of coalition aircraft flying deep into Iraq, their jammers disabling Iraqi air-defence radars. In all, sixty-six F-111Fs and 18 F-111Es were deployed in the 1991 Iraq War, flying 5,000 missions.

Contrary to popular belief, the Iraqi Air Force didn't make things a cakewalk on the first day. Two F-111s were hit by infrared-guided R-23 missiles fired by MiG-23s. Another was struck by an R-60 missile shot by a MiG-29. In all three cases, the hardy Aardvarks made it back to base.

An EF-111 was not so lucky in February. While taking evasive manoeuvres after detecting an enemy plane, it crashed into the ground, losing both crew members.

However, a Raven piloted by James Denton went on to score one of the most unusual aerial victories of the conflict.

On the opening day of Desert Storm, Denton's EF-111 was skimming just 400 feet above the ground in the morning darkness, leading the way for a strike package of F-15E fighter bombers with F-15C fighters for top cover. While passing the H3 airfield, an Iraqi Mirage F1 fighter fell in behind the Raven. Denton rolled sharply to the left, then to the right and pumped out chaff, evading a heat-seeking missile. As the Iraqi pilot attempted to match the Raven's evasive manoeuvres, he lost situational awareness and his jet slammed into the ground.

Thus, the unarmed Raven variant scored the only aerial victory for the F-111 "fighter".

As Iraqi defences thinned out, the Aardvarks were redirected to hit ground forces. The F-111F's Pave Tack system proved effective at "tank plinking"—identifying Iraqi armoured vehicles with its infrared scanner, and then precisely directing a laser-guided bomb on top of it. Over 1,500 Iraqi vehicles were "plinked" by F-111s.

F-111s also targeted the oil manifold Saddam had sabotaged, stopping the flow of petroleum polluting the Persian Gulf.

Desert Storm was the Aardvark's last hurrah. The F-111 was finally withdrawn from U.S. Air Force service in 1998. Though the Aardvark was good at its job, it had high maintenance costs, and the Air Force judged that its fleet of F-15E Strike Eagles could take care of shorter-range attack missions, while B-1 bombers could handle longer range strikes.

ANNEX G- ABOUT THE AUTHOR

Colonel James Cook OBE works within the Strategy Directorate of the British Army Headquarters, responsible to the Chief of the General Staff for the Conceptual shaping of the future Land Component strategy, ten years and beyond. He is in his 22nd year of service, and was appointment OBE in HRH Birthdays honours 2016.

He is the Chairman of the Royal Artillery Historical Trust, responsible for the historical representation of the Royal Artillery and its vast collection of artefacts. In his capacity as Chairman he is widely invested in museum affairs, collection policy and the narrative of what is important to the Royal Regiment and wider society.

Colonel James is in his final year of part time study for a Doctorate in War Studies with Kings College London; considering a thesis around the ways in which military entities learn and develop in times of conflict. He expects to be awarded PhD in spring 2018.