## Copy of Report from B.T.H. Files

The B.T.H. Company first came into contact with Sir Frank Whittle in November, 1930, when he paid a visit to Rugby from number 2 Flying Training School, R.A.F. Digby, Lincolnshire in connection with a paper he was writing for publication in the Royal Aeronautical Society journal on the Turbo-Compressor and Supercharging.

The B.T.H. Company had at that time in commercial service a Centrifugal Compressor operating at speeds up to 22,000 r.p.m. and capable of delivering 1,800 cu.ft. of free air per minute up to a delivery pressure of 12 lbs. per sq.in. gauge.

The design of the impeller of the compressor was of the axial radial flow type with curved vanes at the inlet to reduce shock loss at entry, and this design of impeller was incorporated in the first experimental engine built by the B.T.H Company for Sir Frank Whittle.

In October, 1935, there was a discussion at Rugby with Sir Frank Whittle on the possibility of the B.T.H. Company being prepared to undertake the manufacture of a supercharging blower, but at the time of discussion, it was not possible for legal reasons for Sir Frank Whittle to reveal the whole object of his proposals.

In January, 1936, a meeting was held at Rugby, at which Sir Frank Whittle explained the object of his invention and advised the performance which he hoped could by achieved from a gas turbine engine used for jet propulsion purposes.

The B.T.H. had obtained in the operation of a 10,000 kw. turbo alternator built by them for the Delray Number 3 power house of the Detroit Edison Company, a considerable amount of information on the behaviour of material exposed to temperature of the order of 1,000°F.

In view of this experience, and also that which they had in building of high rotational speed turbines and compressors, B.T.H. decided to proceed in collaboration with Sir Frank Whittle in the design and manufacture of a gas turbine propulsion unit.

In December 1935, Messrs. Falk and Partners, 10, Old Jewry, London, advised B.T.H. Company that a private company to be called Power Jets Ltd. was being registered by them for the purpose of financing and developing Sir Frank Whittle's invention and that the company would be placing an order with B.T.H. for an experimental unit.

On 11th March, 1936, B.T.H. were requested to proceed with the draft work in connection with the preparation of manufacturing instructions for the factory to build the proto-type gas turbine and compressor equipment, the order being given to B.T.H. by the Power Jets company. Manufacture to start on 17th June, 1936.

The design put forward by Sir Frank Whittle for the engine departed from the conventional design of centrifugal compressors as regards the diffuser system, and a revolutionary feature of his proposals for the turbine was the using of a volute to distribute the gases to the turbine blading and having no guide vanes or nozzles to control its distribution. B.T.H. engineers indicated to Sir Frank Whittle that they thought the efficiencies of both the turbine and compressor on which his calculations were based were optimistic.

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Design layouts were started on 6th April, 1936 and it was manufactured and ran for the first time in April, 1937. His engine exhibited several defects and was not up to expectations. The engine was extensively modified, the engine having one large combustion chamber and ten jet pipes were provided. The first modification did not prove satisfactory and was again modified, in which ten separate combustion chambers were provided. This second modification to the proto-type was satisfactory on test and a complete new engine was built under strict A.I.D. inspection conditions for flight purposes. This engine was known as W.1.

The engine was installed in a plane built by Gloster Aircraft Company Limited. E 28/39 designed by Mr. W. G. Carter, it was the first engine to fly, and the flight took place at Cranwell, Lincolnshire on 14th May, 1941.

B.T.H. built a second flight engine to the order of Power Jet Limited which had an air cooling to the turbine wheel, water cooling being dispensed with. This engine was known as W.la.

An engine known as "W.1 experimental" was manufactured to the order of Power Jets Limited, and was shipped to America by Power Jets Limited.

In connection with their early development work on the jet engine a considerable amount of investigation and experimental work was also carried out by B.T.H. Company into the properties of special materials and special methods of manufacture, such as welding techniques etc. and the original combustion experiments were carried out in the B.T.H.

factory by Sir Frank Whittle and Mr. Laidlaw of Laidlaw, Drew and Company, Edinburgh. These tests were continued at the B.T.H. works until late 1939 when Power Jets Limited commenced carrying out combustion tests in part of a factory leased from the B.T.H. Company Limited at Lutterworth.

