

# BRISTOL AND THE AIRCRAFT INDUSTRY

by C. H. Barnes

About five years before Brunel died in 1859, another pioneer of transport was born; unlike Cabot, McAdam and Brunel he was a native Bristolian; his name was George White. Leaving school (St. Michael's, Kingsdown) at 14, he became articled to a solicitor, John Stanley, who found him an apt pupil and within two years had entrusted most of his bankruptcy business to him. In 1870, this was extensive and much of it was the aftermath of the "Railway Mania" of twenty years earlier, when speculators promoted branch railways everywhere without regard for public utility or wasteful competition. Many such enterprises were so exhausted by the cost of construction that no capital remained for the purchase and operation of rolling stock, let alone the organisation of reliable and punctual services for goods and passengers. Inevitably many companies went bankrupt including some which held important Parliamentary concessions to serve particular districts; it became urgent to arrange the lease or sale of such valuable links to older companies, such as the Great Western and the Midland, who could afford to operate them until they earned enough revenue to justify their continued existence. George White, travelling from court to court, soon found which lines were worth saving and became adept at arranging take-over bids for them; thus he reorganised the finances of the Taff Vale Railway and arranged the acquisition of the North Somerset Railway and the Severn Bridge Railway by the Great Western, so prolonging the usefulness of these lines until the recent fall of the Beeching Axe. Improved travel between cities brought a collateral demand for improved local transport within those cities and it was a natural step to extend the success of railways to street tramways; these, like railways, needed Parliamentary sanction. Consequently although trams began running in New York in 1832 about the same time as Shillibeer's first Omnibus in London, trams in Britain were delayed until 1858 (at Birkenhead) and were not regularly permitted in London till 1868. Two years later the Tramways Act simplified licensing procedure but mechanical propulsion was not legalised till 1879 and even then carried a 4 m.p.h. restriction until the repeal of the "Red Flag Act" in 1896. In spite of these difficulties, a Bristol Tramway was promoted in 1871 and, after failing under Corporation management in 1874, was taken over by a private company and extended from Redland to Eastville and St. George with notable success. The Parliamentary Bill authorising the new lines was handled by George White, who in 1875 was appointed Secretary of the Bristol Tramways Company soon after his 21st birthday. He then decided to leave the law and joined Bristol Stock Exchange, where he was able to make take-over bids on his own account and to extend his railway experience to urban transport promotion. By 1879 trams were running to Bedminster, Hotwells, Horfield and Totterdown, but the gradients on the latter two routes made heavy work for horses and there was an obvious case for mechanical propulsion in spite of the speed limit. Steam traction was tried experimentally, but horses remained in charge until 1895 when electric trams were introduced with marked success. Soon afterwards George White became Chairman of Bristol Tramways and formed the Imperial Tramways Company to acquire and electrify a number of other systems, including Dublin, Coventry, Middlesbrough and London United. He also organised a first-rate hackney and private hire service in Bristol and Bath, and bus services to feed the tram routes. He had become a self-made millionaire and was a generous patron of charities, particularly Bristol Royal Infirmary, and for these services was created a baronet in 1904. With horse trams and buses practically gone from Bristol by 1906 he began to organise a fleet of motor-cabs and in 1908 imported high powered Charron cars from France for his famous Blue Taxis. He had been impressed by their hill-climbing ability while on holiday on the Continent and in that year also Wilbur Wright had first demonstrated his aeroplane in Europe. Wilbur's mastery of flying encouraged aspiring French aviators to improve their technique and by the end of 1909 Louis Bleriot and Henry Farman had caught up with the Wright Brothers. Sir George White visited their flying ground at Pau to see their progress and, so the story goes, immediately recognised that this was a spectacle which could not fail to draw crowds and so increase tramway revenue.

## **Formation of the Company**

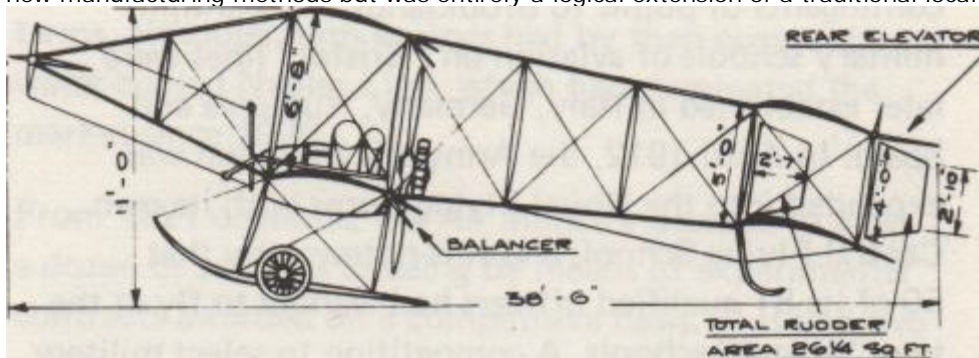
In the 1880's, George White had lived for a time at Filton and had bought 2 acres of land adjoining his residence, Fairlawn House. After removing to Old Sneed Park in 1907 he extended the tram route from Horfield Barracks to Filton Church; at the same time he built a garage for taxicab maintenance and as a depot for motor buses which ran to Thornbury 3

