The Elmer A. Sperry Award for 1959

"To commemorate the life and achievements of
Elmer Ambrose Sperry, whose genius and perseverance
have contributed so much to all types of transportation . . ."

Presentation of the
ELMER A. SPERRY AWARD
FOR 1959

to

SIR GEOFFREY DE HAVILLAND

MR. CHARLES C. WALKER

MAJOR FRANK B. HALFORD
(*in Memoriam*)

and to their co-workers in

THE DE HAVILLAND AIRCRAFT COMPANY

at the joint meeting of
the Institute of the Aeronautical Sciences
and
the Royal Aeronautical Society
New York, October 7, 1959
by
the Board of Award, under the sponsorship of:—

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

SOCIETY OF AUTOMOTIVE ENGINEERS

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

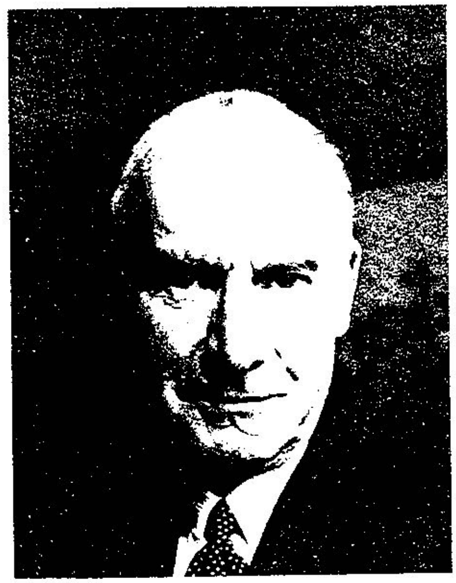
CITATION

THE ELMER A. SPERRY AWARD FOR 1959 is made to The de Havilland Aircraft Company Ltd. for the vision, courage, and skills displayed in conceiving, developing, and producing, the world's first jet-powered passenger transport aircraft, the de Havilland Comet, powered by de Havilland Ghost jet engines.

This accomplishment is especially noteworthy as providing the example and inspiration which has brought into being the succession of efficient, high-performance, subsonic jet transports that have followed under various leaderships throughout the world.

The Award is made to Sir Geoffrey de Havilland as President and inspired leader of the Company that bears his name; to Mr. C. C. Walker, the Company's then Technical Director and Chief Engineer; and, In Memoriam, to the late Major Frank B. Halford, then Chairman and Technical Director of The de Havilland Engine Company.

A Certificate of Citation is likewise awarded to the co-workers for their contributions in this pioneering venture.



Sir Geoffrey de Havilland

Mr. Charles C. Walker

Major Frank B. Halford

ADDRESS BY SIR AUBREY F. BURKE, O.B.E., M.INST.T., F.R.S.A.

Chairman and Managing Director, the de Havilland Aircraft Company Limited

THE COMET

THE COMET'S real origin goes back to 1943, the year in which the first jet engine and aircraft to be built by de Havilland started flight trials. The aircraft, the Vampire fighter with the Goblin engine, exceeded 500 miles per hour by a handsome margin and although as a fighter its high speed was its outstanding characteristic, it had other qualities which seemed to offer attractive prospects in wider fields.

The test pilot who made the first flights in the Vampire, Sir Geoffrey de Havilland's eldest son, was impressed by the lack of vibration and the quietness in the cockpit, which he compared to a glider. Frank Halford, with some thirty years of piston-engine experience behind him was encouraged by the simplicity and the reliability exhibited by his first engine, while Sir Geoffrey de Havilland and Charles Walker, always glad to turn their thoughts to civilian aircraft, were quick to appreciate the advantages which these qualities might bestow on the airliner of the future.

In these mid-war years the jet engine was being hailed as the future power plant for military aircraft — by any previous standards its power for a given weight was enormous and it clearly offered prospects of flying speeds far in excess of those of the past. But in 1943 such high speeds were still linked, in most people's minds, with fighting aircraft only.

The most impressive feature of the jet engine was of course its power. Hardly less impressive in those days was the high fuel consumption, a characteristic which caused the commercial possibilities of the turbine to be dismissed almost universally without more ado.