A considerable amount of air test work was done in the B.T.H. wind tunnel on the effect of efficiency of blade edge thickness and overlap of the blade nozzles, all of which had an effect on later design.

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SIR FRANK WHITTLE

Born on 1st June 1907 in Coventry, Earlsdon district. Father worked in Cotton Mills (was prolific inventor and skillful mechanic).

Moved to Leamington Spa in 1916 (Father acquired small engineering business). Frank Whittle worked on machines at 10 years old in his fathers factory and received small sums on a piecework basis.

SCHOOL

First six years at Council schools in Coventry and Leamington. At age 11 succeeded in gaining a scholarship to a Secondary School - Leamington College.

Only subject he admits he took a real interest in was Chemistry. He was a voracious reader of popular science books (Astronomy, Physiology, Engineering, particularly Aircraft Engineering).

R.A.F.

Attempted to join in 1922 as Aircraft Apprentice, passed exam with flying colours but failed medical for being to short (only 5ft).

Because he was so persistent a Physical Training Instructor, Sgt. Holmes, took pity and showed him some exercises and made up a diet for him. In six months doing these he added 3" to his height and chest measurement. Re-applied but was turned down as having already failed. After further unsuccessful attempts to have his case recognised, he re-applied as if starting all over again and was accepted. Passed exam and physical with flying colours.

Started with 600 apprentices at Cranwell in September 1923, did a three year apprenticeship and was one of five apprentices to be awarded Cadetships at the end of it (largely, he thinks, due to his work on model aircraft making while doing his Apprenticeship). He was delighted at receiving a Cadetship as it meant a commissioned rank in sight and it also meant he was to become a pilot.

Started R.A.F. college in 1926 and finished in July 1928. He first flew solo in his second term but did not have time to continue model aircraft construction. He became quite proficient at fencing (Foil, Sabre & Epee). Each term cadets were/are required to write a thesis. During his fourth term his subject was "Future Developments in Aircraft Design". He said this task was really the starting point of his subsequent work on jet propulsion. In this thesis he thought it unlikely that conventional piston and propeller combination would meet the power plant needs of the kind of high speed, high altitude aircraft he had in mind. He was looking at an aircraft which could travel at speeds of 500 mph. The top speeds of RAF fighters then being 150 mph.

At the end of his two years as Flight Cadet, he passed out second with the Abdy Gerrard Fellows Memorial prize for Aeronautical Sciences. His flying time amounted to 80 hours, 10 minutes.

He was then posted to 111 Fighter Squadron at Hornchurch in 1928. He was 21 years old. He says these fifteen months were the most carefree of his life. Towards the end of 1929 he was attached to Central Flying School at Whittering.

He had continued to give thought to a jet propulsion arrangement using a propelling jet instead of a propelling propellor. During this time he was instructed to report his ideas to the Air Ministry. His idea for a Gas Turbine was deemed impractical because materials did not exist capable of withstanding

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the high temperatures or stresses. Despite rejection a friend convinced him to take out a patent and this he duly filed on 16th July 1930. It was at this time he started looking for sponsors and it was towards the end of 1930 that he first approached BTH in Rugby to discuss his Turbo Jet engine with Mr. F. Samuelson, Chief Turbine Engineer and his deputy R. H. Collingham.

He was turned down because they said his engine would cost £60,000 to develop. Their argument being it was the height of the depression and the engine he was proposing was purely for aircraft use and not in BTH's field. At the end of 1930 he was posted to the Marine Aircraft establishment as a float plane test pilot/engineer. He married in May 1930 (Dorothy Mary Whittle), his son son Francis born May 1931.

At Felixstowe he was involved in flying aircraft on testing flights which included ditching and flotation trials plus catapult launching trials. One of these flights caused one of the most alarming incidents of his flying career when his passenger was thrown out of the rear cockpit on launch [?] the aircrafts tailplane.

During his 18 months at Felixstowe he maintained a strong interest in his Turbo-jet engine and continued in efforts to interest commercial firms.

