From the Author of the Bestselling
SPITFIRE

HARRIER

The Biography

JONATHAN GLANCEY

HARRIER

HARRIER

THE BIOGRAPHY

JONATHAN GLANCEY

Atlantic Books
London

Published in hardback in Great Britain in 2013 by Atlantic Books,
an imprint of Atlantic Books Ltd.

10 9 8 7 6 5 4 3 2 1

A CIP catalogue record for this book is available from the British Library.

Hardback ISBN: 9781843548911
E-book ISBN: 9781782394433

Printed in Great Britain

Atlantic Books
An Imprint of Atlantic Books Ltd
Ormond House
26–27 Boswell Street
London
WC1N 3JZ

www.atlantic-books.co.uk

CONTENTS

List of illustrations

Preface

Introduction: To tread upon the air

1 A leap of imagination

2 Kestrel breeds Harrier

3 Cold War warrior

4 Baptism at sea

5 Foreign legions

6 New wars for old

7 Wing feathers clipped

8 What flies ahead

Epilogue: The Windhover

Acknowledgements

Select bibliography

Index

‘The airplane won’t amount to a damn until they get a machine that will act like a hummingbird, g
straight up, go forwards, go backwards, come straight down and alight like a hummingbird.’

Thomas Alva Edison

‘All modern aircraft have four dimensions: space, length, height and politics.’

Sir Sydney Camm, Hawker Aircraft

LIST OF ILLUSTRATIONS

1. VZ-9 Avrocar. © Bettmann/CORBIS.
2. Convair XFY Pogo. © Bettmann/CORBIS.
3. Ryan X-13 Vertijet. Courtesy of Philip Jarrett.
4. Short SC.1. Courtesy of Philip Jarrett.
5. Frank Whittle, John Herriot and Stanley Hooker. Copyright Rolls-Royce plc/Courtesy of Rolls-Royce Heritage Trust.
6. Bill Bedford. Courtesy of Philip Jarrett.
7. Sydney Camm. Courtesy of Philip Jarrett.
8. Hawker P.1127, XP831, first tethered flight. Courtesy of Philip Jarrett.
9. Hawker P.1127, XP831, HMS *Ark Royal*. Courtesy of Philip Jarrett.
10. FGA.1 Kestrels. Courtesy of Philip Jarrett.
11. *Daily Mail* Transatlantic Air Race. Courtesy of Philip Jarrett.
12. Hawker Siddeley P.1154. Courtesy of Philip Jarrett.
13. Yakovlev Yak-38s. US Navy/Wikimedia Commons.
14. Harrier analogue cockpit. Courtesy of Philip Jarrett.
15. Harrier updated cockpit. Courtesy of Philip Jarrett.
16. FRS.1 Sea Harrier. Courtesy of Philip Jarrett.
17. Commander Nigel ‘Sharkey’ Ward and Lieutenant Commander Kris Ward. SWNS.
18. Sharkey Ward landing FRS.1 Sea Harrier at Pebble Mill. Courtesy of Philip Jarrett.
19. FRS.1 Harrier landing on HMS *Hermes*. Courtesy of Philip Jarrett.
20. GR.3 Harrier, Belize. Mirrorpix.
21. GR.3 Harrier, West Germany. Courtesy of Philip Jarrett.
22. GR.3 Harrier, RAF Gütersloh. Courtesy of Philip Jarrett.
23. FRS.1 Sea Harriers from HMS *Invincible*. © Imperial War Museums (HU 92567).
24. AV-8A landing on USS *Franklin D Roosevelt*. Courtesy of Philip Jarrett.
25. USMC AV-8A. Courtesy of Philip Jarrett.
26. GR.7 Harriers painted in camouflage. Courtesy of Philip Jarrett.
27. GR.7 Harriers, Ahmed Al Jaber Air Base. © PA Images.
28. USMC AV-8B Harrier. Courtesy of Philip Jarrett.
29. GR.7 firing CRV-7 rockets. Courtesy of Philip Jarrett.
30. AV-8B Harrier II. © George Hall/Corbis.
31. Northrop Grumman X-47B. Rex.
32. Lockheed Martin F-35B. Rex/Layne Laughter/US Navy.
33. GR.9 Harriers farewell flight.

PREFACE

The weather was hostile. Blustery. Ice-cold winds. Grey skies barely visible through banks of lo cloud. Conditions, in fact, that would have been all too familiar to the pilots of the Royal Navy ar Royal Air Force who flew to victory in the Falklands War nearly thirty years earlier. As some tw thousand military personnel, their families and friends – and not forgetting the media – stared into th unforgiving sky, sixteen Harrier jump jets, in diamond formation, each of four aircraft, thundere towards RAF Cottesmore to land, vertically, and to shut off their engines simultaneously. But no before one of these GR.9A Harriers – the final development of this legendary military aircraft, painte for the occasion in glossy 'retro' camouflage – stopped in midair, turned to the control tower, and landing light blazing, made a deep and courtly bow to those assembled below and, by extension, everyone who, one way or another, had been a part of the story of the Harrier over the previous hal century.

That aircraft was ZG506, flown by Group Captain Gary Waterfall, commander of Joint Forc Harrier, controlling Harrier squadrons of the Royal Air Force and the Fleet Air Arm (Royal Navy), ar the last station commander of RAF Cottesmore, which itself was closed shortly after this final, high emotive flight of Britain's jump-jet force. That afternoon – 15 December 2010 – the sixteen jets ha flown low in homage, and as a farewell, over the RAF bases of Cranwell, Coningsby, Marhar Scampton, Waddington and Wittering, with their ghosts of Spitfires, Dambusters, Cold War V bombers, Phantoms and generations of officer cadets earning their 'wings'. They flew, too, above th still-handsome town centres of Stamford and Oakham and over the soaring medieval towers Lincoln Cathedral before returning to their Rutland base, by now wreathed in eerie and ever-shiftin tendrils of low rolling mist.

As the Rolls-Royce engines of the pugnacious jets span on cue to a collective stop, and a hauntin silence, those gathered on the ground or clambering from cockpits knew all too well that this was tru the end of an era. The Harrier had been in service with the RAF for forty-one years, and in actio from the Falklands War to the most recent missions in Afghanistan. The Harrier was a development o the Hawker P.1127, the world's first successful vertical take-off and landing (VTOL) aircraft. On th drawing board in 1957, the revolutionary P.1127 made its maiden flight on 19 November 1960; on way or another, the jump jet born and nurtured in Kingston upon Thames, Surrey spanned half century in the service of the country that invented and manufactured this magnificent flying machin – a fighter aircraft that, perhaps justly, has been dubbed the jet-age Spitfire. It is a machine – th product of an optimistic new Elizabethan age when British design, technology, engineering an aircraft not only matched but led the world, if only for what proved to be an unduly brief time – th has spanned my life, too. As much an emotion as a brilliant invention and a finely resolved and huge characterful machine, the Harrier ranks in the pantheon of the world's greatest aircraft.

Now, out of the blue, one of the world's most potent and proven combat aircraft was to be taken ou of service to save the British government some £900 million. That decision had been announced

Parliament on 12 October 2010, shortly before the fiftieth anniversary of the P.1127's first hover, as result of the latest Strategic Defence and Security Review. The effect of the cuts was immediate. Th following month, the aircraft carrier HMS *Ark Royal*, like her sister ship *Invincible* another victim the latest round of government spending cuts, made a final voyage with Harriers on board, fro Tyneside, where she was built, and launched in 1981, to Hamburg.