But at Hatfield, Sir Geoffrey and Charles Walker, with their traditional leaning towards civil aviation, found time to discuss together the pros and cons of the jet airliner. Rough calculations were not discouraging and further study seemed justified. The aerodynamicists were asked to make more detailed investigations in the light of their experience with the Goblin–Vampire combination.

A potent factor in these early thoughts was the disadvantageous position in which the British aircraft industry would find itself in the manufacture of transport aircraft at the end of the war.

In the early days of the war, when the first priority was to beat off the enemy, Britain had no choice but to concentrate her energies on fighter aircraft, at first even at the expense of her bomber force, and at no time during the war could any part of Great Britain's production capacity be spared for transport aircraft. By agreement we looked to the United States for these. How well these needs were met by, for example, the versatile DC.3 is another story, but one to which due tribute should be paid and has already quite rightly been paid by the donors of the Elmer Sperry Award.

The de Havilland team studying the possibilities of the jet airliner were well aware of the handicap which this wartime policy would impose on the British aircraft industry in the bid for a share of the post-war airliner market. It was clear that it would be difficult, with a conventional aircraft, to match the well-developed transports already in production in the United States; to produce something better in time to compete would be a near impossibility.

In this context the jet engine seemed to offer a chance for Britain to gain a commanding lead.

With this attractive possibility in view the exploratory work at Hatfield continued and a reasonably hopeful picture began to emerge. It was becoming evident that the jet airliner could be made commercially competitive because the high cost of fuel would be partly offset by the low weight of the engine and by the high speed which the aircraft could achieve with jet power at high altitudes. In other words the high speed of the jet aircraft resulted in a reasonable fuel consumption reckoned in terms of miles-per-gallon although the figure for gallons-per-hour was high. The attraction of jet travel, its quietness and lack of vibration, were an additional bonus, whilst the speed had its commercial value in that it almost doubled the work capacity of the aircraft when reckoned in terms of ton-miles per annum.

These factors are of course now widely appreciated and proved in practice, but in 1944 I imagine there were few, outside the de Havilland team, who gave them more than a passing thought.

Many will remember the Brabazon Committee, of which Lord Brabazon was Chairman and Sir Geoffrey a member, which was convened in London in 1943 and sat during the closing years of the war. Its brief was to study and make recommendations regarding the types of civil aircraft on which the British aircraft industry should concentrate after the war. It may be remembered that one of the eight types recommended, the Brabazon 4, was a jet transport.

As the investigation went deeper so the enthusiasm grew and as the end of the war approached, the decision was made to go ahead and design a jet transport. All that was needed was an order. For some time the two British airlines then operating long distance routes, the British Overseas Airways Corporation and British South American Airways, had been studying the de Havilland proposals and eventually these airlines placed an order for eight and six aircraft respectively. In addition, the British Ministry of Supply ordered two aircraft. This was, incidentally, an early example of the confidence and foresight in airline management which is always so valuable to the manufacturing industry.

So the project progressed from generalised calculations to specific layouts. Many different forms were investigated ranging from a twin-boomed arrangement similar to the Vampire but with three Goblin engines, to a tail-first configuration with three rear-mounted engines; the first application of an engine installation now adopted by the second generation of jetliners such as the DH.121. Serious consideration was also given to a flying-wing version with no tail, and a scaled-down model of this shape was built around a Vampire fuselage. This aircraft was known as the DH.108 and three were built. It will be remembered that it was in one of these aircraft that Sir Geoffrey's son, then the Company's chief test pilot, lost his life in September, 1946, while flying at a speed greater than had hitherto been achieved anywhere. He was carrying out trials prior to an attack on the world speed record.

Later the DH.108 became the first British aircraft to exceed the speed of sound, but although it proved that the aerodynamic efficiency of the tailless formula was sound, control at high speed was inadequate and it was also clear that, in a tailless jetliner, the landing weight for a given landing speed would have been uneconomical mainly because ailerons had to serve as elevators ("elevons") and reduced the lift of the wing when landing. It was therefore decided, during September, 1946, that with the knowledge then available, the tailless layout was not suitable for a passenger aircraft.

