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FRANK WHITTLE

1907–1996

BY RICHARD J.COAR

ONE OF THE twentieth century's best "hands on" engineers, Sir Frank Whittle, will be remembered as the earliest inventor of the aircraft turbojet engine, and for his persistence in demonstrating its feasibility in the face of initial rejection and despite later bureaucratic roadblocks thrown in his path by the British government. During the latter half of the 20th century, billions of dollars have been invested by governments and by engine manufacturers to develop Whittle's invention into remarkable propulsion systems that have changed the face of the world. Now no point on the globe is more than a day away by air; aircraft fly routinely faster than Mach 3, at more than 70,000 feet of altitude; and 400 passengers can be carried nonstop across the country using less petroleum than if they traveled by car or train.

Whittle was born of working-class parents in Coventry, England, on June 1, 1907, and attended local schools until age fifteen. Then he tried to join the Royal Air Force as an aircraft apprentice but flunked the physical exam for being undersize. Now early in his career, we see Whittle's persistence paying off— less than a year later, by diet and exercise, he had added three inches to his height and three inches to his chest measurement to enter the September 1923 class of the Royal Air Force. During Whittle's three years there, he was trained as a metal aircraft rigger. Probably because of the aircraft engineering aptitude he displayed building a large powered model aircraft in off-duty

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hours at the Model Aircraft Society, Whittle was one of five from his 600-man apprentice class selected for flight cadet training at the R.A.F. College, Cranwell. In his two years at Cranwell, Whittle learned to fly (surviving an engine failure in flight and the total loss of an airplane he flew into a tree on a foggy go-around), and he began thinking about how to achieve high-speed, long-range, high-altitude flight. His thesis was the starting point for his subsequent work on jet propulsion: "Future Developments in Aircraft Design." His flying instructor's final comments in Whittle's flight log included these words in red ink "inclined to perform to gallery and flies too low." Frank loved aerobatics.

While qualifying to be a flight instructor at the Central Flying School in 1929, Whittle had his first thought of using a turbine to produce a propelling jet instead of turning a propeller. The school's commandant brought this invention to the attention of the Air Ministry, who then requested Whittle to report there with his sketches and calculations. As Whittle put it later, "The result was depressing," and he returned in low spirits. He had met the not-invented-here syndrome head-on. Before the year was over, the Air Ministry informed him that because his scheme was a "form of gas turbine, it was considered to be impractical, as materials did not then exist capable of withstanding the combination of high temperatures and high stresses that would be necessary." It seems likely that the ministry really believed that such materials would soon enough become available, because it was already funding a program at its own laboratory under Dr. A.A.Griffith to develop a turbine to drive a propeller.

At the flying school, one of his instructors offered to help Whittle apply for a patent, and this application was filed on January 16, 1930. The Air Ministry advised Whittle that it had no official interest in the patent, so it was not put on the Secret list, and it was published worldwide in its 1932 issue. (Unfortunately, Whittle allowed the patent to lapse in 1935 when he decided not to spend the money for a renewal fee. None of us is perfect.) As a qualified flying instructor and then test pilot, Whittle managed to crash a few more airplanes and learned the flying peculiarities of eighteen different kinds of aircraft. A nonswimmer, he was fortunate to escape with his life during a year and a

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half of being catapulted from new experimental catapults. To get backing for his jet engine during this period, Whittle made overtures to four commercial firms, but without results.

When it came time, after four years with a permanent commission, to select a specialist course of advanced training, Whittle chose engineering. In August 1932 he was posted to the officers' engineering course at Henlow, where he completed the twenty-four-month course in eighteen months. The Air Ministry had by then discontinued its practice of sending one or two officers from Henlow on to Cambridge University for the Mechanical Sciences Tripos (an honors course named after the three-legged stool one sat on to take the oral examination). Whittle persisted again and got the ministry to make an exception, so in July 1934 after being promoted to flight lieutenant, he was attached to the Cambridge University Air Squadron. In two years instead of the usual three, he took first-class honors and was then well grounded in the aerodynamic and material sciences he would need to succeed with his jet engine invention.

Whittle recognized the important contribution made to his jet engine by two ex-RAF officers, Dudley Williams and J.C.B. Tinling, who approached Whittle at Cambridge and convinced him they could find investors to sponsor development of the jet engine. The outcome of these discussions was a "Four Party Agreement" sanctioned by the Air Ministry, between Whittle, Williams, Tinling, and the investment firm Falk & Partners, and the incorporation in March 1936 of Power Jets, Limited. Because Whittle was a serving officer in the Royal Air Force, Power Jet's field of play was severely circumscribed by the Air Ministry—25 percent of Whittle's interest in the venture was allotted to the Crown; he was entitled to act as honorary chief engineer, but only off-duty and no more than six hours per week; all of Whittle's patent rights were assigned to the company, but the government retained right of "Free Crown Use." With very little capital, no employees, no facilities, and an unproved concept, one must be amazed that Whittle accomplished what he did, and not be surprised that his health failed in the end.

Power Jets placed orders with the B.T-H (British Thompson-Houston) Company to provide design drawings of an experi

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mental engine based on requirements Whittle had laid down at Cambridge to manufacture parts, and to make facilities available for testing, all on a cost-plus basis. B.T-H had been selected because it had experience supplying industrial turbines and compressors. It soon became clear that this background was not relevant to aircraft engines. Whittle rejected B.T-H's first design and then gave B.T-H a preliminary design to use. Despite many procurement difficulties, and the fact that neither the turbine nor the compressor had been run as an individual component, the first run of the engine was self-sustaining on March 12, 1937.