On 24 November, four Harriers, led by Lieutenant Commander James Blackmore, blasted off th ship's deck on a flight to RAF Cottesmore. This would be the last time a British military aircra would operate from a carrier. A replacement carrier, HMS *Queen Elizabeth*, and the superson Lockheed Martin short take-off and vertical landing (STOVL) F-35B stealth jets she is meant to tak to sea, will not be ready for active service until 2020. Watching the Harriers abandon their floatin nest, the *Ark Royal*'s skipper, Captain Jerry Kyd, said it was like 'taking the teeth from a tiger', whi General Sir David Richards, Chief of the Defence Staff, noted in a decidedly low-key manner that th decision to decommission the *Ark Royal* had provoked an 'understandable emotional response'.

'Understandable' and 'emotional'? Certainly. And besides, by axing both such a formidable fightin machine as the *Ark Royal* and the seventy-nine-strong Harrier force, Britain had deliberately opened gaping hole in its defence strategy. The ever-controversial Commander Nigel 'Sharkey' Ward, wh had led Sea Harriers to victory from the deck of HMS *Invincible* in spectacular style in 1982, an whom we will meet again in this book, told the British media:

> The connived withdrawal of the Harrier from service is an appalling miscarriage of justice, and of operational wisdom; the reprehensible actions of those who contrived this as 'a logical operational decision' must be condemned as disloyal and against the direct interests of our national defence capability.

To make matters seem much worse than they were, the perfectly serviceable, and saleable, *Ark Roy* was sold, like *Invincible* before her, for scrap to Leyal Ship Recycling, a Turkish company on th Aegean coast, while the Harriers were flogged off, at bargain-basement price, to the US Marine Corp to be broken up for spare parts for the Americans' highly prized AV-8B Harrier II force. In 2013 these Harriers are still active in Afghanistan, and the Marines intend to hang on to them until 2030 they possibly can.

The GR.9A Harriers that flew for the last time in service that December afternoon at Cottesmo were not machines, or a type of aircraft, due or fit for retirement. In fact, the latest Harrier model ha only been delivered to RAF Cottesmore, and so also to the *Ark Royal*, between 2004 and 2009, whi in July 2008 a contract had been awarded to QinetiQ, the Farnborough-based aerospace company, further upgrade and maintain the Harrier fleet until 2018. Imagine buying dozens of Aston Mart DB9s, kitting them out with every latest James Bond-style gizmo and then selling them to a American car dealer for a few thousand quid, each to be broken up into spare parts for DB9s bui under licence in the United States. Madness? Well, yes. And yet, as this biography of the Harrier wi show, while tracing its genesis, development and action-packed service history, politics have toye with this magnificent British flying machine from one end of its long, if now truncated, life to th other.

In November 2011, perhaps stung by criticism both within and without the armed services, Pet Luff, a junior defence minister and former PR man, announced that seventy-two of the Harriers bou for the United States would be converted to match the Marine Corps's AV-8B fleet, but as the caree of junior ministers rather resembles that of inexperienced pilots flying into fog for the first time, was hard to know. The following year, Mr Luff was no longer a junior minister of defence and was, any case, due to leave Parliament at the next general election. As it was, in 2012 the US Naval A

System Command said that at no time had there been plans for upgrading and operating Britis Harriers for service with the Marine Corps. The aircraft were for spare parts, and that was that.

Intriguingly, the Harrier – in the guise of the prototype Hawker P.1127 – was nurtured into RA service at a time when a Conservative government was hell-bent on destroying the very idea of fight aircraft in favour of ground-to-air missiles. Half a century on, meanwhile, a coalition government Conservatives and Liberal Democrats ditched the Harrier while setting its cost-cutting eyes o pilotless 'drones' that would, if possible, supersede jet fighters and more or less every other fixe wing military aircraft in the near future. It was, however, a Conservative government that had gaine most, politically, from the sheer efficacy of the Harrier in the early 1980s: British victory in th Falklands War in 1982, in which Harriers flown by the Royal Navy and the RAF played a vital an legendary role, had led to a landslide political victory for Margaret Thatcher in Britain's 1983 gener election. Indeed, on 17 December 1982, Mrs Thatcher had paid a visit to the Hawker Siddeley facto at Kingston upon Thames. The prime minister had posed, beaming, for press photographers from th cockpit of a Harrier. 'I would have loved to have flown in it,' she had said. No one had doubted her.

Inevitably, the prospects of any British military aircraft are highly susceptible to the Mad Hatt logic of Westminster and Whitehall. The loops, stalls and spins of politicians can either buoy up o bring down the very same machines – from Spitfires to Harriers – that have fought for our hard-wo freedoms. And the Harrier was, of course, very much a servant of democracy: it should never b forgotten that, in one of its finest moments, it did its bit in helping to bring down the cruel and pueri military government of the Argentine Republic, a dismal regime that had killed many of its ow people – some 20,000 – including students, trade unionists, journalists and the daughter of Livio Dan Porta, one of the country's finest engineers, who had pushed so hard for the development of a clea and efficient steam-railway technology fit for the twenty-first century. Many of the 'disappeare were pushed from aircraft over the Río de la Plata or the South Atlantic. These 'death flights' wer planned by Vice Admiral Luis Maria Mendia (1925–2007), the former head of Argentine nava operations; a document signed by the admiral called for the 'physical elimination by using planes tha in flight, would throw out the prisoners drugged beforehand'.

Back under the cold, grey clouds of Rutland on 15 December 2010, Air Vice Marshal Pete Dodworth, one of the first four RAF pilots to be trained on Harriers, told reporters:

> [The Harrier] was an exciting adventure for us. The first time I did a conventional take-off I was astonished by the acceleration. My first vertical take-off was exhilarating. It is pretty sad to see the demise of the aircraft after forty-one years. I watched it develop into the formidable and effective fighter jet it is today. It has been amazing for me to see it fulfil its potential.

Air Vice Marshal Graham Williams, who delivered the first Harrier into service at RAF Wittering i 1969 and who flew the triumphant return leg of that year's Transatlantic Air Race from New York' Empire State Building to London's Post Office Tower, added:

> The Harrier means everything to me. It is just one of those planes that becomes a part of your life. It was so different from everything else, and it was the greatest fun, almost better than sex. Today is also a very sad day for me, because it seems that politics and finance has got in the way of what still is a very viable aircraft. The Harrier still has ten to fifteen years of life left in it. To go and dump it like this is almost criminal.

Walking away from Harrier ZG506 without stopping to look back, Group Captain Gary Waterfall, on of the 135 RAF Harrier pilots and fifty-three Navy pilots facing an uncertain future, was stoica

‘Without doubt this is an emotional day for all those who have been fortunate to be involved in one o the true icons of aviation, alongside Concorde and Spitfire.’ But, he added, ‘life goes on, and it always important to look forward, not back. Right now, though, our thoughts are with everybod involved with Harrier over the years as we bid a fond farewell to a truly remarkable aircraft.’

As he said this, Harriers and Sea Harriers were still reaching for the sky, in their inimitable wa with the Indian, Italian and Spanish navies as well as the US Marine Corps. It is not quite time to sa farewell to the instantly recognizable, compact and much-loved British jet that revolutionized flig and could not just fly like a hummingbird but sting like a bee, wasp and hornet rolled into one.

INTRODUCTION

TO TREAD UPON THE AIR

History records, in myth, legend and fact, all too many vertical descents, from hilltops, temples an church towers, which led to the deaths of early would-be aviators. The dream of flight is as old as th hills – and certainly as old as the temples of the ancient Greeks. According to Aulus Gellus, th second-century Roman author, it was the Greek philosopher, mathematician, astronomer an politician Archytas (482–347 BC) who designed and built the world's first self-propelled flyin machine. A steam-powered jet called the *Pigeon*, it was said to have flown 650 feet. Did it? Wh knows? But Hero of Alexandria, a Greek mathematician and engineer, published notes on a stea turbine, and possibly built and demonstrated it, so perhaps the Greeks were as ahead of their times an the rest of the Western world in this respect as they were in architecture, science, sculpture an philosophy.