Finally it was decided to concentrate on a design which was conventional within the limits of the new technique, and the outline of the Comet began to emerge. This decision was partly dictated by the fact that time would not allow the building of an experimental prototype — the new aircraft must necessarily go straight into production off the drawing board if the post-war demand was to be met promptly and the hoped-for British lead in this new form of air transport was to be established.

Frank Halford, then Technical Director of the de Havilland Engine Company, took part in all the jet airliner discussions from the earliest days and his enthusiasm for the project rivalled that of his colleagues in the Aircraft Company.

His association with Geoffrey de Havilland dated back to the days of the first world war when de Havilland and Halford worked together to fit Halford's B.H.P. engine into the early DH.4 biplane bomber, and there had grown up between the two men a close understanding. From the first they seemed to have appreciated the necessity for the closest collaboration between aircraft and engine designers.

In 1924 the same trend was evident in Halford's production of the original 60-B.H.P. Cirrus (made up of parts from a war-surplus engine) to suit de Havillands requirements for the light aircraft which became the Moth. Another much publicised example was the Comet racer of 1934, with two special Halford-designed Gipsy engines, designed and built in nine months to win the England–Australia race.

Halford's approach to the gas turbine engine was characteristically energetic. Working during the blitz of 1940–41 against the background of Whittle's great pioneering work, Halford was able to visualise a somewhat different conception of jet engine having a single-sided impeller combined with straight-through combustion. These features were decided upon in April, 1941, and they were retained in the Goblin engine for the Vampire and in the subsequent Ghost engine which powered the first Comet.

The Ghost engine, an enlarged version of the Goblin, was developed primarily for use in fighter aircraft (it is still in service with the Royal Navy and the Royal Air Force) but with its 5,000 pounds of static thrust it was just what was needed at that time for the jet airliner. The Ghost first ran on the test bed in September, 1945, and a civil version for the Comet was given high priority.

The axial-compressor type of jet engine is now established as a satisfactory power plant for civil operation but at the time when the Comet design was being finalised there were many advantages in using the well-tried centrifugal type. By then the axial-compressor type of engine already held out a promise of higher compression ratios and better specific fuel consumption, but the new type of engine was still relatively unknown and the problems of the axial-compressor, with its critical surge and stall characteristics, had not then been solved. Furthermore, the extreme robustness of the centrifugal compressor had great attractions. For these reasons there was no hesitation in choosing the Ghost engine for the Comet and in retrospect it is clear that this decision was right; it was the Ghost engine which made possible the Comet's early entry into service.

Although in its essentials the Comet was a fairly conventional aircraft, its design inevitably introduced many new problems associated with such features as power-operated controls and the use of a cabin-pressure differential of 8¼ pounds per square inch; double the pressure in general use at the time.

The new problems called for an intensive programme of practical experimental work which continued during the design and early production stages. Having completed its aerodynamic programme the DH.108 tailless aircraft was used for developing the Comet's power-operated control system. Subsequently a full-size Comet control rig was assembled on the factory floor and operated day and night for three years to prove its reliability.

During this period much use was made of the altitude test chamber at Hatfield, which can produce an equivalent pressure altitude of 70,000 feet and a temperature of −70° Centigrade. This equipment proved invaluable in perfecting the pressurisation apparatus (then, as now, operated from the engine compressors) and the temperature and humidity controls for the cabin.

It was found by experience that the testing of pressurised fuselage sections within the chamber was neither desirable nor practical. An early test specimen which gave way under pressure in the chamber produced an explosion sufficiently powerful to lift two of the chamber's 2-ton bulkheads out of their seatings.

To avoid this hazard subsequent pressure testing of the fuselage sections was done, for the first time ever, in water tanks at Hatfield. The Comet fuselage was designed to withstand a pressure of 2½ times its maximum working load, that is 20½ pounds per square inch, and full-size specimens were repeatedly subjected to this differential without damage. The windows, always recognised as critical points, were subjected to a very practical endurance test. Specimen Comet windows mounted in a rig on the roof of the Hatfield factory were kept at working pressure every day for more than three years during which times they were regularly cleaned as if in airline service. These specimens repeatedly withstood pressurisations of 100 pounds per square inch.