several times a week. Unfortunately this bus service and the Filton tramway extension were not paying their way in 1909 and this seemed to be an excellent reason for converting the Filton depot into an aviation centre and factory, where aeroplanes could be built and demonstrated. He announced this intention at the Tramways Company's annual general meeting on 16th February 1910, making it clear that the new venture would be privately financed without involving the Tramways shareholders in any way. Three days later he registered four new companies, three (including the Bristol Aeroplane Co.) with nominal capitals of £100 each, and one, the British & Colonial Aeroplane Co., with the really handsome capital of £25,000. Of course his stockbroking colleagues thought (and said) he was - in the modern phrase - "stark, staring honkers", but his sense of timing, as always, was excellent and the country was just, but only just, ready for such a development. Short Brothers and Handley Page had entered the field the previous year, as professional constructors of aeroplanes to private orders, but no one had previously set out to build aeroplanes to be offered for sale "off the shelf". A.V. Roe, the Blackburns, Geoffrey de Havilland and other pioneer aviators were still experimenting with their early machines and had not yet established themselves as manufacturers.

Sir George, of course, was neither an aviator nor an engineer himself, and had to rely on the best expert advice he could find, but there was already a good deal of technical talent available within the Tramways Company's staff, including his nephews Sydney Smith and Herbert Thomas, also George Challenger and Collins Pizey, whom he appointed respectively Engineer and Deputy Engineer at Filton. He looked to France for the latest state of the art and chose a Zodiac biplane designed by Gabriel Voisin as the first model to be manufactured under licence at Filton, mainly because its material and workmanship were good and it was sold with a guarantee to fly. Unfortunately Voisin (an architect by training) lacked the practical experience of Henry Farman (a successful racing motorist); the superior finish of the Zodiac concealed basic aerodynamic shortcomings and when assembled at Brooklands in April 1910 it completely failed to get off the ground. Sir George immediately invoked the Zodiac guarantee, cancelled the licence and eventually obtained 15,000 francs in compensation; meanwhile he was advised by his pilot, Maurice Edmond, to adopt the Henry Farman design and Challenger drew out an improved version of it. Two of these biplanes were built quickly and the first was taken to Larkhill on Salisbury Plain, where it rose to 150 feet on its first flight on 30th July 1910. Production then went ahead and fifteen more biplanes (soon to be dubbed "Boxkites") were completed by the end of the year. They were offered at a list price of £1,100, which included £600 for the 50 h.p. Gnome engine. Given the basic

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aeronautical principles established by the Wright Brothers and applied by the Farman Brothers, there were no special problems of aeroplane construction that skilled joiners, coachbuilders and engine fitters did not already have at their finger tips, so Sir George's venture did not require new manufacturing methods but was entirely a logical extension of a traditional local industry.



#### Flying Instruction

Obviously, the next step was to provide flying instruction, free to Boxkite purchasers and at reasonable fees to others. "Bristol" flying schools were therefore started at Brooklands and Larkhill, and soon pupils were enrolled from many parts of the world. The first to qualify at Brooklands was Bristol-born Leslie Macdonald and the first at Larkhill was Joseph Hammond from New Zealand. Herbert Thomas qualified at Larkhill on 31st December at the age of 18, and was then the youngest certificated aviator in the country. Meanwhile, after much pressure the War Office had rather grudgingly allowed Army officers to fly at their own expense and invited two of them to take part in the autumn manoeuvres on Salisbury Plain, where they showed the immense value of aeroplanes for military reconnaissance. Sir George then wrote to Mr. Haldane, Secretary of State for War, offering him the entire resources of his Company, but the Minister declined the offer and preferred the Company to develop business abroad without restriction; so Sir George felt free to negotiate with the Russian Government and on 15th November obtained a contract for eight biplanes. On the previous day the Company had held its first public flying display, on Durdham Down; this was in fact a dress rehearsal for similar displays to be given by two missions sent to India and Australia in December. On 18th January 1911 the Company's capital was increased to £50,000 and Stanley White became Managing Director (a post he held until 1955, when he became Deputy Chairman until his death on 19th January 1964). At the end of its first year, Filton Works employed 80 men and had been enlarged to allow five aircraft at a time to be laid

down. New types were put in hand, including a successful series of monoplanes designed by Pierre Prier. The two flying schools enrolled large numbers of pupils all through 1911 and in October the Company offered to train 250 army and 250 naval officers at specially low tuition rates, but both the War Office and the Admiralty declined; the only encouragement 7

given by the War Office was the purchase of four Boxkites in March and another four in July, followed by a grant of £75 to accepted volunteers to the new Army Air Battalion after they had qualified at their own expense.