For all the intriguing flying machines that may or may not have taken to the air between Archyta *Pigeon* in Athens of the fifth century BC and the Wright brothers' *Flyer* in 1903, the ability to take o and land vertically was far beyond the capabilities of heavier-than-air machines, whether legendary not. Interestingly, though, vertical flight by lighter-than-air machines was achieved some two hundre years before the prototype Hawker P.1127 rose into the air, by itself and with no guiding string attached, on 19 November 1960. While attempts had been made, on paper at least, by Roger Bacon England in the thirteenth century and Leonardo da Vinci in Italy in the fifteenth century to develo vertical take-off ornithopters, the first successful vertical take-off with humans on board – in fact, th first ever free flight by humans – was made by the Montgolfier brothers, inventors and pap manufacturers, from the grounds of Château de la Muette on the edge of Paris on 21 November 1783.

What a magnificent and thrilling sight this great paper and varnished taffeta hot-air balloon mu have made as it rose 3,000 feet above cheering spectators. The blue-and-gold balloon was seventy-fiv feet high and adorned with images of fleur-de-lis, signs of the zodiac and suns emblazoned with th face of King Louis XVI. The crew, Jean-François Pilâtre de Rozier, a chemistry and physics teache and the Marquis d'Arlandes, an Army officer, flew the best part of six miles in twenty-five minute and brought their craft down to land safely.

The sheer exoticism of its decoration, and the magic nature of its flight, must surely have s Parisian minds racing back through childhood stories of fairies, dragons and flying carpets. Antoin Galland's French translation of *The Arabian Nights*, published between 1704 and 1717, had been huge success; by the time of Pilâtre de Rozier and d'Arlandes' flight, many Parisians would have bee familiar with tales of magic carpets, of how Prince Husain, the eldest son of the sultan of Indi bought such a carpet in Bisnagar that could rise in an instant – vertical take-off, of course – an transport him, in 'the twinkle of an eye', to places 'many a day's journey and difficult to reach Stories of flying carpets go back even further than these tales, a thousand years old or more. Kin

Solomon was said to have flown on a green-and-gold silk carpet measuring sixty miles square; could carry 40,000 passengers, or a hundred times more than a Boeing 747 jumbo jet. Even toda Iranians tell wondrous stories of magic carpets used, at least in one case, for warfare. In 1213, or s the story goes, Prince Berhoz of Khorasan in eastern Persia married a young Jewess, Ashirah, whos father wove magic carpets. Berhoz commissioned from his father-in-law two dozen flying carpe supported on bamboo frames. Two soldiers were assigned to each carpet, which was equipped wi bows and poison-tipped arrows and fireballs, and when Berhoz's father launched a war against th neighbouring shah of Khwarzem, this mythical thirteenth-century fighter-bomber squadron made successful attack on the shah's castle, setting it ablaze. It was not so very different from a Harri operation in Iraq or Afghanistan some eight hundred years later.

In India, meanwhile, many stories are still spun, often with impassioned seriousness by ferve Hindu nationalists, concerning 'vimanas', or highly advanced rocket-powered aircraft that were flov across the subcontinent very many thousands of years ago by the enlightened high priest-kings of th Rama empire. The 'ancient' manuscript relating to flying machines, however, seems to have bee dictated by the mystic Pandit Subbaraya Shastry (1866–1940) some time after the end of the Fir World War. A Hindi translation published in 1959 included diagrams of complex jet engines, althoug these were the work of T. K. Ellappa, a draughtsman at an engineering college in Bangalore.

Flying chariots are, of course, staples of tales told in India's national epic, the *Mahabharata*, datin from much the same time as the Bible. One such spherical vimana was apparently able to fly u down, backwards and forwards. In the Sanskrit *Samarangana Sutradhara*, a wide-ranging treatise o classical Indian architecture written in the eleventh century by Paramara, king of Bhoja of Dhar, w learn that a vimana must be:

> Strong and durable… like a great flying bird of light material. Inside one must put the mercury engine with its iron-heating apparatus underneath. By means of the power latent in the mercury, which sets the driving whirlwind in action, a man sitting inside may travel a great distance in the sky. The movements of the Vimana are such that it can vertically ascend, vertically descend, move slanting forwards and backwards. With the help of the machines, human beings can fly in the air and heavenly beings come down to earth.

Quite clearly, the design team at Hawker Siddeley, the best part of a thousand years later, had bee extraordinarily slow on the uptake.

British observers, meanwhile, appear to have missed the flight of a latter-day vimana, alleged constructed by Shivkar Bapuji Talpade (1864–1916), a Sanskrit scholar, his wife and an archite friend, and flown successfully to a height of 1,500 feet over Chowpatty Beach, Bombay (no Mumbai), in 1895. It landed automatically. The *Marutsakha*, or 'Friend of the Winds', was powere by a 'mercury ion engine', but sadly, said Talpade, a paucity of personal funds, a lack of sponsorsh and imperial animosity ensured that this sensational performance was a oneoff. After his death 1916, his relatives are said to have sold the machine to Rally Brothers, a firm of British exporte based in Bombay. Presumably the brothers Rally assumed that the British government would have n interest in the world's first successful heavier-than-air flying machine, or perhaps they were simpl too dull to make sense of its highly advanced Vedic jet technology.

However fanciful, stories like these drawn from across at least two-and-a-half thousand yea continued to haunt the imaginations not just of poets, novelists and artists, but of inventors an pioneer aviators, too. Even so, the first reliable VTOL aircraft were the rigid airships – an advance form of hot-air balloon – that took to the air at the beginning of the twentieth century. The very fir was Ferdinand von Zeppelin's *Luftschiff Zeppelin 1*; it made its maiden flight, over Lake Constanc

on 2 July 1900. During the First World War, the Zeppelins became the first successful long-rang bombers. On 13 October 1915, L.15 bombed central London, damaging the Lyceum Theatre Charing Cross, killing seventeen people and injuring twenty more.

The aim, post-war, sought by the Germans, the British and the Americans was to nurture enormou dirigibles or rigid airships that could fly across continents and oceans, and take off, land and moor city centres. Rather fancifully, it was assumed that mighty airships would tie up at the top of th Empire State Building. The idea of using airships as airliners and bombers was abandoned after number of spectacular accidents – in particular, the loss of the British government-sponsored R10 over France on 5 October 1930, and the fire, caught on newsreel, that destroyed LZ 129 *Hindenburg* it attempted to dock at Lakehurst Naval Air Station, New Jersey on 6 May 1937. Still, thes impressive, if flawed, machines highlighted some of the advantages of what might be achieved b aircraft that could take off and land vertically, and that could hover, whether benignly or menacingl over 'targets' and city centres – which, as the Zeppelin raids over London proved, had become one an the same thing.

It was the Germans who took the next successful step in the story of vertical flight with the maide flight of the world's first practical helicopter on 26 June 1936. This was the Focke-Wulf Fw 6 designed by Heinrich Focke and Gerd Achgelis. It was an instant success, and a step forwards from th autogyro, a small aircraft invented by the Spanish engineer Juan de la Cierva and first flown on January 1923. The helicopter blades of the autogyro were not driven by or connected to the aircraft engine, but, rotating in flight, they allowed the pilot to fly very slowly, something that fixed-win aircraft were unable to do without stalling. The arrival of the Fw 61 meant that pilots were now able take off and land vertically, to fly just above the ground if necessary at low speed and, of course, hover. This ability to stay still a few inches above the ground was, although it sounds odd to say so, giant leap for aviation.

