

# BIOGRAPHICAL MEMOIRS

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## JOHN WILLIAM FOZARD, O.B.E.

16 January 1928–17 July 1996

Elected F.R.S. 1987

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The name of John Fozard will, in aeronautical circles, for ever be linked with the Harrier and vectored thrust jet V/STOL—that species of aeroplane endowed with the ability to take off and land either vertically or in a short distance by jet engine propulsive nozzles which may be rotated from pointing conventionally rearwards through any angle downwards to forwards of the vertical. He did not conceive the idea of the vectored thrust engine or of vertical take-off aircraft or even the basic layout of the uniquely successful Harrier jump jet. However, when put in charge of its development he not only led the team that turned a ‘demonstrator’ into an operational fighter to a demanding specification that could be built economically in large numbers to a fixed-price contract, but also embraced the concept of vectored thrust jet V/STOL with a religious zeal and set about preaching its gospel far and wide.

Testament to John’s success is the fact that at the time of his death in 1996, 36 years after the Harrier’s prototype first flew, current model Harriers are in frontline service with the Royal Air Force, the Royal Navy, the United States Marine Corps (USMC) and the Spanish, Italian, Indian and Thai navies. As to the future, it is accepted by the USMC and the RN that their next generation of attack fighter, currently known as ‘JSF’ (Joint Strike Fighter) will be a STOVL (short take-off, vertical landing—the contemporary manifestation of the original V/STOL acronym with changed emphasis) aircraft. Of the two contenders recently selected to build ‘demonstrators’, one favours pure, single engine vectored thrust like the Harrier (Boeing), and the other vectored thrust with a vectored thrust lift fan (Lockheed-Martin). The winner, whichever it is, will be flying the Fozard banner far into the 21st century.



*W. G. S. 1931*

## YORKSHIRE ORIGINS

As a small boy John displayed a natural talent for line drawing and a fascination with the complex machinery to be found in the woollen mills of his home county, Yorkshire; fitting attributes for a potential engineer. An early interest in aviation was sparked by a visit from Alan Cobham's Flying Circus, which a penniless 10-year-old John viewed from outside the airfield boundary. This foundation was to be built on, some three years later, when a shot-down Messerschmitt Me109 was displayed in Heckmondwike market square for fundraising in the 1941 Wings for Victory week. John passed through the square on his way to and from school, so was able to spend many a happy hour looking and admiring but never dreaming that one day he would work for the greatest fighter designer in the country. But before we trace this latent career, let us look at John's family and home background.

There have been Fozards in the Spenn Valley of West Yorkshire, some nine miles southwest of Leeds, since the 15th century, as evidenced by gravestones in Batley churchyard of two other John Fozards: one of 1680–1733, another of 1717–1767. Our John's grandfather was Sam Fozard (b. 1855), a skilled colliery blacksmith who married Martha Taylor in 1878. They had 11 children, eight boys and three girls. Another John Fozard, but known as Jack, was the second of these children, born in 1880. Heavily built, he became an underground face worker in the coal mines and secretary of the local National Union of Mineworkers. So he toiled for 23 years until the Great War when, in 1914, he volunteered for army service. Rising to the rank of lance corporal in the Royal Horse Artillery, he fortunately spent the entire war on the North-West Frontier of India. After the war Jack became a carter and haulier and in 1927, at the age of 47, married Eleanor Paulkit.

She was the survivor of two children born to Will and Alice Paulkit, who had married in 1890. Sadly, Will was killed while attending a Territorial Army summer camp nine years later, leaving Alice pensionless to find work in the local woollen mill in order to bring up her two young daughters. The harsh and oppressive working conditions led her to become active in the Labour Party in the drive to improve the life of the working class. Daughter Eleanor left school at 13 or 14 also to work in the woollen mills, and she too became a committed Labour activist and organizer for her local union branch. It is not known where or when she met Jack Fozard, but she became pregnant and they were married in Dewsbury Register Office in October 1927, their son John being born on the 16 January 1928 at home—21 Home Street, Millbridge, Liveridge. This was a humble terraced dwelling: one up, one down, a cellar and a shared, detached w.c.

Christened John William at the local Wesleyan chapel, he started his education at the early age of 4½, a hundred yards from home at the Millbridge Church of England Elementary and Primary School. The 200 children aged 4 to 11 were firmly taught the three Rs, doing their written work on slates. Family fortunes were low at this time as Jack was unable to work as a result of spinal injuries accrued during his mining days and the only regular earner was grandmother Paulkit. Unaffected by the hardship, John proved to be intelligent and an effortless achiever, enjoying school and learning.