As a result of this work the static strength of the Comet 1 was proved not only to meet the Government requirement of the day but to meet the Company's standard which had been set at 25 per cent. higher than the statutory requirement.

Less sophisticated but no less practical methods were used to test the nose-wheel steering apparatus. The complete gear, with nose-wheel and pilot's steering wheel, were mounted on the fore end of a three-ton truck chassis which itself was loaded with ballast to produce the correct nose-wheel loading. The apparatus, which could in favourable conditions reach 50 miles per hour, provided valuable knowledge during its 120 miles of test running.

The development of the Ghost engine proceeded in parallel with that of the airframe. The Ghost first ran in September, 1945, and in July, 1947, two of the new engines flew for the first time mounted in the outboard bearers of a Lancastrian bomber-transport. This aircraft and another like it were responsible for some 1,700 very useful engine hours in the following two years.

This work was, however, handicapped by the fact that the ceiling of the Lancastrian was limited to about 23,000 feet, far short of the Comet's cruising altitude. A Vampire fighter was therefore modified to take a Ghost engine. With slightly extended wings and with the 5,000 pounds of thrust from the Ghost the Vampire operated without difficulty at 40,000 to 50,000 feet, and provided valuable experience of high altitude operation. It was with this aeroplane that John Cunningham in March, 1948, established a world's altitude record of 59,446 feet.

The first Comet flew on July 27, 1949, by which time the production line at Hatfield was well established. Fortunately all went well and as the flight tests proceeded it was found that the aircraft was up to calculated performance and no major modifications were called for.

The first two Comets built were for the Ministry of Supply and these two were used for test flying and performance measurement and later for route-proving flights by B.O.A.C. The first of the Comets for B.O.A.C. flew in January, 1951, and by the end of that year four B.O.A.C. aircraft had been completed. On January 21, 1952, the Comet received its Certificate of Airworthiness and on February 4, some six months ahead of the contract date, the first Comet was delivered to B.O.A.C. at London Airport: other deliveries followed during March and April.

B.O.A.C. inaugurated the world's first public jet airliner service on May 2, 1952, with a 6,700-mile flight from London to Johannesburg in 23½ hours.

At that time 45 Comets were on order, many of them for the Comet Series 2 which was then being developed. The Comet 2 had a longer fuselage and the all-up weight was increased to 120,000 lb. The need for more engine power to meet these new conditions was met by the fitting of Rolls-Royce Avon engines of 6,500-lb. thrust.

Meanwhile B.O.A.C. maintained their Comet 1 services with marked success. During the first year of operation routes were extended to include India, Singapore and Tokyo, and the route mileage amounted to 21,000 miles. Passenger load factors were exceeding 90 per cent. and 104,600,000 revenue passenger miles were flown in the first twelve months.

In service both the aircraft and its engines had proved exceptionally reliable and within 13 months the overhaul life of the Ghost engine was raised to 600 hours, an unprecedented figure for a turbine at the time.

Experience on the routes had shown that many of the so-called operational hazards which jet airlines would have difficulty in overcoming had not materialised. In practice the Comet has worked normally in and out of London Airport with its traffic congestion and its high incidence of bad weather. The Comet was never given landing priority and there proved to be no need to ask for such concessions. On occasions Comets have been held in the approach pattern for as much as 90 minutes and on other occasions diverted to Prestwick some 330 miles away.

All seemed set fair for the Comet when on January 10, 1954, occurred the first of the two accidents which led to the suspension of Comet services. On that day an aircraft on a flight from the Far East crashed into the Mediterranean in mystifying circumstances. The services were temporarily suspended and many precautionary modifications were introduced, but the real cause was not then known. Soon after the resumption of services a second accident took place in similar circumstances, again over the Mediterranean, and all Comet services were suspended pending a detailed investigation.

The progress of the Comet enquiry is now well-known history. Every effort was concentrated on solving the mystery. The Royal Navy evolved unique salvage techniques whereby some 80 per cent. of the Comet structure was raised from the bed of the sea. The Royal Aircraft Establishment at Farnborough concentrated its extensive technical resources on the problem and the de Havilland Company, with its future at stake, needed no other stimulus for a maximum effort to solve the problem.