Every officer with a permanent commission was expected to take a specialist course after four years of General Studies. Frank Whittle chose Engineering. In preliminary exams for new students at RAF Menlow he achieved 98% in all subjects. On the strength of this the Air Ministry allowed him to do a 2 year course in 18 months. After taking the final examination at the end of 1933 he applied for and received permission from the Air Ministry to take an engineering degree at Cambridge. It was at this time that he was posted to Flight Lieutenant, he started this course in July 1934.

In May 1935 he received as he says a letter "That was to affect my life probably more than any other document ever has". He received a letter from R. Dudley Williams, a fellow cadet at Cranwell, saying he had found someone who had taken an interest in his engine. After discussions with Williams and his partner J.C.B. Tinlings, they made an agreement by which they could [?] expenses of making out further patents (the original taken out by Whittle in 1930 having elapsed), and any other expenses which might arise in their efforts to raise money and Williams and Tinlings would act as Frank Whittle's agents in return they were each to receive a quarter share in their joint commercial]?] rights.

They also decided to try and raise £50,000 which they felt ample develop a jet propelled plane.

In a meeting with a Mr. M. L. Bramson who was well known in in aeronautical circles, Bramson made the suggestion of approaching a firm of investment bankers O.T. Falk & Partners. After receiving a formal report on Frank Whittle's design and ideas, agreement was reached in November 1935. Frank Whittle was at the time in his final year at Cambridge.

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When it appeared they were nearing agreement with Falk & Partners it was decided that they should start practical work and also place a contract for an experimental engine with a suitable engineering firm. At Frank Whittle's suggestion they approached BTH Rugby, they talked to two senior Turbine engineers F. Samuelson and R. H. Collingham. BTH said they might be willing on a 'cost plus basis' to build an engine.

An agreement was drawn up, which includes the Air Ministry that a company was to be formed with a capital of not less than £2000 for the purpose of exploiting the Turbo-jet engine. Falk & Partner to provide the first £2000, with the option to put in a further £18000. The company was duly formed in March 1936 and was called Power Jets Limited.

In March 1936 BTH was requested to proceed, it was at this time Frank Whittle obtained a first in Mechanical Science Tripos at Cambridge.

It was Whittle's plan at this time to test at Cambridge where he was still a post graduate. This was abandoned when BTH agreed to allow testing in the Turbine Factory.

Combustion tests where done at the end of 1936, outside and underneath turbine factory planning office.

On 12th April 1937 all was ready for the first test run, with Collingham, Senior BTH Turbine Engineer and three fitters. The engine ran up to 2000 rpm then went out of control up to 8000 rpm and had to be shut off.

They tried again next evening and the same thing happened. A third test also failed.

After modifications to the fuel injection system the engine ran under control up to 7600 rpm. In spite of further modifications they could not achieve a speed of over 8500 rpm. It was at this time that Whittle disagreed with (Laidlaw) Samuleson and Collingham as to how fuel injection should be applied, which resulted in heated arguments.

Further tests continued, on one occasion the engine seized at 12000 rpm. Modifications and re-designs were done but due to lack of funds a lot of work was make-shift repairs. Again arguments between Whittle and Laidlaw. The modifications did not bring the results Frank Whittle was looking for and in late August Frank Whittle came to the conclusion that a major reconstruction was necessary. His biggest hold up was finance, Falk & Partners were getting cold

feet. About July 1937 Frank Whittle finished at Cambridge and was allowed by the Ministry to devote his time to development of the engine.

Frank Whittle moved to Rugby and spent much of his time in the BTH works where he as able to oversee the work on the spot and build up a personal liaison with the employees concerned. He was prevented from conducting more testing in the factory at speeds over 11000 rpm which made further testing pointless. In reply to Frank Whittle's request for a test area he was offered for rent an old and dis-used BTH foundry at Lutterworth known as Ladywood Works., Frank Whittle was now concentrating on reconstruction of the engine. He had to use parts from the original engine as much as possible to keep costs down. In October 1937 Whittle started new combustion tests. In December he was promoted to Squadron Leader.