In 1938, John was selected to go on to Heckmondwike Grammar School, where he studied for five years to gain a formidable set of School Certificates from the Northern Universities Joint Matriculation Board. During this period, in 1942, John joined the Air Training Corps, soon after his infatuation with the Me109. He enjoyed his first air experience flight, as it is called by the ATC, in an Armstrong Whitworth Whitley bomber on 5 November 1942 at RAF Lindholme. With the ATC he visited a number of northern bomber bases and flew in Avro

Lancasters and a Handley Page Halifax and Sparrow. After some 18 months as a cadet, performing well at morse, aircraft recognition and drill, John approached the CO in the hope of advancement in rank. However, he was deemed 'unsuitable for further promotion' (John selected this phrase to be the title of the autobiography he was working on when he died). Thus his service career stalled.

In the light of John's excellent School Certificate results, his headmaster arranged interviews with Blackburn Aircraft Ltd at Roundhay Road, Leeds, and A.V. Roe & Co. Ltd at Yeadon, a wartime 'shadow factory'. He was accepted by Blackburns as an indentured apprentice but was directed, exceptionally, by apprentice supervisor Tom Wolstenholme along the engineering degree path rather than towards the usual Ordinary National Certificate. So John started two years of three evenings and one day release study at Leeds College of Technology, thanks to Blackburn's enlightened approach to training. Back at the factory, John worked in the shops where the Fairey Swordfish torpedo bomber biplane, and its less successful successor the Fairey Albacore, were being built. Here he became familiar with the details of aircraft construction as he helped build wing spars for these aeroplanes.

In June 1946, John gained a London University Intermediate Degree. At about this time, Blackburn's Leeds factory closed and John moved to their Brough site near Hull. A West Riding Council scholarship allowed him to continue his degree studies full time at Hull Municipal Technical College and in July 1948 he gained a University of London External B.Sc. with first class honours in aeronautical engineering.

While at Hull, John came across the Fedden Report (1946). Sir Stafford Cripps, when Minister of Aircraft Production towards the end of the war, set up a committee under Sir Roy Fedden to look into the best way of handling aeronautical education in the postwar years. The report recommended the establishment of a college to teach aeronautics at postgraduate level, with major departments for aerodynamics, aircraft design and propulsion, including flight testing and experimental work, with the opportunity to study problems in flight. The resulting College of Aeronautics was opened at Cranfield in 1946 with a first intake of 38. The then head of the project office at Hawker Aircraft Ltd, Robert (now Sir Robert) Lickley, had been invited to set up the Department of Aircraft Design, an event that was to help John's career move in the right direction. It became John's aim to get to Cranfield and this was realized, by an extension to his WRCC scholarship, when he joined the third entry in 1948.

Besides obtaining a Diploma of the College of Aeronautics with a distinction in aircraft design (under Professor Lickley), John learned to glide, went solo in a Tiger Moth and terrorized Bedfordshire cricket teams with his Yorkshire-style fast bowling. Between his two years at Cranfield he spent the long vacation in the stress office of Saunders-Roe Ltd at Cowes, working on the giant and beautiful but misconceived Princess flying boat. During his second year he started looking for jobs and had interviews with Shorts (also jet V/STOL pioneers in Britain), English Electric and, among others, Hawker Aircraft Ltd at Kingston-upon-Thames.

### ONE OF CAMM'S YOUNG GENTLEMEN

John was seen by Hawker's great chief designer, Sydney Camm, who offered him a position in the stress office with a transfer after six months to the project office. This department was concerned principally with preliminary design, but encompassed aerodynamics, weapon systems and other technologies not catered for in the main design offices. Unbeknown to John,

Hawkers were not enamoured of Cranfield, it being the view of Camm's deputy, Roy Chaplin, that it would have been better to allocate the Cranfield funds to existing universities. Hawkens had, in fact, taken only one Cranfield graduate previously, Ralph Hooper from the first intake. His and John's careers were to be closely linked. However, Professor Lickley had spoken to his former colleague, Chaplin, expounding the merits of Cranfield graduates in general and Fozard in particular.