At the end of 1911, the Company's capital was again doubled, to £100,000, to cope with orders for new aeroplanes from foreign governments, who also sent contingents of pupils to Brooklands and Larkhill; military schools of aviation on "Bristol" lines were later established in Italy, Germany, Rumania and Spain. In April 1912, the Army Air Battalion was expanded into the Royal Flying Corps with its own Central Flying School, and it is noteworthy that 50 of its 81 qualified officers had learned to fly at the two "Bristol" schools. A competition to select military aeroplanes for the Royal Flying Corps was held at Larkhill in August and a new Bristol-Coanda monoplane gained third place, but the Company's hopes of production orders for this type were dashed by a series of accidents which resulted in the War Office imposing a ban on monoplanes. The Company then developed several types of biplane, which met with fair success, and also began manufacture of BE2 biplanes of the official War Office design. In February 1913 capital was further increased, to £250,000, and several experimental seaplanes were built for the Admiralty. Early in 1914 the designer engaged on these experiments, Frank Barnwell, brought out a small fast single-seat biplane Scout, which reached 100 m.p.h. in races just before war broke out in August. By that time over 200 aeroplanes had been turned out from Filton Works, where 400 men were employed, and nearly half the certificated pilots in the country had been taught at the two "Bristol" schools. You will see from this account how the Company grew from transport origins and prospered through its reputation for excellent workmanship allied to imaginative design. Sir George White undoubtedly foresaw both the military and civilian potentialities of aviation, but realised that the economy and reliability essential for commercial transport services would only come at a much more advanced state of the art. The experiment and experience needed to reach this degree of knowledge and skill would have been gained very much more slowly without the impetus of military aviation in France, Germany and Italy, which our own War Office was somewhat slow to emulate.

#### **World War I**

The immediate effect of war in 1914 was twofold at Filton; half the employees either enlisted or were already reservists and at the same time orders were received for large numbers (totaling 1150 by the end of 1916) of later versions of the standard BE2 biplane. During the first two years of war the Company was not allowed to make any other type at Filton and when both the War Office and the Admiralty ordered Scouts in November 1914 as an afterthought the Tramways works at Brislington were brought into the aircraft industry, and 370 Scouts were made there up till the end of 1916. By that time casualties on the Western Front reached astronomical numbers, the BE2 was hopelessly out-classed and Sir Douglas Haig was insisting on a far larger output of much improved aircraft to combat German air superiority. The aircraft industry was at last allowed to tender original designs and an immediate success was Barnwell's famous Bristol Fighter; this proved its worth in the campaigns of 1917 and 1918 in much the same way as the Blenheim and Beaufighter were to do in 1941 and 1942.

Both Filton and Brislington turned over to Fighter production from the end of 1916 and it was also built in large numbers by other firms, many of them in the motor-car, ship-building and furniture industries. About this time also two other local firms came into aviation as contractors to the Admiralty and eventually produced designs of their own. One, Parnall & Sons, of Eastville, took over the Coliseum in Park Row as an aircraft factory and established an aerodrome at Yate. The other, Brazil Straker and Co. of Fishponds, manufacturers of Straker-Squire motor cars and lorries, who had produced a steam omnibus as early as 1901, undertook overhaul and assembly of Rolls Royce aero-engines. Both firms obtained Admiralty contracts for their own designs in 1917 but in both cases production orders were cancelled when war ended in 1918.

The Armistice found Filton and Brislington producing 2000 Bristol Fighters a year, with a payroll of 3,000, including many women. Filton works by this time covered 8 acres and a new airfield north of the Avon-mouth railway line had been built as an R.A.F. Acceptance Park, to test and despatch new machines to the squadrons. Sir George White had died in November 1916, but his policies and aims were vigorously continued by his son, Sir Stanley White, and his co-directors who now included Henry White-Smith and Herbert Thomas. They sought all possible ways of remaining in the aircraft business when official contracts ceased, and the severity of the post war crisis was partly mitigated by the exceptional merit of the Bristol Fighter, which was retained in limited production as standard equipment for the Royal Air Force overseas. The Fighter was successfully converted to carry one to two passengers in tolerable comfort and 33 of these were built and exported as Bristol Tourers; they went to Canada, Spain, U.S.A. and Australia, and eight of them pioneered the Western Australian airmail service. Reconditioned Fighters were sold in some numbers to Belgium, Greece, Norway, Peru and Spain. The Company also had an experimental contract for 7

three very large triplane bombers with four engines, named the Braemar. Permission was given to complete the third Braemar as a 14 passenger civil transport, renamed the Pullman; it was a valiant attempt to encourage comfortable air travel, but proved too costly to operate in view of the many twin-engined Handley Page bombers available for similar conversion at scrap prices.