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In December 1939 Whittle was astonished to find the blades for his engine, as tested the previous April, had been incorrectly designed. Up until this incident there had been dis-agreements between Frank Whittle and BTH engineers which had been settled by compromise, but this incident was to cause a sharp difference in views and to damage beyond repair the relationship between Frank Whittle and some (but not all) BTH engineers. According to Frank Whittle's calculations the blading needed twice as much twist than BTH had made allowance for. Frank Whittle insisted the blades be made to his specifications. Power Jets Limited also took out a patent for the new blade design which increased resentment between the two companies.

The reconstructed engine was towed to the Ladywood Works, and the first test run was on 16 April 1938. Small problems prevailed until 29th April when the engine ran for an hour and had to be stopped when a rag was sucked into the inlet. On May 16th after running for 1 hour, 45 minutes, overheating caused some blades to fall out, again a re-build was necessary.

After the re-build the engine achieved 16000 rpm and Air Ministry interest. In June an order was placed to produce a flight engine. BTH accepted a sub-contract for its manufacture on a cost plus basis as before.

World War II started a few weeks after Frank Whittle started work on his flight engine.

The Gloucester Aircraft Company were asked to build the plane. It was at this time the Rover Company became involved with developments and production work for Power Jets Limited.

During June, July and August 1940 preceding the Battle of Britain, the close colaboration between Power Jets, BTH and Rover failed, whenever things went wrong BTH or Rover would tell the Ministry that Power Jets were to blame. Despite difficulties and frustrations slow but steady progress was made throughout 1940.

The Gloster Whittle Aircraft was completed at the beginning of April 1940. The first test flight being on 15th May 1941. The success of the Gloster E28 induced the Government to lay plans for quantity production of the W.2B as the power plant for the Meteor Fighter for which design work had started in 1940.

The principle aero engine firms were Rolls-Royce, Armstrong Siddeley, Napier, Bristol and De Havilland. All these companies became interested in aircraft gas turbines during 1941.

In 1941 an engine was shipped to America and with Whittles help on 2nd October 1942 the XP-59A Airacomet made its maiden flight - some six months before the British Meteor became airborne.

Towards the end of 1941 Whittle was exhausted by a four and a half year struggle with formidable engineering problems, overwork and frustration. He suffered a nervous breakdown and was in a Military Hospital for about 10 days.

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In July 1942 Rolls-Royce invited Whittle to Derby in order to discuss a proposal that they should build their version of the Whittle engine. Advances were made in blading material at this time which helped as they were still having trouble with blade failures.

In 1942 Whittle started a complete re-design of the W.2B to be known as W.2/500 as Power Jets had been unhappy with Rovers production engine and Frank Whittle decided to make use of blading development.

In May 1942 Whittle visited America to see and help with work on engines being built there. During his visit he again had to take a rest due to the workload over the previous year and he had not fully recovered from his breakdown. During his visit he learnt that the Americans were planning a production rate of 1,000 engines a month. He returned from

what he called a very successful trip in August 1942.

The performance of the new engine was greatly encouraging but due to the war swinging in Allied favour the urgency of development by the Ministry eased off and planned production of the new Meteor fighters was cut from 80 to 30 a month.

In December 1942 Rolls Royce took over from Rover and Power Jets with approval. For Whittle this was the crucial turning point of his long lone fight.

The immediate result of the Rolls Royce take-over was dramatic. The next few months saw a rapid increase in both reliability and rating of the engine.

In May 1943 Frank Whittle was posted to Staff College on a war course. It was at this time intelligence began to learn of German rocket and jet aircraft.

In November 1943 the Meteor prototypes were flight tested.

Frank Whittle was made Commander of the Order of the British Empire in the New Year's Honours List.

He received sudden fame on January 6th, 1944 when a joint statement was issued by the British and American Governments. In January the Government nationalised Power Jets Limited much against Frank Whittle's wishes. The option to nationalising being virtual threat of extinction. So ended Power Jets Limited. The Government Company was called Power Jets (Research and Development) Limited.