So it was that John headed south in 1950 to join the team that had the finest fighter design pedigree in the UK. Tom Sopwith had set up his aviation business at Kingston in 1912 and Hawker Aircraft Ltd was its direct descendant. Famous fighters from Kingston included the Pup, Camel and Snipe from the First World War, the Fury and Nimrod between the wars and the Hurricane, Typhoon and Tempest from the Second World War. Prior to John's arrival the postwar jet era had started with the Sea Hawk, and the classic Hunter was about to emerge.

In 1951, John married Mary Ward, youngest daughter of Regimental Sergeant Major C.B. Ward, V.C., of the King's Own Light Infantry. They lived at first in a flat in Hampton Wick but soon moved to a small house in Thames Ditton about 10 minutes' drive from Hawker's Kingston factory and offices in Canbury Park Road. John took a night school course in furniture making, built a garage—later to house his VW Beetle—and lectured in aerodynamics at Kingston Polytechnic. In due course John and Mary adopted two baby boys, Paul and Nigel. As John's career progressed so the family moved to St George's Hill in Weybridge where he bought, on a fixed interest rate mortgage (the wisdom of this choice becoming clear when interest rates soared), a small bungalow. Set in a large garden among the luxury homes of wealthy professionals and show business celebrities, this proved ideal for extension and improvement in step with John's growing status and salary. Its style reflected the best of contemporary domestic architecture and he was to live there until 1987, but sadly the marriage began to founder in the 1970s and in 1985 the divorce became absolute on the grounds that the marriage had irretrievably failed. Mary moved to a house of her own and both boys were now young adults making their own way in the world.

When John joined the 'young gentlemen' of Camm's project office its head was Vivian Stanbury, who resigned in 1956 to join Rolls-Royce cars as chief designer. It is his signature that approved John's early project designs. Bob Marsh succeeded Stanbury and John became his deputy in 1960 and took over as head of the project office in 1961, when Marsh was promoted to assistant chief designer projects.

A project numbering system was introduced by Camm in 1940 starting with the P1000—a single-seat Napier Sabre powered fighter—to leave room for all the earlier Sopwith and Hawker projects. The last in the series was the P1246 of 1989, a supersonic V/STOL design, after which all mainline project work was moved from Kingston to British Aerospace, Warton.

During his 10 years in the project office John was a prolific designer, scheming a wide variety of configurations, including the P1089 rocket-powered delta fighter, P1090 50°-sweep Gyron Hunter, P1091 delta Hunter, P1092 two-seat blended delta all-weather fighter, P1093 single-seat blended delta, P1096 delta research aircraft, P1097 swept-wing research aircraft, P1098 twin-radial-engined light transport, P1100 rocket-boosted supersonic Hunter, P1102 supersonic Hunter development, P1103 supersonic fighter, P1104 twin-podded engine M2 fighter, P1106 big-wing missile-armed Hunter, P1107 straight-wing 4-6 engine supersonic fighter, P1116 M2 fighter, P1121 M2 strike fighter, P1124 supersonic two-stage target system, P1128 seven-seat business jet, P1131 four-turboprop long-range freighter, P1134 M3-4 research aircraft, P1136 V/STOL canard with four lift engines, P1139 V/STOL fighter with



two lift engines and lift/cruise engine, P1140 supersonic V/STOL fighter with four lift engines, P1149 variable sweep supersonic fighter with six lift engines and the P1152 supersonic V/STOL fighter with variable incidence wing and 4–8 lift engines. Other designs not allocated P numbers included supersonic research aircraft, a Gyron-powered supersonic fighter, a slender delta supersonic research aircraft and an annular jet and jet flap VTOL aircraft. While in the project office John was also seconded to Hawker Siddeley Aviation's Advanced Project Group, located at Kingston, to work on its supersonic transport proposal.

As is the case with most project studies, none of these, with the partial exception of the P1121, was built, but the work done solving the design problems added to the body of knowledge at Hawkers. It should be understood that there were sometimes many versions of a P number project and these could be by different project designers, and also one project could be developed to such an extent that it was renumbered. A good example among the above, is the P1103. John's was not the only configuration drawn to meet that Operational Requirement, there being very many studies by Ralph Hooper and others, both in the project office and the experimental drawing office over the period from early 1954 to 1956. In 1956, Hawkers, having been unsuccessful with their submission to what had become Ministry Specification F135T, decided to continue on a PV (private venture, company-funded) basis with the design now renumbered P1121. Again, many versions were drawn before the definitive configuration was arrived at and the Hawker Board decided, in January 1957, that PV design, rig testing and manufacture should commence. In the event, this work was stopped in early 1958 when the airframe was 60% complete. This had been brought about by the emergence of a more arduous Operational Requirement and the 1957 Duncan Sandys Defence White Paper indicating no future UK need for manned fighters. The hiatus in work at Kingston consequent upon the halting of the P1121 effort no doubt was instrumental in the conservative Camm deciding to start work on the radical V/STOL opportunity offered by Stanley Hooker at Bristol Aero Engines, and his new vectored thrust jet engine, the BE53.