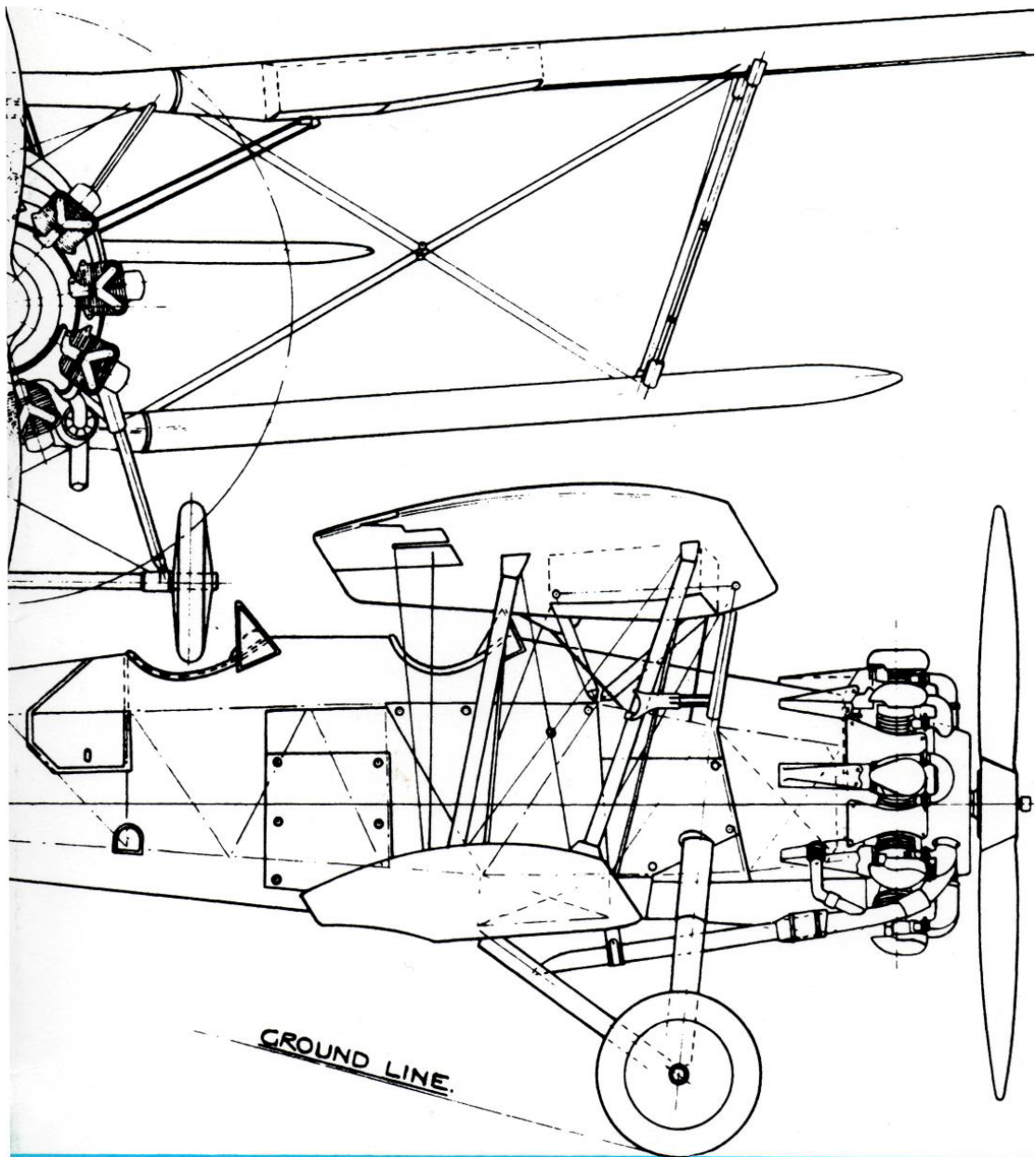
### **The Inter-War Years**

Early in 1920 the Treasury claimed payment of the Excess Profits Duty based on trade returns prior to August 1914; naturally this fell exceptionally heavily on firms which had only taken up aircraft manufacture since the war began. Among these were Parnall's and Brazil Straker. Parnall's had received a last-minute contract for 300 of their Panther naval fighters and the Air Ministry still wanted 150 of these for deck landing experiments, but Parnall's new proprietors, W. & T. Avery of Birmingham, held out for 300 or none at all, so the contract for 150 was transferred to Filton and Parnall's closed their aircraft department. Brazil Straker were in a similar predicament, having received an order for 200 Mercury radial engines designed by Roy Fedden and L.F.G. Butler, and organised a new subsidiary, Cosmos Engineering Co., to manufacture them. When these were cancelled at the Armistice, Fedden already had on the drawing board a new engine of exceptional promise, the Jupiter, and had obtained an order for six prototypes. One of these was successfully flown in a Bristol Badger in 1919, but by the end of that year no more capital was available for development and Cosmos went into voluntary liquidation. Fedden managed to keep his team of key workers together while he sought for a new proprietor and, after being refused by John Siddeley, eventually, with Air Ministry support, persuaded the Filton directors to acquire his design, materials and staff as the nucleus of a new Aero Engine Department. Just previously the British & Colonial Aeroplane Co. had itself been voluntarily wound up, following transfer of all its fixed assets to the Bristol Aeroplane Company, whose authorised capital was increased from £100 to £1,000,000 in March 1920, its actual paid up capital being £553,000. By this perfectly legal device, the effects of the Excess Profits Duty became less punitive.

For the next ten years, aircraft work at Filton was virtually confined to orders for small batches of new Bristol Fighters and a steady trickle of the same type for overhaul; altogether over 5,300 Fighters were built up till the end of 1926, over 3,500 of them at Filton and Brislington. During the same period, the Company built a number of prototypes at its own expense, notably the Bullet racer and the Ten-seater, which did much to establish the economy and reliability of the Jupiter for airline use. The biggest break-through for the Jupiter came after the 1920 Paris Salon, when it was adopted on a wide scale by the French Air Ministry, subject to its manufacture in France. A licence was granted to Societe des Moteurs Gnome et le Rhone, whose rights covered most European territories, and French Jupiters soon became famous all over the Continent. The Air Ministry, however, still favoured the rival Armstrong Siddeley Jaguar engine and it was not until 1926 that the Jupiter began to compete with the Jaguar on level terms, although both engines had by then ousted the water-cooled Napier Lion, which had dominated the market since 1920.