As is well known these efforts were successful in establishing, without doubt, the fundamental cause of the two accidents. This may be briefly described as metal fatigue in the pressurised cabin structure, a phenomenon hitherto unrecognised and one which the Court of Enquiry found could not have been anticipated in the light of the knowledge then available. It was a subject quite separate from the static strength test programmes which had seemed so adequate five years before.

As soon as the cause of the accidents became clear — some time in advance of the official enquiry's findings — work began on applying the new knowledge. The target aimed at and subsequently achieved was to give the aircraft a safe fatigue life of 20 years of airline service. To-day a fatigue life requirement has been established throughout the structure of the Comet 4. It is the first transport aircraft in history for which this new standard has been set, and perhaps still the only one.

The enquiry showed that the Comet 2, which was by then in production, and the Comet 3, the first of which was about to fly, would both need modification, and for a time all production work was stopped. But the Company's confidence in the ultimate success of the Comet was still high and the suggestion that the name should be changed was never entertained.

Work on the Comet's structural design went on without a break and in March, 1955, a new version with still more power, range and payload, known as the Comet 4, was announced. Nineteen of them were ordered by B.O.A.C.

In the meantime the Comet 2s already on the production line were being modified for service with the R.A.F. Transport Command. These aircraft, ten of which were delivered to the R.A.F., have been in service since June, 1956, and have flown more than 22,000 hours in operational services extending round the world. In the main the modification consisted of a simple strengthening of the cabin in certain areas. It was the thoroughness of the investigation which took the time, not the amount of work done on the design.

Similar modifications were made to two Comet 1As which had been in service with the Royal Canadian Air Force since 1953, and these two aircraft are still in commission; one of them was used recently by Queen Elizabeth and Prince Philip during their Canadian tour.

The new Comet (having twice the power and twice the payload of the pioneer version, but embodying the same proved and uncontroversial basic engineering) made its first flight on April 27, 1958, and less than six months later Comets of B.O.A.C. inaugurated the first Atlantic jet service. B.O.A.C. services have since been extended to India, Hong Kong and Japan and Argentine Airlines have started services linking South America with Europe and the United States. Deliveries to the third and fourth operators are about to begin, and we are now building Comets in several versions which offer the alternatives of higher speed or better range/payload characteristics, according to the needs of a particular route network.

We are often told that the Comet must be the most thoroughly tested aeroplane in the world, and this we believe. However, this is not an end in itself. The achievement of the three men whom you are honouring to-day was that they visualised in the middle of war a new conception of travel in peace, and to have led their project through some astonishing vicissitudes with a determination which is now yielding its dual reward — a fine practical airliner coming and going easily and regularly from airports large and small all over the world, and a design team rich in experience. These men are already immersed in the problems of the second and third generation of jet airliners and their future successes will rest to a great extent on the leadership, foresight and single-mindedness of de Havilland, Walker and Halford.

Elmer Ambrose Sperry, 1860–1930

The Founding of the Award

The Elmer A. Sperry Award is made annually for a distinguished contribution which through application, proved in actual service, has advanced the art of transportation whether by land, sea or air.

The purpose of the Award is to encourage progress in engineering of transportation. It was established by Elmer Sperry's daughter, Helen (Mrs. Robert Brooke Lea), and his son, Elmer A. Sperry Jr., in January, 1955, the year marking the 25th anniversary of their father's death.

Recipients of the Award are selected by a Board of Award of eight members representing the four engineering societies in which Elmer Sperry was most active, The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Society of Automotive Engineers and The Society of Naval Architects and Marine Engineers.

In the words of Edmondo Quattrocchi,
the sculptor of the medal . . .

"*This Sperry medal symbolizes the struggle of man's mind against the forces of nature. The horse represents the primitive state of uncontrolled power. This, as suggested by the clouds and celestial fragments, is essentially the same in all the elements. The Gyroscope, superimposed on these, represents the bringing of this power under control of man's purposes.*"

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