### JET V/STOL GENESIS

At another desk in the project office Ralph Hooper was devising aircraft configurations around this new engine, later to be named Pegasus. He developed these schemes into the P1127 vectored thrust V/STOL strike fighter prototype, of which six were built. The first flew tethered vertical take-off and landing hops in October 1960, with the first free hover, by Dunsfold chief test pilot Bill Bedford, on 19 November. By September 1961 the complete sequence of VTO, transition to wingborne flight, and back to the hover and VL had been demonstrated as entirely practicable, and by the end of the year supersonic speed had been achieved in a dive. As project designer, Hooper developed the P1127 prototype into the P1127 Kestrel service evaluation aircraft which, in the hands of a tri-national (UK, US, Federal Republic of Germany) squadron with nine aircraft proved the military value of V/STOL. The Kestrel was the first jet V/STOL aircraft in the world to be cleared for use by regular service pilots.

Next Hooper turned to supersonics, with the P1150 and P1154 supersonic vectored thrust V/STOL tactical strike and reconnaissance fighters. The latter won the international competition to meet NATO Basic Military Requirement No. 3 (NBMR 3) against 11 major fighter design organizations from the US and continental Europe. However, the competition

collapsed for political and funding reasons (NATO has no funds; each member nation provides its own), but the British government decided to go ahead unilaterally with P1154 versions for the RAF and RN.

The P1154 programme became the victim of misguided government policy, differing operational requirements and fruitless Treasury spending cuts, a saga worthy of a book in itself. Prior to John's appointment as chief designer P1154, the NBMR3 design had been altered to meet the RAF requirement for a single-seat, low-altitude strike fighter and considerably redesigned for the RN's two-seat, high-altitude, Mach 2 all-weather interceptor role. The Government, at that time inspired by the McNamara (US Secretary of Defense) doctrine of airframe commonality between services, rejected these designs as being too different, so Kingston, by now Hawker Siddeley Aviation–Hawker Blackburn Division, embarked on a lengthy struggle to make the two types more and more similar with, at each stage, the designs inevitably becoming more and more compromised. In the autumn of 1963, the navy was making strong moves to withdraw completely because by that time the 'bi-service' P1154 was on the table. This was a single-seat fighter, the same for both services except for the avionics fit, undercarriage layout and folding wings for the navy, who now felt that their needs had been compromised out of existence.

It was to this background that John's interview with HSA's managing director, John (later Sir John) Lidbury, took place in October 1963, when he was offered the position of chief designer P1154. Camm was then director of design for HSA and John was also charged with the task of keeping Sir Sydney happy; a condition of acceptance. There already existed, as John put it, 'an excellent apprentice–master relationship' between the two men, so John happily accepted the new challenge. The chief engineer at the time and John's immediate boss was Barry Laight, a recent arrival from Blackburns.

In the event the RN did withdraw from the P1154 in 1964 (to buy US McDonnell Phantom fighters re-engined with Rolls-Royce Speys; supposedly a simple change but in fact a very expensive mistake which failed to yield the predicted performance improvement), so John's task was to turn the P1154 back into a single-service RAF aircraft. Work continued apace: mock-ups were built, rig tests carried out, drawings issued, components manufactured and assembly commenced, but in February 1965 the Wilson government cancelled the entire project (together with the Armstrong Whitworth AW681 jet V/STOL transport and, shortly afterwards, the TSR-2). For Kingston the blow was softened by the go-ahead for a developed version of the P1127 Kestrel to serve a somewhat reluctant RAF as a V/STOL strike reconnaissance aircraft, the Kestrel Development.