From 1921 onwards, the Air Ministry decided to keep a dozen or so firms in being by means of experimental contracts awarded on a competitive basis. This had two results of local importance; first it ensured a series of other firms' prototypes for which Jupiter engines might be ordered in addition to any aircraft contracts awarded to the Company; secondly, George Parnall was able to reassemble his design team, under Harold Bolas, at Yate and in 1922 re-entered the industry as G. Parnall & Co. Bolas was a talented and original designer with special knowledge of deck-landing aircraft; one or two prototypes were produced each year, including the Possum triplane with a central engine driving two outboard propellers and the Peto seaplane which folded away into a hangar on the submarine M2, from which it was launched by catapult within minutes after surfacing. No substantial production orders were ever awarded and in 1930 Bolas emigrated to America; the firm survived marginally until 1935 when it undertook component production for the Hawker and Gloster companies and developed and manufactured aircraft gun turrets designed by Captain Frazer-Nash, which were extensively used in the second world war. Since then the Yate works have changed over to the manufacture of domestic machinery, including refrigerators and washing machines and are now a division of Radiation Ltd. Diversification is nothing new in the aircraft industry and the Filton factory itself was kept going for several years in the 1920's making coachwork for Bristol buses and (in spite of aero-engine rivalry) Armstrong-Siddeley cars.

In planning the peacetime Air Force, the Air Ministry encouraged the development of all-metal construction and the Bristol Aeroplane Co. experimented with a system of high-tensile steel strip, rolled into suitable sections and protected by stove enamelling. It was much cheaper and lighter than seamless steel tube and was free from the corrosion and heat treatment problems associated with aluminium alloys. After building a series of prototypes to prove the method, the Company produced, as a private venture, an outstanding single seater which won a keen competition for day-and-night fighters in 1928. This was the Bulldog, which went into large scale production at Filton from 1929 to 1934, during which time nearly 450 were built. It had a