Due again to over work Frank Whittle was again hospitalised in 1944. It was not until May 1944 that the first Meteors powered by Rolls Royce Wellands (i.e. the production W.2B) were delivered to the RAF. The Meteor was not involved in any air to air combat clashes during World War II due to policy reasons.

Whittle came out of hospital at the end of August 1944 still in poor health. He came out of hospital to find himself in an atmosphere of argument and discontent in regard to how he saw the way in which the company was going, and came close to leaving. It was decided by Rolls-Royce that at the end of the war they would switch over from piston engines to gas turbines.

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In January 1945 Frank Whittle accepted a directorship of Power Jets (R & D) Ltd., with the sanction of the Air Council.

He resigned in 1946 on the grounds that Power Jets (R & D) were not allowed to develop and build new engines. As he put it "It is the right crew in the wrong ship".

A week or two after his resignation some sixteen key members of the original team resigned en bloc.

When the break-up occurred the members of the old pioneer team formed an association known as 'The Reactionaries' (Whittle did not want the society named after him) which until May 1985 met at an annual dinner held on the Saturday nearest May 15th, the anniversary of the first flight in 1941.

Following his resignation Whittle made a short lecture tour in Holland and Belgium.

He was offered a job as technical adviser on engine design and production to the Controller of Air Supplies, which Whittle accepted.

After a long and gruelling tour in the U.S.A. and Europe he agreed to a second visit to America in 1946 primarily to receive the U.S. Legion of Merit and the Daniel Guggenheim Medal, with a lecture tour packed in. During this tour he had his third major breakdown. Treatment was to last into 1947 after which he was obliged to retire from the RAF through ill-health. He retired with the rank of Air Commodore.

In May 1948 the Ministry of Supply and the Treasury accepted a recommendation of the Royal Commission on awards to inventors that he should receive an ex gratia award of £100,000 free of tax.

A few days after receiving this award he was made a Knight Commander of the Order of the British Empire (K.B.E.) in the birthday Honours List, and was subsequently knighted by George VI in July 1948.

When Whittle retired from the RAF in 1948 on the grounds of ill health some people regarded him as a spent force,

and would probably vanish from the scene, instead he has led a fascinating and eventful life to date with honours and rewards that the world has bestowed upon him

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THE WHITTLE GAS TURBINE

USED IN JET PROPULSION.

THE events leading up to the association of the BTH Company with Air Commodore F. Whittle and Power Jets, Ltd. in developing the jet-plane engine, are shown below in chronological order.

1930. Air Commodore Whittle, who at that time was a Flight Lieutenant, stationed at No. 2 Flight Training School, R.A.F. Digby, Lincolnshire, paid his first visit to the BTH Company at Rugby in November, 1930. Whittle was preparing a paper for publication in the Royal Aeronautical Society Journal, on " Turbo-Compressors and Super-Charging." The BTH Company already had in commercial service a centrifugal compressor operating at speeds up to 22,000 R.P.M., and capable of dealing with the duty of 18,000 cubic feet free air per minute, up to a delivery pressure of 12 lb. per square inch gauge. The impeller of this compressor was of an advanced design for that time, being of the axial radial type with curved vanes at the inlet so as to reduce shock loss at air entry. Whittle was able to obtain from the BTH designing engineers, various data to aid in the preparation of his paper.

1933. During this year the BTH Company carried out a comprehensive investigation into the possibilities of various gas turbine cycles from the point of view of using this form of prime mover for generating power for purely commercial purposes.

1935. In October, 1935, a discussion took place at Rugby Works with Whittle, in which the BTH Company was asked if it was prepared to undertake the manufacture of a supercharging blower. At that interview Whittle was debarred from revealing the whole object of his proposal, but in the following December, the BTH Company was advised by the firm of Falk & Partners, Ltd., 10 Old Jury, London, that a private limited company was being registered by them , the purpose of which was to finance the development of some inventions by Whittle, and that the new Company would shortly be placing an order with the BTH Company for an experimental unit.