## ENTER THE HARRIER

In 1965, John was appointed chief designer P1127 (RAF), the definitive designation until the name Harrier was officially adopted in 1967. Although the basic layout of the aircraft was settled, John's responsibility was to manage the thousands of changes needed to ensure that the resulting fighter met all the requirements specified by the customer within the firm budget constraints imposed by a fixed-price contract, the latter being an innovation in British military aircraft procurement. The P1127 (RAF) had to be a minimum change from the Kestrel yet incorporate much of the novel avionics and weapon systems from the P1154 (a much larger aircraft), mount two 30 mm Aden guns and carry munitions, fuel tanks, practice weapons,



flares and reconnaissance pods on five pylons. Equipment new for that era included a head-up display (HUD), inertial navigation system (INS), weapon-aiming computer (WAC) and moving map display. The aircraft also had to be easily serviced, highly reliable and survive a punishing air and inertia loads regime imposed by a comprehensive service fatigue life spectrum. Extensive programmes of structural and system rig tests had to be planned and executed, wind tunnel tests to optimize the wing aerodynamics had to be completed and, always in the front of any chief designer's mind, thousands of drawings had to be prepared, checked and issued to the shops so that the vital development batch and subsequent production aircraft could be built to the contractual programme agreed with the customer. John inspired the team that achieved all this and the first P1127 (RAF), XV276, was flown at Dunsfold late on the 31 August 1966 by Bill Bedford.

This was just the first of several milestones, but now the all-important flight test programme could get under way. John led his teams at Kingston and Dunsfold to good effect and fought the company's corner at frequent meetings with the Ministry of Defence and the RAF. Knowing full well that the Harrier would stand or fall on the performance, behaviour and life of its Pegasus engine, he now nurtured the excellent and special working relationship existing with the Bristol Siddeley development team at Filton, led by John Dale. Much important time and effort was saved by this typically Fozardian direct contact approach to mutual problem solving, a principle he applied to all major suppliers, customers and operators.

The Harrier GRMk1 was cleared for service use, or granted a CA (Controller of Aircraft) Release, in April 1969, less than three years from first flight—no mean achievement for a conventional fighter but even more significant for the world's first fully operational jet V/STOL aircraft. The two-seat Harrier TMk2 entered service with the RAF in July 1970 as a trainer, with the full operational capability of its single-seat brother only marginally reduced, a mere 15 months after chief test pilot Duncan Simpson flew the first one, XW174. There can be no doubt that John's inspirational leadership was a major factor in these unique achievements.

At about this time John, now also deputy chief engineer since 1968, gave the first of many jet V/STOL lectures, the First JD North Memorial Lecture, before the Birmingham and Wolverhampton branch of the Royal Aeronautical Society (RAeS) on 26 February 1969. Entitled 'The Harrier—an engineering commentary', the paper (1)\* was published in the September *Aeronautical Journal* and was awarded the RAeS George Taylor Prize for the best published paper on design and construction of aircraft. The paper not only addressed the design philosophy of the Harrier but also discussed the military merits of jet V/STOL, a theme that was to become ever more prominent in his future papers. Also in 1969, John masterminded the preparation of what at the time was the most thorough description of an aircraft ever published in a UK journal—in this case *Aircraft Engineering* (2). Issued in five monthly parts from December 1969, it was written by his senior specialist engineers, as well as by himself, and covered every aspect of the Harrier's design and development.

In September 1970, John presented his paper 'Engineering solutions to some conflicts between transonic flight and jet V/STOL' (3) at the Seventh Congress of the International Council of Aeronautical Science in Rome. Here he explained the rationale of the Harrier layout as well as describing the solutions adopted to a number of development problems. Another prizewinning paper, 'Harrier—the first of the new' (4), sponsored by the Society of

\*Numbers in this form refer to the bibliography at the end of the text.

Engineers, was presented at the London International Engineering and Marine Exhibition in April 1971, winning the Society's Simms Gold Medal. This paper discussed at some length the benefits of jet V/STOL in the naval environment, drawing on the experience of P1127, Kestrel and Harrier trials carried out on 12 ships.