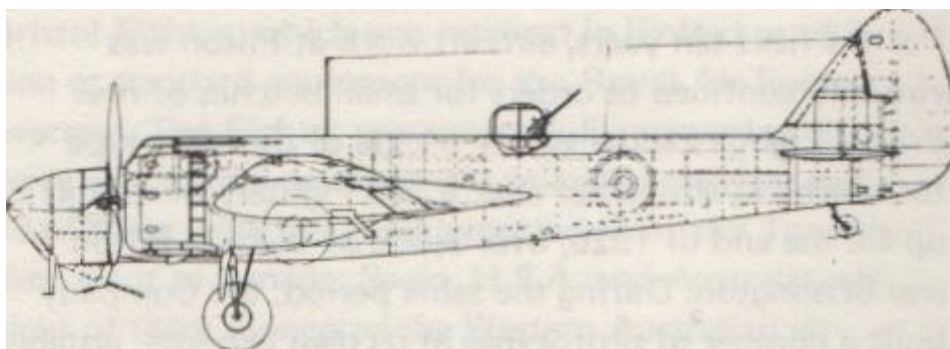
supercharged Jupiter engine and equipped ten out of the thirteen fighter squadrons comprising the Air Defence of Great Britain, as well as the air forces of eight other nations. The final batch, for Finland, had Mercury engines of higher power and were still in service at the outbreak of the Russo-Finnish "Winter War" in November 1939. The Jupiter was superseded in 1931 in production by more advanced Mercury and Pegasus engines of generally similar design and these were widely adopted, to the virtual exclusion of the larger Armstrong-Siddeley engines. Pegasus engines were standardised for the Short Empire flying boats of Imperial Airways and for a new generation of single and twin-engined bombers for the R.A.F. Five times between 1928 and 1938 Pegasus engines gained the World's Altitude Record and in the latter year the Distance Record also. But Fedden had meanwhile developed sleeve-valve engines of higher potential and these were ready for production in 1935.

### **The Blenheim**

That was the year in which the British Government abandoned its policy of appeasement in face of the growing threat of Hitler's Germany and began to re-build the Royal Air Force with modern equipment. The Company had prepared for this by developing stressed-skin construction in aluminium alloy, using successful American techniques, and had obtained a prototype order for a twin-engined troop transport, later produced as the Bombay; with its 96 ft. span cantilever monoplane wing, this was the largest aeroplane so far built at Filton. On the strength of this contract, the Company also built a high-speed four gun monoplane fighter, the Type 133, which seemed a certain winner, but unfortunately it crashed on its final test flight before going to official trials. Con-currently, a fast twin-engined eight passenger cabin monoplane had been designed and Fedden mentioned this in a talk at which "Blos" Lewis, editor of the "Evening World", was present. Soon afterwards, Lewis was lunching with his boss, Lord Rothermere of the "Daily Mail", who wanted to buy "the fastest commercial aeroplane in Europe", and the new Bristol design was discussed. Rothermere asked for all particulars and stated his requirements, which Barnwell met by revising the design to take Mercuries of twice the intended power. Lord Rothermere then ordered it at a price of £18,500, on condition that it was flying within one year. It is noteworthy that the project was roundly condemned as suicidally dangerous, by Rothermere's aviation adviser General P.R.C. Groves, but fortunately his advice was not taken. Very fortunately, because when the Bristol 142 flew in April 1935 it proved to be 50 m.p.h. faster than the newest standard R.A.F. fighter, and was adopted by the Air Ministry as the basis for a bomber version, for which an order for 150 was placed straight off the drawing board; thus the Blenheim was

born and over 1,000 had been supplied to R.A.F. squadrons before war broke out again in 1939. Filton works were drastically reorganised and expanded to cope with its production and this required greatly increased capital, so on 15th June 1935, the Bristol Aeroplane Company became a public company for the first time, with a share capital of £1,200,000.

At that time there were 4,200 employees, mostly in the engine factory, but by Christmas the payroll had nearly doubled, to 8,233. The aircraft works, covering 13 acres in June 1935, was extended several times and early in 1936 the first of four new engine factory extensions, each of 200,000 square feet, was built, together with Rodney Works to specialise in engine installations. By the outbreak of war, the Company had become the biggest single aircraft manufacturing unit in the world, with nearly 3 million square feet of buildings occupying 732 acres of land. In 1937 an improved Blenheim IV was introduced and the Blenheim I was in squadron service and in production in two other factories in England; later they were also built in Canada, Finland and Yugoslavia and flown by Turkey, Greece, Portugal and Rumania. Altogether 6,200 were built, just over 1,000 being produced at Filton. Concurrently with Blenheim IV a new design, the Beaufort, was put into production, although the first did not fly until 1938, some months after Frank Barnwell had been killed in a light aeroplane accident at Whitchurch. His successor, Leslie Frise, was a Bristol graduate, who had been closely associated with Barnwell since 1915 and responsible for most of the aero-dynamic refinements. The Beaufort was the first production aircraft to standardise sleeve-valve engines and these gave trouble at first which delayed entry into squadron service till 1939. By that time the Beaufort had been adopted for manufacture in Australia, mainly in railway workshops, with final assembly plants at Melbourne and Sydney. Although larger than the Blenheim, the Beaufort was specially designed for unit assembly by sub-contractors and it is not surprising to find that in 1940 these included both G. Parnall and Co. and the Bristol Tramways Co., the latter still in their old works at Brislington although owned since 1930 by Thomas Tilling.