What neither the airship nor the helicopter could do, though, is what aircraft like the Sopwith Cam and Fokker D.VII had been doing in the late stages of the First World War: flying fast an aerobatically. These, in modern parlance, were 'air superiority' fighters and their latest equivalent the Supermarine Spitfire and Messerschmitt Bf 109, were both making their maiden flights in th mid-1930s. But despite the undoubted success, and omnipresence, of the piston-engined fighter an bomber in the Second World War, the next challenge for military aircraft design – a step aside from the helicopter, an aircraft that was to succeed brilliantly in its own right, and from the burgeonin dream of supersonic flight – was surely a fighter that could take off, land and hover like the Fw 6 and shoot off at great speed and with great dexterity to engage the enemy. If such an aircraft prove feasible, it would also mean that air forces would be able to fly it from the most basic forward a bases; there would no longer be a need for long grass strips or concrete runways. The potential w enormous. But how to get there?

There were several routes that, one way or another, led to the Hawker P.1127 prototype and so to th Hawker Siddeley Harrier. Equally, the development of pilotless aircraft, or drones – which might y altogether replace manned fighter aircraft, however ingenious these can be, in years to come – evolve at much the same time. In 1941, Robert Lusser (1889–1969), a German aircraft engineer, moved fro Heinkel, where he had been working on a rival to the Messerschmitt Me 262 jet fighter, to Fiesele Here he played a key role, with Fritz Gosslau of the engine manufacturer Argus, in the design an development of the Fieseler Fi 103, dubbed the V1 flying bomb (V standing for *Vergeltungswaffe*, revenge weapon) by the Nazis. Wernher von Braun, meanwhile, was at work on the V2, a vertical tak off rocket and worryingly effective long-range ballistic missile against which there was then n defence. Both V1 and V2 were produced too late in the day to radically affect the outcome of th Second World War. However, Lusser and von Braun teamed up after the war, working at Huntsville

Alabama in the United States on the rocketry projects that would see Neil Armstrong and Buzz Aldr landing on the Moon less than a quarter of a century after VE-Day.

The importance of these weapons – one leading to the 'drones' employed frequently by the U military in recent years, the other to NASA's successful manned space rockets – had much to do wit the urgency that had driven their development. With Germany under aerial assault night and day b British and US bombers, escorted later in the war by powerful and well-armed long-range fighter scientists and engineers were propelled into thinking quickly and creatively. What was the type aircraft, or drone or rocket, best able to defend Germany from Allied bombers?

One answer, which led to a cornucopia of imaginative ideas, was for aircraft that could be deploye from makeshift airfields established along the bombers' anticipated flight paths. These machine needed to be cheap and quick to build, easy to transport, and yet capable of climbing rapidly an hitting the enemy's bombers hard. Here truly, as the Allies approached the German border from th west and the Russians from the east, were desperate measures for desperate times. The sheer ingenui of many of the designs called for by the Luftwaffe's Emergency Fighter Programme of spring 1944 which featured various forms of high-speed jets, some with swept wings, others with delta wings an vertical take-off aircraft too – was extraordinary. A number of books have been published in recen years on these 'secret' Nazi aircraft designs. While some were little more than sketches on scraps paper, others were not only promising but were even taken up after the war by the Allies, especially the United States and the Soviet Union.

One of the most promising was the Bachem Ba 349 Natter (Viper), a small vertical take-off rocke powered interceptor designed by Erich Bachem, a Fieseler engineer, and produced under the auspic of Heinrich Himmler's SS at a purpose-built workshop at Waldsee in the Black Forest. The idea fo such an aircraft had, in fact, been proposed by Wernher von Braun in 1939, and althoug enthusiastically received by Field Marshal Ernst Milch, the partly Jewish Air Inspector General wh had done much to create the new Luftwaffe that went to war that same year, it was rejected by th Reich Air Ministry, which believed it to be both unnecessary and unworkable.

Designed to be constructed using semi-skilled labour, the Natter was essentially a wooden aircra powered by the Walter 109-509A rocket motor. This produced 3,740 lbs of thrust boosted by a furthe 4,400 lbs generated by four Schmidding 109-533 solid-fuel rockets bolted in pairs to either side of th fuselage. Launched from a steel guide tower, the Natter should have climbed vertically at th astonishing rate of 37,400 feet a minute, reaching a top speed of 621 mph; as Allied bombers rarel flew much above 20,000 feet, the rocket plane, armed to the teeth with a formidable cluster Henschel unguided rockets in its nose cone, might well have spelt sudden death for many unsuspectin bomber crews. Once the rockets had been released, the Natter's pilot would escape and parachute bac to safety and the next mission, while the expended fuselage would, ideally, strike another enem bomber and destroy it.

Progress on this secret machine was rapid. On 3 November 1944, a prototype, piloted by Eric Klockner, was carried, it seems, up to 18,000 feet by a Heinkel He 111 bomber, and then released. flew surprisingly well and landed safely. In late February 1945, a successful vertical rocket launc was made with a dummy pilot. On 1 March, a Natter lifted off with Oberleutnant Lothar Siebe aboard. The launch was radio-controlled; the pilot was to take control as the machine descende towards enemy bomber formations. At about 1,600 feet, however, the aircraft inverted and, flying fifteen degrees to the vertical, vanished into the clouds; it reappeared and within thirty secon smashed into the ground, killing Siebert. The war, of course, was all but over at this point, an although the Germans are said to have had ten further Natters ready on launchers at Kirchheim, ne Stuttgart, these saw no action – despite Squadron Leader Paddy Payne, Warrior of the Skies, nobl attacking a fully functioning, bright-red Natter with his late-model Spitfire in the pages of the *Lic*

comic I pored over as a young boy in the 1960s. One of the surviving Natters was shipped to th United States for inspection; today, it rests, unrestored, in a warehouse belonging to the Smithsonian

There were several other intriguing designs on the drawing boards of German aircraft manufacture as late as the end of March 1945, some of which seem even more futuristic, and might have been mo successful, given time, than the Bachem Ba 349, of which a total of thirty-six appear to have bee built. Focke-Wulf offered the Triebflügeljäger, or Thrust-Wing Fighter, an astonishing wingless VTOL interceptor. Sitting on its tail with its nose cone pointing skywards, the Triebflügel was to hav been powered by ramjets located on the tips of the three blades of a giant propeller designed to sp around the centre of the fuselage. The aircraft would have taken off vertically, rather like a helicopte and then levelled out with the jet-powered blades acting like a giant airscrew and propelling th fighter forwards at what Focke-Wulf engineers calculated would be a top speed of 621 mph. It looke like a machine Dan Dare's mortal enemies, the Treens, might fly on short missions across Venus i the pages of the *Eagle*, the British boy's comic launched in 1950 that celebrated the kind o technological progress that led to the Harrier and men on the Moon. It was not until 1955 that th Americans released information on this top-secret VTOL jet.

Meanwhile, Heinkel proposed the Lerche (Lark), a VTOL fighter and ground-attack aircraft that wa also to have stood on its tail at take-off. Eschewing jet or rocket propulsion, the Lerche was to hav been powered by a pair of 2,000 hp Daimler-Benz 605D V12s, the ultimate development of the engi produced in tens of thousands and fitted to the Messerschmitt Bf 109 fighter. These were to hav driven two large contrarotating propellers set within an 'annular' wing – a metal ring encompassi the centre of the fuselage – and, theoretically, would have given the Lerche a top speed of 497 mp and a ceiling of 46,910 feet. This remarkable aircraft might well have flown successfully. I appearance, at the bitter end of the battle for Germany, would certainly have been a shock to Allie aircrew. It would have seemed wingless, an aircraft, or spaceship, from the pages of a science-fictio fantasy, a machine inhabiting a parallel universe to that of Spitfires, Mustangs, Thunderbolts an Flying Fortresses. Even today, the Lerche retains something of the look of a flying machine that mig have been dreamed up by NASA scientists and engineers twenty years later – and NASA was, o course, well staffed with brilliant young ex-Nazi engineers and scientists.