The Harrier entered service with the United States Marine Corps (USMC) in April 1971 as the AV-8A and so started to accumulate really significant experience in operating at sea from a variety of ships and aircraft carriers. In the preceding 2½ years since the initial evaluation of the Harrier at Dunsfold, by USMC Colonel Tom Miller and Lt Col Bud Baker, John had travelled many times to the US to help 'sell' the Harrier and jet V/STOL to the US Navy who controlled the USMC budget. In this period John built a lasting, close relationship with the US armed forces, government agencies and industry, the McDonnell Aircraft Co. being HSA's Harrier licensee in the US. Originally it had been planned that the USMC Harriers would be built by McAir, but this proved impractical and all 102 single-seat AV-8As and eight TAV-8A two-seat trainers were built by HSA. The Spanish Navy also bought AV-8A and TAV-8A 'Matadors', which they operated from their wooden-decked carrier *Dédalo* until they were sold to the Royal Thai Navy in 1996.

There was to be close collaboration between John's team at HSA Kingston and Larry Smith's at McAir St Louis on developing the Harrier/AV-8A. The first such collaboration, in the early 1970s, was the AV-16 'Advanced Harrier' project, which resulted in the delivery to the UK and US governments of a multi-volume report of several feet total thickness. This described a Harrier development with an increased thrust Pegasus engine in versions for the USN, USMC, RN and RAF—the AV-16A. A UK appendix covered a supersonic design, the AV-16S. John took personal charge of those parts of the joint report written at Kingston and was, of course, in continual contact with Larry Smith via datafax, telephone, telex and personal visit. Although the submission was rejected for cost reasons, largely due to the new engine, the exercise which exposed John to the full panoply of the American way of military aircraft procurement was to stand him and HSA/BAe in good stead in the future, when another Anglo-American Harrier would succeed and Kingston's Hawk would sell to the US Navy.

## SEA HARRIERS AND SKI JUMPS

Royal Navy interest in jet V/STOL had been awakened on 8 February 1963 when Bill Bedford flew the first P1127, XP831, from Dunsfold to HMS *Ark Royal* for five days of exceptionally successful trials, by Bill and his deputy Hugh Merewether, which proved the basic compatibility of jet V/STOL with aircraft carriers at sea. We have seen how the RN P1154 foundered, but in time it became clear to the admirals that Britain could not afford a new 50 000 ton carrier for their Phantoms and Buccaneers and that the only way to keep fixed-wing air power under Navy control would be to adopt a type that could be flown from their planned 'through-deck' cruisers intended for helicopters only. So in 1971, the Directorate of Naval Air Warfare (DNAW) issued a Naval Staff Target for a fighter, reconnaissance and strike aircraft capable of operation from the new CAH 'Invincible' class ships.

As usual, John, an HSA Kingston executive director since 1971, grasped this opportunity with enthusiasm and much preliminary project work had been completed when feasibility and design study contracts were received at the end of 1972. Again, the object was a minimum change design from the RAF Harrier, adapted to meet RN requirements which included a large

nose-mounted radar, a new digital head-up display and weapon-aiming computer, an attitude and heading reference system, a Doppler radar, autopilot, missile armament, twin electrical generators and deck handling equipment. The RAF Harrier had been criticized for its poor rearward view during air combat and John used the radar installation to achieve a dramatic improvement. He promoted the idea that to house the radar equipment properly in the front fuselage it was necessary to raise the cockpit to provide extra volume. The aircraft would then require a bubble canopy over the pilot, who now sat 10 inches higher with an excellent rearward view. John knew that he would have failed had he tried to sell this extra cost change on the basis of view alone. The change was agreed by the Ministry, to the delight of potential RN Harrier aviators.

With design studies completed and the formal Development Cost Plan submitted, in 1973 agreement was reached by the government that the programme should proceed. However, a number of factors dramatically intervened: the world fuel crisis, the mineworkers' strike, the three-day working week and a change of government. In this period, as well as leading the design team, John was heavily involved in politics and lobbying, including writing papers on the economic benefits to the country of the Navy Harrier programme. Eventually, in May 1975, the go-ahead was given when the Secretary of State for Defence announced that a fixed-price contract was to be awarded for an initial batch of Sea Harrier FRS Mk1 aircraft.

In parallel, John and his team had been developing and proving an idea by Lt Commander Doug Taylor, RN, for significantly enhancing the take-off performance and launch safety of V/STOL aircraft from ships—the 'Ski-Jump'. John adopted this idea and promoted it with great fervour within HSA and the Ministry of Defence. The result was that, in 1976, HSA Kingston was contracted to design and build an adjustable ski-jump ramp and to conduct flight trials to measure the performance improvement and to establish aircraft handling techniques. The outcome was an unqualified success and the RN installed ski jumps on all three 'Invincible' class ships and on HMS *Hermes*, the first ship to operate Sea Harriers.