**Blenheim Mk. IV - Type 142M 9**



During the ten years between July 1935 and VJ-Day the Company had produced some 12,000 aircraft and over 100,000 engines, half the latter being Hercules.

### **Post-War Development**

In 1945, the Company was better prepared than in 1919 for adjustment to peacetime conditions, for plans had already been made for the aircraft industry by the Brabazon Committee. When the United States entered the war after Pearl Harbour, she continued production of transport aircraft so as to leave the British industry free to concentrate on fighters and bombers. So in 1945, American military transports, apart from over 50,000 Dakotas, included four-engined prototypes of sophisticated airliners with pressure cabins and fuel tankage for transatlantic operation. British bomber conversions, tried out initially, were no match for DC-4's and Constellations and B.O.A.C. was soon able to make out a good claim for dollars with which to acquire a competitive American-built fleet. Nevertheless the government of the day supported the Brabazon Committee's recommendations, one of which was for a transatlantic airliner capable of flying non-stop between London and New York against the most adverse head-winds. The Bristol Aeroplane Company's proposal for an eight-engined 100-ton monoplane with a range of 5,000 miles was approved and two prototypes were ordered, one with piston engines and the second with turbines. The design studies required to produce so large an aircraft were very extensive and many new problems had to be overcome. Although the Company gained an unassailable position, equal to the Americans' in the field of technical design, the Brabazon's first flight was delayed until 1949, by which time smaller airliners had begun operating transatlantic schedules with acceptable regularity and the west-bound refuelling stop at Gander was generally tolerated. Among the problems raised by the Brabazon was that of runway strength, which resulted in the biggest single advance in the study of soil mechanics since John McAdam set out his principles of road-making in 1820. Apart from technical problems, the Brabazon was controversial from the start on economic grounds and has been compared with Brunet's "Great Eastern", which was also designed to carry passengers in comfort together with fuel for an extremely long-range operation. However, it showed that physical size in a land based aeroplane was not in itself an insuperable limitation and the lessons learned during its structural design and manufacture were put to good account in 1948, when B.O.A.C. accepted the smaller but faster Britannia as the basis of their new Empire fleet. Since 1945 the Company had concurrently produced a "bread-and-butter" aeroplane, the Freighter, developed from the pre-war Bombay troop-carrier; more than 200 of these were built at Filton and sold all over the world between 1946 and 1958. Many are still in service and are well known for their car ferrying activities

### **. World War II**

In 1938 the Air Ministry programme for new aircraft was seen to be deficient in one or two roles, particularly in respect of long-range cannon-armed fighters. Once more Filton came up with an inspired stop-gap - a fighter version of the Beaufort with 50% more power and four 20 mm guns, using the existing wings, tail unit and landing gear. In spite of reservations about its size, the Air Ministry received the proposal with enthusiasm and ordered four prototypes in November; the first of these flew in July 1939, when it was named Beaufighter and 300 were ordered. It was as fast as the Hurricane but big enough to carry the early airborne radar, whose "Black Boxes" were at first very bulky and difficult to install in smaller fighters. Beaufighters went into squadron service in September 1940 when the Filton production orders were raised to 900 in addition to 1,000 Beauforts already in progress, while further batches of 500 Beaufighters were ordered from each of two new factories, one managed by Fairey's at Stockport, Cheshire, and the other by Bristol at Weston-super-Mare; the Company also managed a new Hercules factory at Accrington. The Filton payroll reached 38,000 soon after war began, making the Company a bigger employer than Bristol's previous largest, the Imperial Tobacco Company. By 1942, the overall payroll reached its maximum of 52,000 and the Company then occupied over 100 dispersal premises, many taken over after the daylight bombing raid on 25th September 1940, when 91 employees were killed. Among the first dispersals programmed was that to various houses in Clifton, including Lennards Buildings to which the aircraft drawing office should have moved on 24th November. Fortunately the move was delayed and that night Lennards Buildings were gutted in one of the first intensive raids on the city, and so the entire stock of Beaufort and Beaufighter production drawings escaped destruction; the move was eventually made further afield, to Clevedon, while the aero-engine design offices were dispersed to Tockington and Somerdale. Later a new factory for Centaurus engines was built and equipped entirely underground at Hawthorn, in limestone workings adjacent to Box Tunnel. The Beau-fighter proved to be one of the most versatile aircraft of the war and served in every theatre; after its debut as a night-fighter, it succeeded the Beaufort in Coastal Command and was able to carry on exceptionally heavy armament, which could include a torpedo or bombs or rockets, in addition to its normal cannon and machine guns. Nearly 6,000 were built in all, including 3,336 at Weston-super-Mare and 364 in Australia; they remained in front line service overseas until 1950 and thereafter as target-tugs for a further ten years. From 1943, the Filton payroll was reduced by redirection of labour to other priorities, such as tank

production, and at the end of the war had fallen to 25,000; many employees then returned to their peacetime occupations and the total fell gradually to under 15,000. 10