The next two years were fraught with difficulties on every front—Falk failed to find adequate funds; the Air Ministry threatened to terminate Whittle's special duty assignment because progress was so slow; B.T-H evicted Power Jets from the marginal facilities they were using but provided space in an abandoned foundry; and every engine test disclosed some new mechanical or aerodynamic problem. A visitor to Whittle's dilapidated office in the foundry at that time might find him with his rifle pointed out the window shooting rabbits. Whittle had assumed that B.H-T, whose primary business was turbines, at least knew how to design them, but the tests showed the jet's turbine efficiency to be low. Whittle, still a graduate student, gave B.T-H new aerodynamics that solved the problem. The fact that the boy aerodynamicist knew more about turbines than the old pros soured the relationship from that point forward. Over this two-year period, enough funds were slowly provided by the Air Ministry so that on June 30, 1939, Power Jets demonstrated to the ministry's director of scientific research a twenty-minute engine run up to 94 percent of design speed. This one demonstration led the director to conclude they now had the basis for an aeroengine. The ministry agreed to pick up the costs of parts for the experimental engine and gave Power Jets a contract for a flight test engine that was subcontracted to B.T-H. The ministry also contracted with Gloster Aircraft for an experimental aircraft, the E.28/29. When war broke out, the Air Ministry had already decided to pursue Whittle's turbojet work and to continue Whittle's appointment to Power Jets.

The W.1 experimental flight test engine powered the first

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British jet flight successfully on May 15, 1941. By the end of 1940, before the E.28/29 had flown, the Air Ministry decided to have the W.2, a higher thrust engine, developed and produced to power a twin-engine jet fighter, the F9/40 *Meteor*. The ministry named the Rover Company to produce the engine, a choice that soon proved disastrous. Rover decided to design its own engine rather than use Whittle's design. Rover had no background in aircraft engine development or manufacture and refused to take Whittle's technical advice to correct the engine's problems. By December 1942 the production program was so far behind schedule that the new ministry of aircraft production transferred the production program to Rolls Royce. Then with close cooperation the mode between Rolls and Whittle's team, and with Rolls' aggressive technical policy, the 100-hour type test of the W.2 was completed only five months later. Whittle's special-duty-list attachment to Power Jets continued until 1946, with responsibility for the design of the W.2b (the Rolls Royce "Welland"), the W.2/ 500, and W.2/700 ('Parents' of the Rolls Royce Derwent and Nene).

In Germany at Ernst Heinkel's factory, Hans von Ohain had begun experiments in secret and had bench-tested his jet engine in 1937. This He S 3B engine powered the world's first turbojet aircraft flight on August 27, 1939. Although this reduction to practice preceded the British flight, Whittle is usually considered to be the earlier inventor. In any event, both British and German governments failed to exploit the turbojet engine aggressively, so this new invention was not a factor in the conduct of World War II. The few Me 262s (powered by two Jumo 004 axial compressor turbojets) flown by the Germans at the end of the war were 100 miles per hour faster than Allied fighters, and on one occasion in 1944 destroyed thirty-two B-17 bombers out of a flight of thirty-six. Fortunately the Me 262s were unreliable, too few, and too late—Allied bombing had left the Nazis little fuel for flying.

In October 1941, the U.S. Army Air Corps delivered a W.lx engine, the W.2b drawings, and a team of three from Power Jets Ltd. to the General Electric Company. This was the beginning of turbojet development in the United States. Tradition says

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General Electric was selected for turbojet development because the company had relevant turbosupercharger experience, and because the administration wanted no interference with the aircraft engine production needed to meet Roosevelt's May 1940 call for 50,000 planes a year. Some say General H.H. "Hap" Arnold had another concern—that if he gave the job to a traditional engine manufacturer, it might suffer fatally from the not-invented-here syndrome.

In 1944 Power Jets was nationalized and in April 1946 merged with the aircraft gas turbine section of the Royal Aircraft Establishment to form the National Gas Turbine Establishment, whose sole function was limited to conducting research and to assisting the aircraft industry. In Whittle's words, the company he had cofounded and nurtured "was smothered to death by the government." This ended Whittle's activities in the design and development of engines. After resigning from Power Jets, he was appointed adviser to the Ministry of Supply and retired in 1948 with the rank of air commodore. He was knighted by King George VI, and finally in May 1948 he was awarded 100,000 pounds on the recommendation of the Royal Commission on Rewards to Inventors.

Sir Frank remained active in retirement, consulting, lecturing, and writing his book *Jet—The Story of a Pioneer*. Separated from his first wife since 1952, he was divorced in 1976 and emigrated to the United States, where he married Hazel Hall. At age seventy, Frank Whittle would still confound younger engineers, who were apt to solve their aerodynamics problems on multimillion-dollar computers, by quickly getting useful results on the back of an envelope using his 5-inch slide rule. He closed his colorful career in the position of research professor at the U.S. Naval Academy. His textbook on gas turbine aerodynamics was published in 1981.

In addition to his knighthood, Whittle's work has been recognized by awards and medals from eight different countries, by eleven honorary doctorates, and by honorary membership in more than twenty professional or learned societies. He was elected by his peers a foreign associate of the National Academy of Engineering in 1979, and in 1991 shared with Hans von Ohain the Academy's Charles Stark Draper Prize of $375,000.

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