In July 1972, John Farley, who as chief test pilot was to fly the first Sea Harrier in 1978, took HSA's demonstrator Harrier Mk52 two seater (registration G-VTOL, the world's first civil jet V/STOL aircraft) from Dunsfold to the Indian Navy carrier *Vikrant* off Cochin in the Arabian Sea. Here several Indian Navy officers flew with John Farley, some of them from the IN Hawker 'Sea Hawk' Squadron. In the two-day trial, 21 sorties were flown at weights of up to maximum, convincingly demonstrating the suitability of the Harrier for IN use. Over the next eight years John Fozard made many visits to India promoting this potential sale and in 1980 the Indian Government ordered the Sea Harrier. The first Sea Harrier FRS Mk51 flew in December 1982 and this first export Sea Harrier was delivered in January 1983, the first of 23 single-seater and four two-seat TMk60 Harriers.

The Sea Harrier story was told in another of John's prizewinning papers, 'Sea Harrier—first of the new wave' (5), the 23rd R.J. Mitchell Memorial Lecture of November 1976, awarded the RAeS George Taylor Prize. In 1977, the RAeS honoured John again with the British Silver Medal for Aeronautics.

The year 1977 also saw the nationalization of the UK aerospace industry and Kingston became headquarters of the Kingston–Brough Division of British Aerospace.

## MARKETING MAN

After the AV-16 was terminated in 1974, Kingston continued to work with McAir on ways of improving the Harrier, but at lower cost. The USMC was McAir's prime potential customer, so BAe became subcontractor and John's engineers joined the St Louis team to whom he again became a frequent visitor. McAir was working on a Harrier development, the Harrier II or AV-8B, with a new, larger, carbon fibre composite wing, V/STOL lift improvement devices, a raised cockpit and a more efficient air intake, but retaining the existing Pegasus engine. These changes would double the payload-range. At Kingston another group of engineers was working on their new, larger but all-metal wing with leading edge root extensions which could be retrofitted to the RAF Harriers. This was not pursued by the UK government but instead, in 1982, a Memorandum of Understanding between the US and British governments was signed giving BAe a large part-share in the Harrier II programme and providing the RAF with the Anglicised Harrier GR Mk5.

By this time John no longer had a professional engineering interest in the Harrier because in 1978 he had been appointed marketing director of the BAe Kingston–Brough Division. He had carried the title chief designer Harrier for 13 of his 28 years in aircraft design engineering and he found it 'an agonising decision' to accept this offer which he 'couldn't really refuse'. John had always been good at explaining things and making complex technical issues understandable. He had been visiting professor at the School of Mechanical, Aeronautical and Production Engineering at Kingston Polytechnic (now University) from 1982 to 1987, he had lectured extensively far and wide and published many learned papers expounding the benefits of V/STOL to the military and the value of the aerospace industry to the nation. He had visited potential customers with members of Kingston's sales team and he had built up influential contacts in high places around the world. All these factors helped him lead a new kind of team: marketeers, salesmen, public relations exponents and product support experts. He did this for six years, during which Harrier and Hawk sales burgeoned, receiving the O.B.E. in 1981 for 'services to export'. In 1983, the University of Strathclyde conferred on him an honorary doctorate and the Royal Society Mullard Award was shared with Ralph Hooper.

In 1984, after 34 years at Kingston, John moved his office to Weybridge. BAe had been privatized and the Kingston–Brough Division had become part of a new Weybridge Division, of which John became director of special projects. This gave him technical and entrepreneurial roles in both engineering and marketing areas. A prominent project was 'Skyhook', devised by Dunsfold chief test pilot Heinz Frick, a stabilized crane system for launching and retrieving Harriers from small ships. At the end of 1987 John moved his office for the second time, across the Atlantic to Washington, D.C.

John had a number of important extramural activities. He was a lifelong supporter of the Royal Aeronautical Society, joining as a student in 1948, becoming an Associate Fellow in 1955 and being elected the youngest ever Fellow in 1963, at the age of 35. He was a Member of Council from 1977, a Vice President in 1979, President Elect in 1985 and the 55th President in 1986–87. Other institutions and societies honoured him. He was a Fellow of the Institute of Mechanical Engineers (1971), Fellow of the American Institute of Aeronautics and Astronautics (1981), Fellow of the Royal Academy of Engineering (1984) and, the greatest accolade, Fellow of the Royal Society (1987).