1936. A meeting was held at the BTH Rugby Works in January, 1936, when Whittle explained the object of his invention, and gave an idea of the performance which he hoped could be obtained from a gas turbine to be used for jet propulsion. The BTH Company already possessed a considerable amount of knowledge regarding the behaviour of materials exposed to temperatures of the order of 1000°F. (faint red heat). Much of this had been accumulated during the operation of the 10,000 kW. steam turbo-alternator which had been built at the BTH Rugby Works and installed in the Delray No. 3 Power House of the Detroit Edison Company, U.S.A. The turbine of this machine had successfully operated in commercial service with steam at an initial temperature of 1000°F. for 26,000 hours. In view of this experience and also of that acquired in the building of other turbines and compressors of high rotational speeds, the BTH Company decided to collaborate with Whittle in the design and manufacture of a jet-plane engine.

In March, 1936, the BTH Company was advised by Falk & Partners, that the new Company which they had registered for exploiting Whittle's new invention, would be called " Power Jets, Ltd." and it may be recorded that the BTH Company became shareholders in this Company.

Falk & Partners requested the BTH Company to proceed with the engineering and draughting work necessary for the preparation of manufacturing instructions to enable the factory to build the sample gas turbine and air compressor equipment. They stated also that the BTH engineers were now full y aware of the nature of the engine, and that the general arrangement of the turbine and compressor might take either of the following two forms :—

(a) A single impulse turbine wheel directly coupled to the compressor.

(b) Two single impulse turbine wheels directly coupled to the compressor and symmetrically disposed on either side of it.

Falk & Partners left the final choice of these alternatives to the BTH design engineers, but stated that they preferred arrangement (a) on the ground that more experience might be gained from it.

The design of the engine was commenced on April 6th, 1936, and the official order received from Falk & Partners on June 17th, 1936.

The design put forward by Whittle for this engine departed from the conventional design of centrifugal compressor as regards the diffuser system ; and a revolutionary feature of his proposals for the turbine was the use of a volute to distribute the gases to the turbine blading, without the provision of guide vanes or nozzles to control its distribution. The BTH engineers indicated to Whittle that they considered the efficiencies of both the turbine and compressor on which his calculations were based were unduly optimistic.

1937. The first experimental jet-plane engine was completed and ran for the first time on April 12th. 1937. As was

to be expected, however, it exhibited several defects, and sundry modifications were carried out. Further jet-plane engines were manufactured by the BTH Company for Power Jets, Ltd., incorporating modifications which experience on the test bed showed were necessary.

1941. The difficulties inherent in the development of the engine having been overcome, a jet-plane engine was installed in an aeroplane built by the Gloster Aircraft Co., Ltd. ; and on May 14th. 1941, at Cranwell, Lincs., the aeroplane was successfully flown for the first time.

With this particular design of jet-plane engine—known as " Unit W 1 "—the gas turbine wheel was provided with water-cooling arrangements consisting of a water-cooled jacket located on one side of, and in close proximity to the disc portion of the wheel.

A second flight jet-plane engine to be built, in which water cooling was dispensed with and air cooling of the turbine wheel adopted, was known as " Unit W 1 A."

In September, 1941. a jet-plane engine known as " W 1 Expl." was manufactured by the BTH Company to the order of Power Jets, Ltd. and sent by the latter to The General Electric Co., Schenectady, Now York, U.S.A. (Associated Company of the BTH Company) for them to study. It was, in fact , the first jet-plan e engine to run on the American G.E. Co's, test bed.

Meanwhile—in January of this year—a direct contract had been placed with the BTH Company by the Ministry of Aircraft Production for three jet-plane engines to give a static thrust at sea level of not less than 1600 lb. These engines were designated " Type W 2 B."

Descriptions of the various jet-plane engines mentioned in the foregoing are given in the following pages.