Other post-war developments at Filton included the Bloodhound defence missile, guided by radar and capable of intercepting the fastest jet bombers; this was developed by a new Guided Weapons Department and was adopted by the Royal Air Force and Royal Australian Air Force, also the Swedish and Swiss Air Forces.

Another new line was the Helicopter Department, whose two main products, the small Sycamore and larger Belvedere both became standard R.A.F. equip-ment; the Sycamore was also exported to Australia, Belgium, Canada and West Germany. About 100 were built at Filton before all helicopter work was trans-ferred to Weston-super-Mare in 1955; a further 90 were built there up till 1960 when the department was acquired by Westland Aircraft Ltd., of Yeovil. Britannias were sold to Argentina, Canada, Cuba, Ghana, Israel and Mexico, and nearly achieved a break-through into the American domestic market. They operated long-range services all over the world and established new standard of reliability and safety. Prematurely retired from front-line service by competition from faster and larger jet airliners, they are still excellent chatter aircraft plying at high load factors and are doing sterling work in R.A.F. Transport Command. Britannia production amounted to 60 at Filton and 25 at Belfast, where Short Bros. & Harland Ltd. set up a second production line and later developed the Belfast heavy freighter using a derivative of the Britannia wing. Canadair Ltd. of Montreal also acquired a licence to build versions of the Britannia and built 33 of one type for maritime reconnaissance and 40 of a second type for passenger and freight transport.

So the Company survived two wars to establish itself at last in the transport aircraft field, as its Founder had foreseen; its former aero-engine division later amalgamated with its old rival, Armstrong-Siddeley, as Bristol Siddeley Engines Ltd., which also includes the former engine departments of Blackburn and de Havilland; now it has become part of the Rolls Royce empire - a complete turn of the wheel since Brazil Straker entered the aircraft industry 50 years ago as repairer of Rolls Royce engines. During this period experimental work went forward at Filton on supersonic jet prototypes of which the 188 explored the possibility of stainless steel construction for flight at twice the speed of sound; while the 221 investigated the aerodynamic properties of slender delta wing

shapes at high speeds. In 1960 the aircraft and guided weapons interests of the Company were merged with those of Vickers Ltd. and the English Electric Company to form the British Aircraft Corporation, of which the Filton Division is charged with the design and production, in partnership with Aerospatiale of France, of the world's first supersonic airliner, the Concorde. This is a project of immense technical challenge, on which far too many opinions have already been expressed, not always by those best qualified to give them. Enormous opportunities are offered for technical advances, and all of them must be achieved in order to operate the Concorde successfully, but most of them are also advantageous to all forms of aviation and indeed to most technologies outside aviation, if in these days any such can be found. And there I think you have the crux of the matter, that the art of aviation does embrace all technologies and epitomises all human endeavour.

It must never be forgotten that aircraft and aero-engines are among this country's most valuable exports, because of the very high conversion ratio of the finished product, about three to four times that of motorcars. So when you export aircraft you are selling a lot of native skill applied to relatively small amounts of imported raw material. It is as important to this country as cotton is to Lancashire, wool to Yorkshire, linen to Ulster and watch-making to Switzerland. But it still needs government support in research and development in order to compete in world markets. Although it has become such a highly sophisticated business, the aircraft industry is not large in terms of manpower; Filton employs fewer than the total of other light engineering businesses in the Bristol area. From 15,000 in 1950, the number of employees rose to a peak of 28,000 in 1957, then fell to 21,000 in 1960, since when it has risen slowly to its present level of 25,000, of whom only 3,000 live within a 2 mile radius of Filton Church. Undoubtedly it has far surpassed Sir George White's wildest dreams as a promoter of traffic along Gloucester Road; its effect on Filton itself has been spectacular, the resident population of the parish having risen from 658 in 1911 to 3,000 in 1931 and 12,000 in 1961, since when it has become nearly static. The foundation of the Sir George White Chair of Aeronautical Engineering in the University of Bristol in 1947 has done much to promote technical progress locally, as has the Company's own (now Rolls Royce) Technical College at Filton.

This article has been extracted by kind permission of the author, from his lecture given to a librarians' conference in October 1967. Further information can be obtained from his 'Bristol Aircraft since 1910', C.H. Barnes, published by Putman, 1964. 11