Heinkel drew up a further design, very similar to the Lerche, for a turboprop version designate Wespe (Wasp). Although the first turboprop plane to fly was a specially adapted British Gloste Meteor in September 1945, the idea had been proposed and tested, although neither in flight nor with full-scale aircraft, by György Jendrassik, a Hungarian mechanical engineer, in the late 1920s. Germa industry had access to this research, and during the Second World War various companies – BMW Hirth and Daimler-Benz among them – invested in turboprop development. But as the fruits of the experiments were not expected to be seen until sometime late in 1945, and probably later, the Wesp was never going to be built, still less flown in action. While it was fortunate that Hitler's Thousan Year Reich missed its target by 988 years, the pace of research and development in the German aero industry in the last two or three years of the war was unprecedented and remains unsurpassed.

The memory, and perhaps the blueprints, of such aircraft lived on well into the following decade. I 1959, SNECMA, the French engine company, unveiled its sensational C.450-01 Coléoptère. A test be for its latest, experimental pulse-jet engine, the Atar 101 E.5V, this tail-sitting jet featured an annula wing and was very much the jet descendant, or younger sibling, of the Lerche and Wespe. Promisin great things, it did actually take off, on 6 May 1959, but crashed two months later while attemptin the transition from vertical to forward flight; the pilot ejected safely, although the aircraft was writte off.

If the Coléoptère was to be a product of prolonged post-war experimentation with new forms military aircraft, the wartime VTOL machines proposed, or tested, by the Germans were the produc

of an ever-increasing urgency. For pilots, they were, or would have been, uncomfortable machines operate. Even if the Lerche and Wespe could have been built in time to take on the aerial armadas four-engined Allied aircraft carpet-bombing German towns and cities in 1945, pilot error would sure have led to any number of accidents. Lying prone in a cockpit staring up at the sky was never going be an easy way for a pilot to take off, while having to land an aircraft vertically on its tail after adrenaline-sapping mission was asking a lot of even the coolest and most competent airman. In ar case, such landings would have made these aircraft easy prey for marauding and highly potent Allie fighters, which were by now capable of flying at very nearly 500 mph and diving close to the speed sound and were armed with batteries of cannons and large-calibre machine guns.

The boundless ingenuity and invention of German engineers, however, was to be redeployed ar nurtured once the Axis powers had been defeated and especially during the Cold War, when, as w will see, a VTOL fighter capable of tackling some of the very same missions originally plotted fo these Nazi 'science-fiction' aircraft became both desirable and then a reality. That aircraft – th Harrier – was, of course, a jet. One wartime German design that was to use piston engines showed th there was an alternative route to vertical take-off and landing. This was the Focke-Achgelis Fa 269, tilt-rotor VTOL fighter. In this design, a piston engine – BMW or Daimler-Benz – was to have bee mounted in the fuselage behind the pilot. Transverse drive shafts were to set two giant propellers, on fitted in either wing, spinning downwards and so lifting the Fa 269 vertically like a helicopter. Thes would then pivot behind the wings and push the aircraft forward.

Much test work was carried out, using a wind tunnel, at the Focke-Achgelis works at Hoykenkam in Lower Saxony, founded in 1937 to manufacture helicopters. The factory, however, was bombe heavily and work on the Fa 269 ended in 1944; Focke-Achgelis engineers were not exactly relieve but they knew full well that the aircraft was unlikely to fly before 1947. Forty-two years later, the fir US Bell Boeing V-22A Osprey took to the air; it had taken that long to make the Fa 269 concept reality. Even then, the Osprey was beset by development problems and several machines crashed wi fatal results during the 1990s. Although taken into service with the US Marine Corps in 2000, th Pentagon only sanctioned full-scale production as recently as 2005. Today, the Osprey operates wit the Marines, the US Navy and the US Air Force. Like the Harrier, it can be based on land or fly fro carriers at sea. It has seen action in rescue and combat roles in Iraq, Libya and Afghanistan and ha become, after a long, expensive, controversial and even tragic birth, one of the brightest stars in th constellation of current US military aircraft.

While the Osprey proves that the Harrier is not the only solution to vertical and/or short take-off an landing (V/STOL) flight, its role is and always will be quite different from that of the jump jet sti flown, and enthusiastically so, by the US Marine Corps. The turboprop Osprey is a successf marriage of helicopter and aeroplane; it can seat twenty-four troops and has a top speed of around 30 mph. A combat US AV-8B Harrier is a single-seat interceptor and ground-attack fighter and flies clo to the speed of sound. It nonetheless remains intriguing that this military tilt-motor aircraft, a typ that might have made its debut in Germany in 1947, took to the air nearly thirty years after th Hawker P.1127.

Mention has to be made of one other type of Nazi German VTOL aircraft, although this one remain the stuff of apocryphal stories, bar-room tales, internet conspiracies and blurred photographs. Give the German proficiency in photography at the time, technically and artistically and in the mo demanding theatres of war, it does seem odd that those involved in such specialist design were unab to take one half-decent snap of a flying saucer. Allegedly, a certain Dr Richard Mehta, 'sometime known as the "Father of Saucerology"', according to a host of copy-cat websites, was hired by th Luftwaffe, or even by a secret branch of the SS, to build a 'flying saucer' to take out Allied bombe by rockets and, presumably, to take them by goggle-eyed surprise, too. Dr Mehta was, it seems, the

recruited by the US after the war to work at Avro Canada, where he worked on classified designs fo
flying saucers.

In 1953, Avro Canada did, in fact, reveal a mock-up of a flying saucer, the Avrocar designed by Joh
'Jack' Frost, a British engineer who had arrived in 1947 from de Havilland, where he had been chi
designer of the DH 108 Swallow, a small jet based on the Messerschmitt Me 163 Komet. Flown b
test pilot John Derry, DFC, a former RAF Typhoon pilot, the Swallow was the first British aircraft t
push through the sound barrier. From 1952, Frost worked on the development of a new form of ga
turbine, or what he called the 'pancake engine', with jet thrust exiting around the rim of the engin
This configuration led, naturally enough, to a machine with a central engine and exhausts all arou
its rim that did indeed look very much like a flying saucer.

Visiting US Air Force officials were clearly impressed, agreeing to fund the aircraft along with Av
Canada. Later on, the US Army came on board, and eventually, despite some terrifying tests with th
proposed power plant – engine fires were endemic – the first Avrocar was completed at Avro Canada
Malton plant, Ontario, in May 1959. A first free flight was achieved on 12 November 1959 – althoug
far from boldly going where no man had gone before, the Avrocar rose just a few feet above groun
and wobbled precariously at a top speed of 35 mph. On 9 June 1961, a demonstration flight for USA
and NASA witnessed a second prototype lifting itself over a six-foot-wide ditch and flying at ju
under 25 mph. The scream of its exhaust was painful to anyone coming anywhere near the Frisbe
shaped aircraft, while the heat generated inside the cockpit was enough to melt instruments. Man
Americans claim to have seen flying saucers spinning in the night skies above them in the years 'Jac
Frost toiled away north of their border trying to make this type of machine an earthly, as opposed t
an extraterrestrial, reality. Whatever those many Americans saw – especially those abducted an
subjected to X-rated probing by inquisitive visitors from other worlds – Avro Canada would have bee
able to assure them, categorically, that their UFOs were not from Planet Ontario. The project wa
cancelled by the US military in December 1961. By then, the Hawker P.1127 had been flyin
successfully for over a year.