Career, honours and awards

Born 1 June 1907, in Coventry, eldest child of Moses and Sara Alice Whittle.
Educated Earlsdon and Milverton Council Schools and at Leamington College.
1923-26 Aircraft Apprentice, No 4 Apprentices' Wing, RAF Cranwell.
1926-28 Flight Cadet, RAF College, Cranwell.
1928-29 Pilot Officer, No 11 1 Fighter Squadron. RAF Hornchurch.
1929 Flying Instructor's Course, Central Flying School, RAF Wittering . In 1930 married Dorothy Mary Lee (two sons).
Crazy Flying event. RAF Pageant. Instructor at No 2 Flying Training School, RAF Digby: also lecturer in Theory of Flight.
Filed patent for turbojet.
1931-32 Test pilot at Marine Aircraft Experimental Establishment , RAF Felixstowc. Turbojet patent granted and published.
1932 Officers' School of Engineering . RAF Henlow. Officer i/c Engine Test Section. RAF Henlow.
1934-36 University of Cambridge (Peterhouse) Mechanical Sciences Tripos.
1935 Became Senior Scholar of Peterhouse.
1936 Formation of Power Jets Ltd . Graduated with 1st Class Honours . Granted postgraduate year, during which arrangements were made to build the WU engine.
1937 WU first run on 12 April.
1937-46 Appointed by RAF to Special Duty List.
1939 Air Ministry contracts for W.1 flight engine and Gloster E.28/39 aircraft.
1941 First flight of E.28/39 on 15 May . Full information handed to USA in October.
1943 War Course. RAF Staff College.
1943 After prolonged delays Rolls-Royce took over engine development and put W.2B through official Type Test at full design performance . Limited production of this engine as Welland 1.
1944 Meteor 1. powered by two Wetlands , became operational and initially used for shooting down flying bombs. Power Jets nationalised.
1946 Appointed Advisor to Ministry of Supply : lecture tours.
1946 Power Jets (R & D) converted to NGTE, and deprived of the right to design and develop engines . Whittle and many colleagues resign.
1948 Invalided out of RAF and knighted . Received an award of £100,000 on recommendation of Royal Commission.
1948-52 Honorary Technical Advisor to BOAC.
1952-53 Wrote "Jet".
1953-57 Mechanical engineering specialist to BPM, main operating company of the Shell Group.
1957-59 Technical Advisor, Shell Research.
1959-61 Consultant and lecturer.
1961-69 Technical Advisor to Bristol Siddeley Engine s (later Rolls-Royce) on design and development of Whittle Turbodrill. Also expert witness for defendants in Rateaux v Rolls-Royce patent action.
1974 Freelance study of SST propulsion.
1976 Emigrated to USA and married second wife, Hazel S. Hall.
1977- Navair Research Professor, and from 1979 Adjunct Research Professor, U S Naval Academy, Annapolis. Wrote textbook on gas-turbine design (Gas Turbine Aero-Thermodynamics).

APENDIX D

SIR FRANK WHITTLE' S VISIT - 29TH JUNE 1987

GUESTS

| TIM E | ACTIVITY | REMARKS |
|---|---|---|
| 10.45 onwards. | Guests arrive and are conducted to the Conference Room. | Guests arrive at main offices to meet F.R. Edwards and take coffee and biscuits. |
| 11.10 a.m. | Guests move to foyer to meet Mayor's party. | |
| 11.15 a.m. | Mayor's party arrive at entrance. | Guests to be introduced to Mayor and party by D.R. Edwards. |
| 11.30 a.m. | Sir Frank Whittle and party arrive under guidance of Mr. F.A. Temke. | Met outside building by D.R. Edwards. |
| | Party to enter foyer to be introduced to guests followed by unveiling plaque. | Guests form greeting of line and introduced in turn by D.R. Edwards. |
| ALL FOLLOWING TIMES ARE APPROXIMATE : | | |
| 11.45 a.m. | All move to M.I.G. by motorcade. | Guests to use cars provided and as indicated by conducting staff. |
| | Walk through factory to Test Site areas and return. | Non VIP guests to Conference Room for coffee. |
| 12.25 p.m. | Return to cars and travel to Brownsover Hall for lunch. | Guests to use own transport from Mill Road to Brownsover Hall. |
| | LUNCH | Presentation of gift to Sir Frank Whittle, |
| 2.30 p.m. | Departure of Sir Frank Whittle followed by guests. | |

[end]