Sydney Camm was John's hero and 6 November 1985 was the 50th anniversary of the first flight of Camm's masterpiece, the Hawker Hurricane. With the Weybridge branch of the

RAeS, John organized a symposium at Brooklands (location of the first flight). An audience of some 650 viewed the last Hurricane built, PZ865, flown in from the RAF's Battle of Britain Memorial Flight, and listened to eminent speakers, including Sir Robert Lickley and Roy Chaplin, tell of their contribution to this famous fighter. From the Proceedings of the Symposium John developed his book *Sydney Camm and the Hurricane* (6), a scholarly work in which are collected many papers on Camm, his aircraft and the work of the Kingston designers.

## TO THE NEW WORLD

A very important event in John's personal life took place on 12 October 1985—he married a charming and vivacious American widow, Gloria Roberts. John had known Gloria on and off for some 17 years, after her husband, Alan Roberts (HSA's Harrier representative in Washington, D.C.) had died. They were married in Washington Street United and Methodist Church in Alexandria, Virginia, and after honeymooning in the southeast US travelled to England and settled in John's St George's Hill home, Wychbury Cottage. John was not only obviously in love with his new wife but also very proud of her, emotions expressed in equal measure by Gloria. During his RAeS Presidential Year, Gloria, usually in a memorable wide brimmed hat, accompanied John on all his many visits, worldwide travels and formal functions. They had a wonderful time together and to John's delight Gloria won many hearts.

At the end of 1987 the Fozards left England for good and moved into Gloria's period house in North Columbus Street, Alexandria, and John began his tenure of the Lindbergh Chair of Aerospace History at the National Air and Space Museum of the Smithsonian Institution, Washington, D.C. The Lindbergh Chair was established to expand the Museum's role as an international centre for the study of the history of flight and Professor Fozard, the first to occupy the post straight from industry, joined a list of distinguished holders, including historian Charles Gibbs-Smith and German jet pioneer Dr Hans von Ohain. John conducted research for a definitive survey of the history of jet powered-lift flight. In effect, this was a well-earned sabbatical year because BAe continued to pay his salary until his official retirement on 31 January 1989.

Retired, John continued to champion the cause of jet V/STOL in many papers, articles and lectures. He resumed teaching, at the University of Michigan Aerospace Engineering School and at the University of Texas. He returned to England several times to participate in formal aeronautical functions, usually staying with friends from Hawkers and getting together with colleagues from what he called 'the days of glory'.

As the years passed, so his pipe, for so long a permanent feature, was seen less frequently and he consumed only soft drinks on medical advice after a mild stroke in 1993.

John maintained his connections with the Smithsonian by working to achieve 'docent' certification at the Air and Space Museum, where he would lecture and conduct visits. He also offered his services to the US government as a consultant on the Joint Strike Fighter but both these aims were thwarted by his premature death.

John's last visit to England, as an American citizen, was in 1996, when to his great pleasure he was invited to Cranfield University to receive an honorary doctorate. He was also asked to deliver the Rolls-Royce Lecture as part of Cranfield's 50th anniversary celebrations. He called the lecture 'A half century apprenticeship. From the stringbag to the jumping jet' (7), alluding



to his work as an apprentice on the Swordfish, and to the Harrier. The lecture was well received but those of us who knew him were aware that the usual fluency was missing although the preparation had been as meticulous as ever. Afterwards Professor D.I.A. Poll, Head of the College of Aeronautics, conferred on Dr John William Fozard the degree of Doctor of Science *Honoris Causa*, stating that the country had every reason to be proud of John's engineering achievements and that he was the College's most famous alumnus. In his reply John addressed the members of the Harrier team from Kingston and Dunsfold there present saying '...I consider this honour as shared between us for what we accomplished together', and he summarized his leadership style in terms well known to his team '...like the 18th-century Kappelmeister who conducted the band from a desk within it and himself made direct contribution to its output rather than the style of the modern orchestral conductor who tries to influence the band's output from a separate railed enclosure with his back to the paying customers'.

These events took place on 6 June 1996 and shortly afterwards John returned to Gloria in the US. It was with shock and sadness that those same colleagues he had honoured at Cranfield heard of his sudden death at home in Arlington, but six weeks later on 17 July. He was 68 years old.

### ACKNOWLEDGEMENTS

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**John William Fozard**

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**Volume 44 (1998)**

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