Back in 1945, however, with Hitler and the Third Reich dead and disposed of, German ingenuity wa
being forcibly exported in human form to the Soviet Union and the United States and, to a less
extent, to Great Britain and France. But if the Second World War was over, leaving sixty million dea
in its devastating wake, a Third World War threatened almost immediately. This was not simply th
result of a clash between political ideologies, of communism – 'the Red Menace' – versus freedom
democracy and capitalism; rather, it was due to the simple fact that Stalin's Soviet Union had eithe
invaded or controlled Eastern Europe, and from 1949, with its new-found ally, the People's Republi
of China, seemed hell-bent on some form of world domination. This is certainly how many ordinar
people, as well as politicians and the military, felt in the West, and in fact they continued to do s
right up to the fall of the Berlin Wall in 1989 and the collapse of the Soviet Union two years late
While the threat of the Cold War prompted the design and accelerated the development of a
enormous variety of fast, powerful jet interceptors and fearsome long-range bombers to carry nucle
weapons, it also led to the genesis of the Hawker P.1127, an aircraft that the military thought of a
almost effete in its early years. If there was to be a shooting war with the Soviet Union, the Warsa
Pact and China, then most RAF and USAF officers, not to mention politicians and military strategist
believed this would be fought in the air with Mach 2 fighters and Mach 1 bombers, with guide
missiles and stand-off nuclear weapons.

But such an insane contest would have seen the probable destruction of every key military airbase
Europe, East and West, if not the kind of Armageddon that many feared and was so brilliantl
satirized in Stanley Kubrick's 1964 film *Dr Strangelove*, in which a crazed, cowboy hat-toting U
pilot, Major 'King' Kong, signalled the end of the world by riding an H-bomb like some buckin

bronco onto a Russian target from his Boeing B-52 Stratofortress. Any air force units that survive might only be able to take to the contaminated skies again to protect what was left of democrat Europe in aircraft that could be operated from a secret bunker, road or forest clearing. And if the were to do so, discreetly, suddenly and unexpectedly, those aircraft would need V/STOL capability Which is why, even while the main thrust of military aircraft development in the US, USSR, Brita and France was towards conventional supersonic jets requiring sophisticated and high-maintenan airbases, the dream – fast becoming a necessity – of VTOL and V/STOL flight was harboured in th late 1940s, nurtured throughout the 1950s and became a reality in the 1960s.

Winston Churchill, the British wartime premier who had done so much to help destroy Hitler, th odious Nazi regime and all its 'perverted science', was on the attack again mere months after th defeat of Germany and Japan. On 5 March 1946, now Leader of the Opposition in Britain, he gave speech at Westminster College, Fulton, Missouri:

> From Stettin in the Baltic to Trieste in the Adriatic, an 'iron curtain' has descended across the continent. Behind that line lie all the capitals of the ancient states of Central and Eastern Europe. Warsaw, Berlin, Prague, Vienna, Budapest, Belgrade, Bucharest and Sofia; all these famous cities and the populations around them lie in what I must call the Soviet sphere, and all are subject, in one form or another, not only to Soviet influence but to a very high and in some cases increasing measure of control from Moscow.

The term 'iron curtain' was not new. Writing in *Das Reich* in spring 1945, Joseph Goebbels, Hitler minister of propaganda, expressed concern at agreements made by Stalin, Roosevelt and Churchill the Yalta Conference that February to carve up Europe after the imminent German defeat, and mad the point that 'an iron curtain would fall over this enormous territory controlled by the Soviet Unio behind which nations would be slaughtered'. If this was rather rich coming from a man who himse condoned the savage and senseless slaughter of millions of hapless people, Goebbels was n altogether wrong. As the war drew towards its appropriately *Gotterdammerung*-style finale in Europ senior Nazis outdid one another in seeking last-ditch alliances with the Allies, who they believe were, at heart, as fiercely anti-communist and anti-Stalin as they were. While there was more than grain of truth in this, the Allies were determined to force Nazi Germany into an unconditiona surrender and, as this required the full force of the Red Army and a huge sacrifice from the Sovi Union in terms of human life, no one in Britain or the United States in their right political mind 1945 was going to turn against Stalin at that point. Indeed, such was the support for good old 'Unc Joe' that Churchill's iron curtain speech was widely condemned. Churchill despised Stalin an communism as much as he loathed Hitler and Nazism. And yet, he was one of the very politician who, even if he had little choice in the matter, had allowed the iron curtain to descend in the fir place.

The reality of this new political divide in Europe was soon evident. In June 1948, Stalin blockade Berlin in a blatant attempt to isolate the city, cutting its transport links to West Germany and so t supplies from the Allied powers – Britain, France and the United States. These, along with the Sovi Union, had been the occupying nations in Berlin, a city geographically stranded since the Na surrender in the new Democratic Republic of Germany. An iron curtain had indeed descended aroun Berlin, and the one way in was by air. In a spirited and defiant rescue operation that lasted the be part of a year, Allied aircraft flew 200,000 missions bringing food and supplies to Berlin, for the los through accidents, of seventeen US and eight British aircraft and the death of 101 military personn and civilians.

NATO, the North Atlantic Treaty Organization, was founded the following year: its mission

according to Lord Ismay, its first secretary-general, 'to keep the Russians out, the Americans in an the Germans down'. The Russians retaliated with the establishment of the Warsaw Pact in 1955. I between, the United Nations went into battle, with South Korea against North Korea and its backe China, in the Korean War of 1950–53. The United States was to be militarily engaged, in one part o the world or another, from then on and up until the present day.

It was the US Navy that made the first demand, in 1948, for VTOL aircraft and, curiously given th nature and design of aircraft carriers, it asked for tail-sitters. The idea, however, was for these fighte to operate from platforms mounted on the afterdecks of cruisers and destroyers. So where a warsh might have been equipped with a helicopter, now it might carry its own high-speed fighter escort o patrol and into battle. On paper, at least, the idea seemed attractive. It led to two dramatic, profoundly flawed, prototypes that the US Navy was to abandon in the mid-1950s. If nothing else, th Convair XFY Pogo and the Lockheed XFV put paid to the tail-sitter concept. The wonder of it is th these two rival experimental VTOL fighters performed as well as they did. From a practical point o view, however, they would have made precious little sense operating at sea in anything other than th calmest conditions. At the same time, it was always going to be hard for even the most athletic pilot t scramble in anything like a hurry into or out of the cockpit of one of these turboprop-powere machines – not least because he would have had to clamber up some sort of gantry and then shi himself from the vertical plane to the horizontal, like an astronaut manoeuvring himself into a spac capsule. And as for coming in to land at sea, this was trying at the very best of times, even for th most experienced test pilots, and would have been fairly hellish for less specialized service pilot especially in poor weather and low light with the sea – and warship – rolling and pitching.

The Lockheed XFV was the first of the two into the air, on 23 December 1953, flown by Lockheed chief test pilot, Herman 'Fish' Salmon, although its maiden flight was little more than a tentative 40 foot hop. It was powered by a 5,332 hp Allison YT-40-A-14 turboprop that drove three-bladed contra rotating propellers. This gave insufficient power to allow the Lockheed to take off vertically, and s all thirty-two test flights were made with the help of a temporary, clip-on and non-retractab undercarriage that enabled the 'Pogo Stick', as Lockheed staff dubbed the aircraft, to take o conventionally from a runway. It landed this way, too. Transitions from horizontal to vertical fligh and back were made in the air. No attempts were made to land the aircraft vertically, although it coul hover – just – in mid-air. In this configuration – in fact, in nearly all configurations – the danglin XFV would have been a sitting duck for enemy aircraft and ship's gunners. In any case, the XFV wa uncomfortable to fly and lacked anything like the performance of contemporary US Air Force an Navy jets. Although there was talk of a 7,100 hp version of the Allison engine that would have booste performance, there seemed little point in pushing further ahead with a type of aircraft that was clear wrong-headed.

In contrast, the Convair XFY Pogo achieved some success. A more compact machine tha Lockheed's, its 5,500 hp Allison YT-40-A-16 engine gave it sufficient thrust to take off vertically, an on 5 November 1954 Lieutenant Colonel James F. 'Skeets' Coleman made a successful transitio from vertical to forward flight and back again to land vertically, and safely. It had been a noteworth achievement, although it was more of a conjuring act than a performance the US Navy would real have wanted its pilots to enact day to day, at sea and in combat. A colour film of this first twenty minute flight, made under a deep-blue sky from the Naval Auxiliary Air Station at Brown Fiel California, is oddly moving. While watching it, I read a note – it could have been written by comedian – to the effect that Convair had provided the pilot with twenty-five feet of rope to shin dow if he had to make an emergency landing away from base. Something interesting had been achieve with this stubby, delta-winged fighter, but to what purpose in an age of fast and competent jet fighte that could shoot off from the decks of the existing carrier fleet? The Pogo continued to fly unt

November 1956, by which time the US Navy had lost interest in tail-sitters. Happily, both the Conva and Lockheed prototypes have been preserved, although neither is ever likely to hop, let alone fl again.

What these tests, and earlier experiments, confirmed was that a practical VTOL design should be close in general arrangement to a conventional aircraft as possible, and that it should be provided wi the same amount of power that by the mid-1950s jets were well able to deliver. The first VTOL je however, also took off with the nose pointing skywards, although, unlike the turboprops fro Lockheed and Convair, the Ryan X-13 Vertijet was suspended off the ground by a nylon cable hangin from the bright-yellow ramp of the lorry-mounted trailer that carried this compact, delta-wi machine. The ramp was raised from the horizontal to the vertical by hydraulic arms. The pilot, le dangling above the ground, was to fire up the X-13's powerful Rolls-Royce Avon jet and to release th hook holding the nose of the aircraft as he applied power and then made a quick transition to forwa flight. Coming in to land, the X-13 was brought back to the vertical and lowered close to the groun where the pilot would manoeuvre it back to the trailer ramp, hook up and switch off. Missio accomplished.

This was a complex way of going about VTOL flight, and yet the X-13 did exactly what it was aske to do. As did Bell's X-14. There is a delightful promotional film shot by the company on 11 Apr 1957 to demonstrate the progress it made with this experimental aircraft that year. Resembling mechanical moth, the silver machine, which had been commissioned by the USAF, perform faultlessly from and over Edwards Air Force Base, California – a performance repeated that summ in front of the Pentagon for an invited crowd of three thousand military officials, politicians an journalists. The precise nature of the flying, and the obvious control the pilot had over th experimental aircraft, were due in part to the vectored thrust of the jet engines and the provision 'puffers', or jet reaction controls, housed in the wing-tips. It was also down to the great skill of Bell test pilot, Peter Gerard, a highly experienced glider pilot who, raised on a Californian cattle ranc studied mechanical engineering at the University of California, Berkeley, and flew B-24 Liberat bombers with the USAF during the Second World War. Gerard lived to the ripe old age of ninety-two his soul slipping into the blue yonder in 2011. On 24 November 1953, he had been the first man hover in vertical flight, although this was at the controls of a test rig, rather than an aircraft, that Be had been working on since 1947.

Bell itself was no stranger to bold experimental aircraft design. The company, based at Niagara Fal Airport, New York, had designed and built the first US jet, the P-59 Airacomet in 1942; the X-1 rocke plane that first broke the sound barrier in 1947 with Chuck Yeager doing the 'right stuff'; and, c course, the thousands of P-39 Airacobra and P-63 Kingcobra fighters with their piston engin mounted, unusually, behind the pilot, many of which were supplied to and flown very successfully b the Soviet Air Force during the Great Patriotic War against Germany of 1941–5.

The pieces of the complex development jigsaw that culminated in the Hawker P.1127 were slowl coming together: engineers, on both sides of the Atlantic, started to see the big picture. At much th same time as Bell built and hovered its jet test-rig, Rolls-Royce produced its Thrust Measuring R (TMR), or 'Flying Bedstead', a device designed under the direction of Dr Alan Griffith, th company's chief scientist, and powered by a pair of Rolls-Royce Nene turbojets. The contraptio which looked like some early prototype for a British lunar landing module, was used for research in controlled hovering. It was a dangerous machine to fly, with sluggish throttle control, little in the wa of stability, and just ten minutes of fuel. Rolls-Royce test pilot R. T. Shepherd managed a free te flight on 3 August 1954, but when the machine was transferred soon afterwards to the Royal Aircra Establishment (RAE) at Farnborough, it crashed, killing its pilot; the second TMR crashed in 195 This risky machine did lead, however, to the development of Griffith's RB.108 engine, a jet designe

specifically for VTOL and hovering aircraft. The British government took an interest and, in Octob 1954, Short Brothers of Belfast was awarded a contract for two experimental VTOL aircraft base around the Rolls-Royce engine. Griffith himself was toying with the idea of a VTOL superson airliner powered by dozens of RB.108s that would have flown confidently from London to Sydney.

The tiny, bug-like Short Brothers aircraft, designated SC.1, were packed off to the RAE Boscombe Down when complete in 1957. With its four RB.108s, mounted in the middle of th fuselage, blasting down and test pilot Tom Brooke-Smith at the controls, the second aircraft achieve the first untethered hover on 25 October 1958, two years ahead of the P.1127, while the all-importa transition from vertical to forward flight, aided by a fifth, tail-mounted RB.108, took place on 6 Apr 1960. The SC.1 was a low-performance aircraft, with a top speed of 246 mph and a ceiling of ju 8,000 feet, but the point of the exercise was to see if a jet aircraft could take off and land verticall hover, and make the transition from vertical to forward flight. These things happen at low speeds. T ensure stability at low speed and when hovering, the engines of the delta-wing aircraft provided thru to small control jets under the nose and tail and at the wing-tips. Information gathered from the RA tests was supplied to Hawker, while the aircraft made themselves known to the public at th Farnborough and Paris air shows between 1958 and 1961. Sadly, the second aircraft, XG905, crashe at Belfast on 2 October 1963 when an auto-stabilizer failed, killing its pilot, J. R. Green, who ha joined Short Brothers from the RAF, where he had been flight commander of 2 Squadron, based i Germany and flying Supermarine Swifts. Green's death was a reminder of the fact that the SC.1, a indeed the P.1127 was to be, was very much an analogue aircraft from an era largely innocent o computers, although the Belfast-built aircraft were among the very first to employ fly-by-wi technology. The two aircraft, XG900 at the Science Museum, London and XG905 at the Ulster Fol and Transport Museum at Cultra, Northern Ireland, have both been preserved. They led long lives fo experimental aircraft, only retiring in 1971.

The 'missing link' between the SC.1, and all the earlier VTOL experiments, and the P.1127 was th work of neither an American nor a German or British engineer. The inventor of the idea of vectored j thrust – the heart and soul of the Harrier and the Lockheed Martin F-35B or Lightning II scheduled replace the British jump jet – was a Frenchman, Michel Wibault (1897–1963). Born in Douai, Wibau had established his own aircraft company in 1919. He made early use of all-metal construction an was well known to Vickers in England, a company interested in this aspect of his work. With th Germans closing in on Paris in 1940, Wibault escaped to London where, soon afterwards, Gener Charles de Gaulle, leader of the Free French, appointed him technical director of France Forever, a organization dedicated to galvanizing support for de Gaulle, in the United States. Wibault made h way to New York, where he took on a job with Republic Aviation and worked on designs for the XF 12 Rainbow, a sleek, four-engined, long-distance reconnaissance aircraft of which just two were bui in 1945 before their role was usurped by now-redundant Boeing B-29 Superfortresses, and for the lov cost RC-3 Seabee seaplane, of which 1,060 were built, and some two hundred and fifty still fly toda a number of them in regular commercial service.

In New York, Wibault was introduced to Winthrop Rockefeller, the billionaire politician an philanthropist, who was to fund the French inventor for the rest of his career. While still in the Unite States in the early 1950s and now having the luxury of time to think, Wibault took out a number o patents related to VTOL flight. In 1955, he came up with the idea of an aircraft driven by a sing turbine feeding four centrifugal compressors, which looked like giant 1950s hair-dryers, or sna shells, mounted in tandem on either side of the fuselage around the centre of gravity. These could b turned to any angle from straight down to the ground to facing horizontally rearwards; in other word Wibault had come up with a convincing patent for a vectored VTOL jet. His design was a litt complex in terms of mechanical engineering, but this was something that Hawker would sort out ov

the next few years.

The connection between Wibault and Hawker, however, had yet to be made. This came about when after Wibault had failed to interest the French military and industry in his patent, an officer in the USAF, Colonel John Driscoll, introduced the French designer to Stanley Hooker. Hooker was the brilliant aero-engine designer who had formerly worked with Rolls-Royce and is famous today – as he should be – as the brains behind supercharged variants of the wartime Rolls-Royce Merlin and the Bristol Olympus turbojet fitted to the Avro Vulcan and Concorde. He was also the engineer who came back from retirement to oversee the transition into production of the then-threatened but ultimately highly successful Rolls-Royce RB.211 jet engine, an achievement for which he was awarded a well deserved knighthood in 1974.

At the time of this first meeting in Paris in late 1955, Driscoll was senior air officer with the Mutual Weapons Development Programme (MWDP), a NATO organization funded by the Pentagon and based in Paris. Driscoll had passed Wibault's design on to the chairman of NATO's Advisory Group for Aeronautical Research and Development, Dr Theodore von Karman of the California Institute of Technology, who strongly recommended the proposal. The following March, Wibault sent Hooker a copy of a brochure outlining details of his VTOL design. Hooker forwarded this to Gordon Lewis, his young number two, who was to be jointly responsible for the Olympus turbofan and later, as technical director of Rolls-Royce, led the design of jet engines up to and including the EJ200 that today send Eurofighter Typhoons rocketing and pirouetting through footless halls of contested air. Lewis simplified and lightened Wibault's engine layout and, following a momentous meeting between Wibault, Hooker and other interested parties, the Frenchman agreed to work with Bristol. A patent for the revised VTOL power plant was filed on 29 January 1957; the names attached were those of Michel Wibault and Gordon Lewis.

Lewis and his colleagues did much work during 1957 on the design of a power plant that would be much lighter and simpler, as well as more powerful and efficient, than the original Wibault proposal based on the Bristol Orion jet. This was the Bristol Orpheus, and although Hooker had expected Short in Belfast to take up the bait, it was Hawker in Surrey who became interested. A week before he paid a visit to the 1957 Paris Air Show, Hawker's legendary chief designer Sydney Camm (1893–1966) dropped a note to Stanley Hooker at Bristol:

> 17th May 1957
> Dear Dr Hooker,
> I saw recently a film on the Ryan V.T.O aircraft and it started me wondering whether we ought to give more attention to this possible development. I have also heard that you have given some consideration to it and I should very much like to have your views. My own view is that before we can go very far we would have to have in mind the practical application of the aircraft; in other words it could not be merely a research aircraft.
>
> There are many aspects, of course, of this development. Up to the present I have thought that the arrangement in which engines are carried merely for take-off and landing would be bad for the overall efficiency but Rolls, on the other hand, have suggested that this is probably the best arrangement.
>
> I am sorry I omitted to discuss this with you when I was down at Bristol. Perhaps you can drop me a line about it.
> Best wishes,
> S. Camm

Camm was to British military aircraft what Hooker was to the engines that sent some of the very be

of them soaring skywards. Nurturing his career through the Windsor Model Aeroplane Club, by 192
Camm was chief designer for the Hawker Aircraft Company. To the genius of Camm, we owe th
Fury, Hurricane, Typhoon, Tempest, Sea Fury, Sea Hawk and Hunter fighters. Now he was about t
add what was to become the Harrier to this pantheon of inspired, highly effective and quintessential
British military aircraft.

At the Paris Air Show, Camm was taken around by Major Gerard Morel, the French representativ
of Bristol and Hawker, who asked him if he knew what Hooker and his colleagues were up to. Th
piqued Camm's interest further. When he returned to Kingston, Hooker had sent him a brochure of th
proposed Bristol BE.53 VTOL engine. Camm was not altogether convinced. He doubted Bristol
claim that the engine would develop 11,000 lbs of thrust and, because of this, he thought it would b
best fitted to a small STOL aircraft, although he was unsure quite what that aircraft might be. In an
event, he sent one of his young senior design engineers, Ralph Hooper, to Bristol to see what was u
and what Hawker might do with this undoubtedly interesting proposition.

This correspondence and these trips were made at the very same time as Duncan Sandys, the new
appointed minister of defence in Harold Macmillan's Conservative government, was defending h
White Paper on Defence in Parliament. Aiming to cut £100 million from Britain's defence budge
Sandys's *Defence: Outline of Future Policy* took careful aim at the RAF and the aircraft industry.

'We are unquestionably moving toward a time when fighter aircraft will be increasingly replaced b
guided missiles and V-bombers by ballistic rockets,' the White Paper stated, adding soothingly, 'bu
all that will not happen overnight. The introduction of these new weapons will be a gradual proces
extending over a good number of years, and even then there will still remain a very wide variety
roles for which manned aircraft will continue to be needed.'

Would they? In fact, the Sandys report led to the cancellation of several key military aircra
projects, including Hawker's supersonic P.1121 fighter, a promising successor to the superb and bes
selling Hunter. In the event, only the English Electric P.1, the glorious and long-lived Mach
Lightning interceptor, was allowed to go ahead because work on the project was far advanced. Th
Lightning had made its maiden flight in April 1957, the same month the Defence White Paper wa
announced to the House of Commons, and it would have been very expensive to cancel it at this la
stage. The only other aircraft approved was the TSR-2 (Tactical Strike and Reconnaissance Mach 2),
potentially very fine aircraft indeed developed jointly by English Electric and Vickers Armstron
This project was to be cancelled in 1965 by Harold Wilson's Labour government, which preferre
instead to buy American McDonnell Douglas F-4 Phantom fighter-bombers to the detriment of Britis
industry and its workers – the latter were only rarely a Labour priority – and a few British Blackbu
Buccaneer strike aircraft. Furthermore, the decision to buy Phantoms was only made after the Wilso
administration had ordered and then cancelled swing-wing General Dynamics F-111 bombers from th
United States. Huge sums had to be paid in compensation.

It is possible to see the logic of the Defence White Paper. How could fighters be of any use again
nuclear missiles, and what fighters would there be to prosecute any kind of war if a single Sovi
bomber got through to West Germany and dropped an H-bomb? At my London primary school in th
1960s, we used to sing these words to the tune of 'Ten Green Bottles':

Ten little H-bombs hanging from a wall,
Ten little H-bombs hanging from a wall,
And if one little H-bomb should accidentally fall,
There'll be no more H-bombs and no blooming wall.

Recalling a well-known post-war Pepsodent toothpaste ad, older children had sung: