THE ELMER A. SPERRY AWARD FOR 1972

ELMER AMBROSE SPERRY
1860 - 1930

FOUNDING OF THE AWARD

The Sperry Award commemorates the life and achievements of Dr. Elmer A. Sperry (1860-1930) by seeking to encourage progress in the engineering of transportation. Much of the great scope of the inventiveness of Dr. Sperry contributed either directly or indirectly to advancement of the art of transportation. His contributions have been factors in improvement of movement of men and goods by land, by sea, and by air.

The award was established in 1955 by Dr. Sperry's daughter, Mrs. Robert Brooke Lea, and his son, Elmer A., Jr., and is presented annually.

Presentation of the

1972
Elmer A. Sperry
Award

to

Leonard S. Hobbs

and

Perry W. Pratt

and the dedicated engineers of the
Pratt & Whitney Aircraft
Division of United Aircraft Corporation
for the design and development
of the JT3 turbojet engine

By the Board of Award

Under the Sponsorship of

The American Society of Mechanical Engineers
Institute of Electrical and Electronics Engineers
Society of Automotive Engineers
The Society of Naval Architects and Marine Engineers
American Institute of Aeronautics and Astronautics

AIAA Ninth Annual Meeting
Eleventh Aerospace Sciences Meeting Luncheon, January 8, 1973
Sheraton Park Hotel, Washington, D.C.

PURPOSE OF THE AWARD

The Elmer A. Sperry Award shall be given in recognition of —

"A distinguished engineering contribution which, through application, proved in actual service, has advanced the art of transportation whether by land, sea, or air."

1972 BOARD OF AWARD

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MEDAL CITATION

LEONARD S. HOBBS and PERRY W. PRATT for their leadership, vision and engineering skill in directing the design and development of the JT3 turbojet engine, the first twin-spool jet engine to go into commercial production, and which by its performance and reliability was an essential element in the initiation and rapid growth of the jet age in commercial air transportation.

CERTIFICATE OF CITATION

To the dedicated engineers and other concerned employees of the Pratt & Whitney Aircraft Division of United Aircraft Corporation for their contributions to the design, testing, development and production of the JT3 turbojet engine and to the many subsequent and even more advanced models of turbojet and turbofan engines which followed it.

Ever since the Wright Brothers took man's first tentative step into the air with a powered machine 69 years ago, advances in air transport have been dependent on production of improved and better engines.

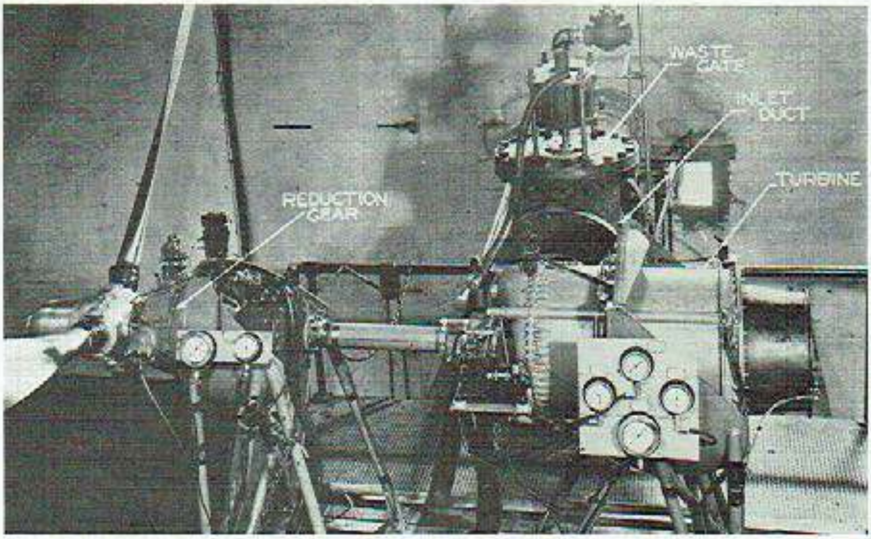
Orville and Wilbur Wright had proven by their glider experiments on the sand dunes of North Carolina that it was possible to fly, but at first they lacked a suitable powerplant, until they built their own. Their hand-made 12-horsepower water-cooled engine wasn't very sophisticated, but it succeeded in launching simultaneously both Orville and the Age of Flight.

The airplane caught the fancy of many in the early years of this century, but its first serious adoption was by military services, primarily in Europe. Commercial seaplane service, capable of carrying a single passenger, was inaugurated on the 22-mile route between Tampa and St. Petersburg, Florida, as early as 1914, but soon foundered on economic shoals. Bigger, more efficient planes, and more powerful engines, were needed to make commercial air service a financial success — and they weren't available.

The end of World War I saw efforts by the British, French, and Dutch to introduce commercial air service, essentially with modified bombers. Red ink again was the norm. A few hearty passengers crammed themselves in along with the mail as the '20s progressed, but not until the latter part of the decade, with introduction of the tri-motor Fokker and Ford "Tin Goose," were passenger-carriers of any real commercial value available to fledgling American airlines.

The first permanent tracings of the airline networks that crisscross the U.S. today emerged as the expanding '30s succeeded the barnstorming '20s with the advent of powerful lightweight, radial, air-cooled piston engines such as the "Wasp," "Hornet," and "Cyclone," as successors to heavier liquid-cooled engines that predominated earlier. The new engines led to the Boeing 247, the first modern commercial transport, and soon the Douglas DC-1, DC-2, and ultimately the DC-3 that ushered in feasible commercial air transport. At the same time, Sikorsky, Martin, and Boeing flying boats pioneered overseas service to Europe, the Orient and Latin America.

World War II both interrupted commercial transport development and gave it its most impelling boost by demonstrating that four-engined land planes could be used efficiently in transoceanic flight as well as on long-haul overland routes.



Initiated in 1940, PT1 engine project was Pratt & Whitney Aircraft's first venture into gas turbine field. Engine used exhaust of a two-stroke diesel to drive a turbine wheel geared to the propeller shaft.

The Douglas DC-4 took on a major postwar role in commercial transport, but was soon superseded by other four-engined planes, the Lockheed Constellation, Boeing Stratocruiser, and two other Douglas-built airliners, the DC-6 and DC-7. These piston-engined aircraft played the major role in establishing worldwide passenger and cargo routes. With such airliners, however, the reciprocating engine began straining its practical limits. Only so many cylinders could be effectively hung in front of, or behind, the wings of a plane.

Fortunately, World War II had given birth, in secrecy, to a new type engine — the gas turbine — that, as it matured, offered the promise of delivering the power needed to propel the much larger aircraft the world's airlines would need to operate efficiently at the speed and ranges envisioned by forward thinkers in commercial transport. The principle of the gas turbine had long been known. An Englishman, John Barber, patented one in 1791. During World War I, American sculptor Gutzon Borglum, involving himself somewhat out of his field, proposed to the U.S. Aircraft Board an idea for propelling planes by taking air in the front and expelling it at the rear, but the proposal lacked any concrete means of accomplishing the feat. A Frenchman, M. Guillaume, set forth the idea of using turbine jet exhaust for propulsion, exactly as it is used today, in a 1921 patent, but nothing came of it.

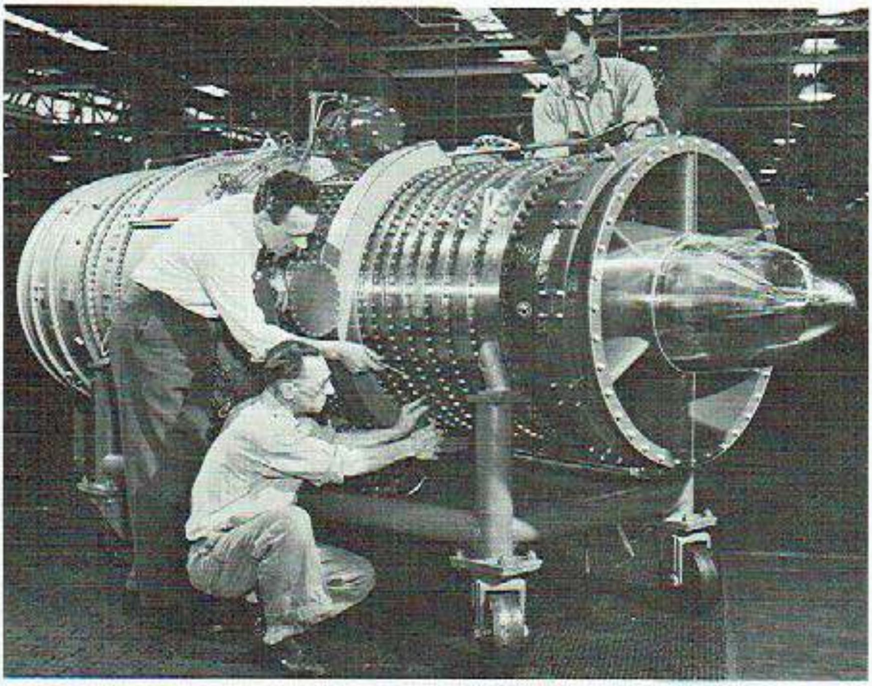
In the late 1920s, Frank Whittle, a young pilot-engineer in Britain's Royal Air Force, seeking a better powerplant, set to work on his own concept for a gas turbine propulsion system. Whittle, belatedly knighted in 1948, filed for a patent on a centrifugal-flow engine in January, 1930, but was hardly besieged with offers from companies wanting to develop his powerplant in a day when 400- to 600-horsepower engines were doing quite nicely.

Working independently in Germany in the early 1930s, and without knowledge of Whittle's published patents, Hans von Ohain conceived and patented a centrifugal-flow turbojet with little resemblance to the Whittle engine. Von Ohain joined the Ernst Heinkel organization in 1936 and began work on a powerplant that eventually became the He S-3b. Wedded to the Heinkel He 178 aircraft, the engine, with 1,100 pounds of static thrust, powered the first turbojet plane ever to fly on August 27, 1939, just before the outbreak of World War II. Other German companies pursued jet engine projects, but Nazi politics and shortages of materials and skilled personnel held up development and introduction of jet fighters until it was too late to change the course of the war. Nonetheless, Nazi Germany was the only country in World War II to put gas turbine-powered aircraft into plane-to-plane combat.

The Italians, too, demonstrated a form of jet-powered flight with the Campini-Caproni plane that was first flight tested in 1940, and on November 30, 1941, flew 475 kilometers from Turin to Rome in two hours, 11 minutes. Secondo Campini's concept used a conventional reciprocating engine to drive a many-bladed variable pitch fan within a closed air passage, or duct. The location of the fan in the duct made it possible to obtain additional thrust by burning added fuel within the duct behind the fan. The performance of the plane, however, was poor and it proved to be nothing more than a short-lived wonder.

In Britain, Whittle lived through years of frustration in attempting to turn his turbine engine concept into hardware. His persistence paid off, however, in 1936 when he succeeded in helping to found Power Jets Limited to develop his engine. A year later, on April 12, 1937, the first experimental Whittle engine was run on test, although this gave little cause for celebration because the engine ran out of control and overheated badly. Nonetheless, development went ahead and the first Whittle engine flew in the Gloster G. 40 (E. 28/39) aircraft on May 15, 1941, delivering an output of about 880 pounds of thrust.

The European countries were not alone in their interest in the gas turbine



First experimental model of the JT3 was cylindrically shaped and had compressor stages with a constant outside diameter. This engine, serial number X-176, ran for the first time on June 28, 1949, and now is part of the collection of the National Air and Space Museum of the Smithsonian Institution.

engine. Leonard S. (Luke) Hobbs, a man who at the age of 43 had already made more than his mark in the field of piston engines, had begun studying in 1939 the possibilities of commercial transports powered by gas turbine-driven propellers. At that time, Hobbs was engineering manager of the Pratt & Whitney Aircraft division of United Aircraft Corporation in East Hartford, Connecticut. Hobbs had earned his degree in mechanical engineering from Texas A & M in 1916, and after World War I service as an engineering officer with the famed 42nd (Rainbow) Division, received his master of science degree at Kansas State College. The intriguing potential of aviation lured him from his first ambition of automotive engineering, and in 1920 he became an aeronautical test engineer at the Army's McCook Field in Dayton, Ohio. There, and later with the Stromberg Motor Devices Corporation, he made significant inventive contributions to aircraft engine carburetors, designing, among others, the first float-type carburetor that permitted inverted flight.

Hobbs joined Pratt & Whitney Aircraft in 1927, two years after its founding, as a research engineer, and for much of his remaining career was directly involved with engine design and development. He played a key role in bringing through development the R1830 powerplant for the DC-3, the R2800 Double Wasp piston engine (P-47, DC-6, Convair Liners, Martin 202/404), and the R4360 Wasp Major, the largest production piston engine ever built (B-36, KC-97, Boeing Stratocruiser).

World War II was already under way in Europe when, in 1940, Hobbs initiated active research into gas turbine powerplants in the constant quest for better and more economical engines. Andrew Kalitinsky of the Massachusetts Institute of Technology was engaged to make preliminary studies on a free-piston turbine engine in which he was interested. The engine, named the PT1, was about midway between a compound engine and a pure turbojet. It utilized the exhaust of a two-stroke diesel to drive a turbine wheel that was geared only to the propeller shaft.

Later, M.I.T. Professor Dr. C. Richard Soderberg, a Swedish-born turbine expert, joined the project. Experimental investigation continued on a small scale throughout World War II. Preliminary aim of the project was exploration and testing of components rather than development of a specific engine. The Navy was aware of the project initiated by Hobbs, and consented to it on the understanding it would not interfere with the mainstream of Pratt & Whitney Aircraft's piston engine effort, particularly in the engineering manpower area.

Following the successful test flight of the Gloster G. 40 (E. 28/39), Britain, in 1941, secretly furnished the Whittle engine design to the United States to help speed development of jet-powered aircraft in this country. A special committee on gas turbines was set up by the National Advisory Committee for Aeronautics. This committee made specific development assignments for axial-flow turbojet and turboprop engines to General Electric Company, Westinghouse, and Allis-Chalmers. Additionally, the Army Air Force imported the Whittle-type centrifugal-flow design and assigned it to G.E.'s turbo supercharger division. At the same time, the conventional engine builders, such as Pratt & Whitney Aircraft and Wright Aeronautical, were deliberately foreclosed from entering the new gas turbine field because of the urgent wartime need for more and more, as well as better, reciprocating horsepower.

Secrecy on gas turbine development was so effective that it wasn't until January, 1944, that the world learned from a joint Anglo-American announcement that there was such a thing as a jet-propelled aircraft. Up

Early JT3, designated J57 by the military services, is shown being installed on experimental Boeing B-52 bomber. The eight-engined B-52 was the first production home for the JT3.

until the end of 1945, the British made their knowledge of jet engine development available to the U. S. government, which decided how the data was to be used. The British actively aided General Electric to get a Whittle-type unit into early production, and the close collaboration continued on the I-16 and I-40, both of GE design. Information flowed freely on the understanding that it would be used by American firms for wartime purposes only. The agreement was scrupulously observed.

As the war was drawing to a close, the senior management of United Aircraft and Pratt & Whitney Aircraft — Chairman Frederick B. Rentschler, who had founded P&WA; President H. M. Horner; Hobbs, and William P. Gwinn, general manager of P&WA — recognized all too clearly that the engine-building division was woefully behind in the new technology of gas turbines. Available technology had been given by the government to companies not previously in the aircraft engine field, and they were certain to become competitors in the postwar years.

Hobbs, who became corporate vice president for engineering in 1944, made a major move toward the end of the war that was to prove of great significance. He split P&WA engineering into two separate departments, one responsible for continuing the piston engine work, and the other charged with developing gas turbine units. A brilliant young engineer, Perry W. Pratt, only 30 years old at the time, was taken off piston engines and assigned the task of learning everything he could about the new jet engines.

Pratt was graduated from Oregon State College in 1936 with a bachelor of science degree in mechanical engineering, and then did postgraduate work at Yale. He joined Pratt & Whitney Aircraft in 1937 as a test engineer. Pratt worked his way up in the engineering department, and early in World War II was assigned as project engineer on the R2800 Double Wasp, an 18-cylinder workhorse in military and commercial aircraft and the first piston powerplant to achieve the long-sought goal of producing at least one horsepower for each pound of engine weight. The R2800 was by a wide margin the most useful piston engine ever developed as measured by the number of different military fighters, bombers, observation, and transport planes and then the number of commercial transports it powered.

Asked, years later, why he had chosen Pratt for the gas turbine assignment, Hobbs replied that it was not only Pratt's work in the development of the R2800, but his technical knowledge and his ability to excel in both technical and theoretical work.

Given his new charter, Pratt at first isolated himself to soak up as much information as was available on gas turbine engines. He then got involved in the PT1 project, all the while working closely with Hobbs, Dr. Soderberg, and Andrew V. D. (Andy) Willgoos, Pratt & Whitney Aircraft's chief engineer and also head of the separate department set up in engineering to carry on the division's turbine engine work.

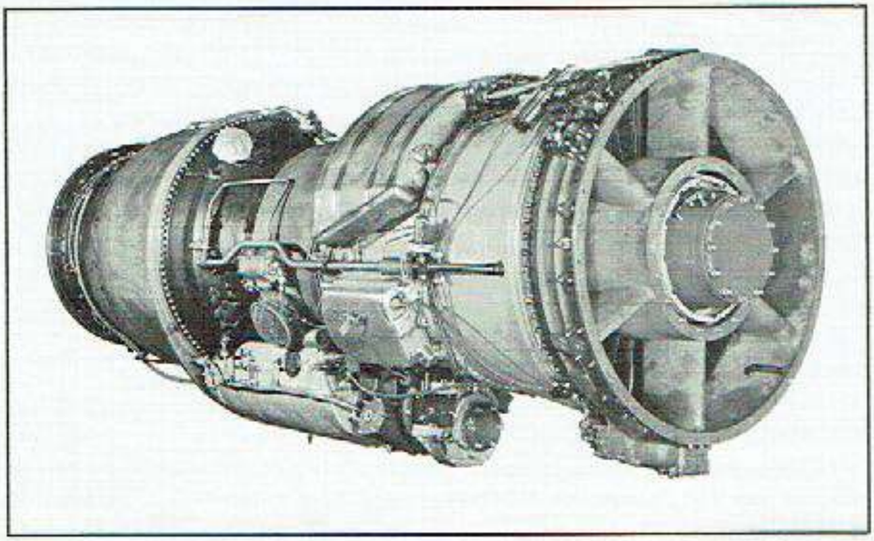
After some months, Pratt was told to put together a small team of bright young engineers, under the heading of the Technical and Research Organization as part of the turbine department, to begin basic, not detail, design work in gas turbines. This group under Pratt's leadership was responsible for all technical aspects and it eventually contributed the dual-rotor compressor concept which was at the heart of the spectacular performance and fuel economy of the JT3 (J57) turbojet that led U.S. commercial aviation into the jet era.

It wasn't until after V-E Day that Pratt & Whitney Aircraft was given the go-ahead to enter the already highly competitive gas turbine field. The PT1 project was still being pursued, and for a while it was sponsored by the Navy as the T32. It continued in being until 1947 when it was abandoned in favor of other more promising projects in the jet field. One enormous plus from the PT1 was the experience built up in turbine design. The PT1's turbine efficiency was well over 80 per cent. What Pratt & Whitney Aircraft needed was compressor design capability.

On July 1, 1945, with the war all but over, the division began development of the PT2, or T34 as it was known in the military. This was a single rotor, axial-flow turboprop engine, and, in a sense, was a "guinea pig" in that the new gas turbine group had to be completely reeducated and reoriented from the piston engine to the techniques of turbine engine design. The Navy was interested in the turboprop for long-range patrol planes and carrier-based fighters and bombers. Perry Pratt and his Technical and Research Organization engineers were in the forefront of this first really "home-grown" development effort. The T34 eventually became a production engine early in the 1950s.

President Harry S. Truman announced the end to World War II on the evening of August 14, 1945, and the next morning production at Pratt & Whitney Aircraft — the source of 11,000,000 horsepower a month — came to a halt. More than $414 million in government contracts were canceled in a single day, leaving the engine builder with only $3 million in outstanding orders. Pratt & Whitney Aircraft recognized that it must quickly get its own programs going in the pure jet field or face an exceedingly grim future.

"We knew the piston engine had grown slowly," Hobbs reflected, "but



Eventual "wasp-waisted" configuration of the production JT3 featured a constant inside diameter of the rotor discs with the compressor pinched down at the high pressure end. The twin-rotor, axial-flow engine was the first in the western world to achieve 10,000 pounds of thrust.

we knew everything would accelerate with a bigger and richer country after World War II. We knew that we were going to have bigger and more powerful engines, that the airplane would win a lot of transoceanic traffic just because speed is always king."

Pratt & Whitney Aircraft got its first taste of turbojet work, albeit reluctantly, beginning in 1945 when, at Navy request, it undertook to produce the Westinghouse 19XB, an axial-flow engine of 1,560 pounds of thrust. The reluctance was embodied in Rentschler's philosophy that "if you're a licensee, you're always about a year or two behind everybody else. You get what somebody else develops. You've got to be on your own to be a leader in the business."

Another Navy decision, to import the design of the Rolls-Royce Nene/J42 centrifugal-flow turbojet in 1946 to power the Grumman F9F Panther fighter, again involved Pratt & Whitney Aircraft in design and production of an engine not of its own conception. This was followed by P&WA development of the Rolls-Royce Tay, or J48, also a centrifugal-flow engine, which at the time of its public debut early in 1950 was the most powerful engine in either Britain or the U.S. at 6,250 pounds of static thrust. Development of these licensed projects was carried out by the regular reciprocating engine side of the engineering department, leaving Andy Willgoos and Perry Pratt and their groups free to pursue purely Pratt & Whitney Aircraft designs.

Although the division from the onset of its gas turbine work in 1940 had amassed about $3 million in component test rigs and equipment, the corporation's management recognized the need for a laboratory devoted exclusively to jet engines, particularly for development work on compressors, the complex key to a jet engine's efficiency.

"We had decided almost from the beginning that we were going to an axial-flow compressor," Hobbs recalled. "It looked so much more simple, and, in the long run, had a smaller diameter (than a centrifugal-flow engine), and would go to higher efficiencies and higher compression ratios. We knew we were really going to have to work hard to get a good axial-flow compressor."

From its piston engine work, Pratt & Whitney Aircraft was well aware that maintaining a position of leadership required substantial investment in large quantities of sophisticated technical and mechanical equipment. Even before settling on what kind of units it would develop, it was planning the facilities and equipment needed for proper development and testing of gas turbines. Accordingly, in 1946, the corporation decided to

Prototype Boeing 707, the United States' first jet-powered transport, lifts off on its initial flight on July 15, 1954, under the power of four JT3 engines. This aircraft, known as the Dash-80, was presented to the Smithsonian Institution in 1972.

build its own gas turbine laboratory for testing jet engines. The largest privately-owned such facility in the world, the Andrew Willgoos Laboratory was to embody the company's basic philosophy of engine development, namely concentrating on component testing as well as entire engines. Testing was going to demand tremendous power requirements, such as could be met by a cruiser-size naval boiler and destroyer-escort turbines and generators. To get work under way quickly, even before the lab could be built, the engineers were given the go-ahead to buy the generators, condensers, boilers, piping, and other equipment from a surplus dealer in Philadelphia who was cutting up ships. In all, machinery was obtained from six scrapped ships, and delivered even before final design of the laboratory was completed. Equipment from one ship, including the decks, was removed, installed ashore in East Hartford, and was running in 1947, supplying power for two compressor stands, three years before completion of the Willgoos Lab itself.

Various paths were examined to determine the proper course to pursue in going over to jets. One involved using the exhaust from the 28-cylinder R4360 to drive a turbine. Another was building a small, simple unit which could be adapted either as a turboprop or a straight jet, and then combining two, three, or four of the small units as building blocks to achieve greater thrust.

It was determined fairly quickly, however, that the only proper course was to build a straightforward gas turbine. And it was decided, as well, that Pratt & Whitney Aircraft should have both turboprops and turbojets in its stable. The first P&WA proposal to the military for a medium size, medium compression turbojet engine, however, was rejected and development of a 7,500-pound-thrust engine, the J40, was turned over to one of the established companies, Westinghouse Electric Corporation.

"We faced a mighty tough situation," Hobbs said years later. "Not only were we five years behind the other companies, but some of them could draw on years of experience in the steam turbine field. We were running a poor race. We decided that it would not be enough to match their designs; that to get back into the race we must 'leap-frog' them — come up with something far in advance of what they were thinking about."

His stance on "leap-frogging" was reinforced by extensive studies he had requested from the corporation's research department which indicated conclusively that to be economically feasible, jet transports of the future had to be much larger than the piston-engined planes they would succeed.

At that time, in 1946-47, the jet engines in service had power ratings of about 4,000 pounds of thrust. Centrifugal-flow engines predominated; the axial-flow designs had only a single rotor to drive the compressor. Pratt & Whitney Aircraft's competitors had on their drawing boards engines in the 6,000- to 7,000-pound-thrust category. Engine thrusts had been increasing on a very gradual curve in this new art, each small step being based on the experience of the preceding step. Hobbs' proposal to go to a much higher thrust and compression ratio engine was a bold move that, if successful, could put the engine builder greatly ahead of the competition.

After intensive studies with Pratt and his T&R group, Hobbs went to Rentschler and Horner with his plan: The company would lay down a big turboprop that could rapidly be converted into a turbojet, but with power in a bracket well beyond the J40's thrust, especially as the engine matured.

The design would incorporate new features, including a dual-rotor, or two-spool, configuration with very high compression in an axial design whose top characteristic would be a fuel consumption rate much superior to anything in sight. In deciding on the dual-rotor compressor, Hobbs and his team were taking a radical approach to the design. Up until that time, axial-flow engines had but single-rotor compressor units. When they rotated at their optimum design speeds, they operated efficiently. But a jet plane cannot operate at a constant speed, and when the single compressor turned slower or faster than its optimum, its power dropped and its rate of fuel consumption increased.

The dual-compressor envisioned for the Pratt & Whitney Aircraft engine would have two units, one behind the other, rotating on concentric shafts. Each would have a different design optimum and each would work at its own most efficient speed, independently of the other. The engine therefore, on paper, could operate efficiently over a wide choice of speeds, gaining added aircraft range from the low fuel consumption resulting from its high compression ratio.

The large turboprop was proposed to the Air Force as a powerplant for a Boeing heavy bomber that eventually became the jet-powered B-52. The Air Force liked the concept, and agreed to joint funding, with P&WA's half of the costs being charged against production, then largely commercial. The engineering order for this venture, known as the PT4, was dated September 2, 1947. Component testing began later that year.

Hobbs and his staff, however, were convinced that straight jets were going to dominate in high-performance aircraft, and he again returned to the Air Force with a proposal that the PT4 be converted to a turbojet. Hobbs' arguments were persuasive. The first lot of engines could be guaranteed to

JT3s also powered initial models of the DC-8, Douglas' first commercial jetliner, one of which is shown undergoing preflight preparations on the flight line at Long Beach, California. DC-8 made its maiden flight on May 30, 1958.

deliver nearly 9,000 pounds of thrust. But more important was the highly appealing curve on fuel consumption that the higher compression of the jet would ultimately provide. The Air Force authorized the switch-over, and design of the JT3 turbojet (designated J57 by the military) was begun on March 8, 1948.

Pratt & Whitney Aircraft hopefully aimed the new engine once again at the Boeing heavy bomber, which, itself, was laid down as a turbojet-powered aircraft, rather than the initially proposed turboprop.

It took three years to develop the JT3 to a production engine, during which time more than 4,000,000 individual complex problems had to be solved.

Actual mechanical design of the JT3 was under Andy Willgoos, as head of the Turbine Engine Department. Pratt and his people were charged with coming up with the answers to the exact flow path through the compressor and the turbines. Pratt's group, for example, would determine the blade form, shape, and thickness and the technical part of the blade, and then it was up to Willgoos' designers to deliver what was needed.

Although the JT3 design had started out at 8,750 pounds of thrust, as a conservative figure, Hobbs' goal was 10,000 pounds of thrust, and by steps he kept increasing its size.

Before the first JT3 was ever run, however, major problems cropped up involving weight and seal leakage that simultaneously threatened the thrust level and fuel consumption target. The initial design called for a cylindrically shaped engine with a constant outside diameter of the compressor stages. This constant diameter was just what was causing the weight and seal troubles. Redesign was imperative, but it would delay availability of engines, perhaps critically, for the Boeing heavy bomber at a time when the J40 was still a contender for the plane.

Andy Willgoos suffered a heart attack and died after shoveling snow early in 1949, and the responsibility for the Turbine Engine Department was shifted to Wright A. Parkins, who had succeeded Hobbs as P&WA engineering manager when Hobbs took over the engineering vice presidency in the corporation.

Perry Pratt and his people had devised a redesign of the JT3 that offered the promise of curing the problems — the so-called "wasp-waisted" engine with a constant inside diameter to the rotor discs, but with the exterior of the compressor pinched down at the high pressure end. The constant I.D. offered higher efficiency, better sealing characteristics, and, best of all, a loss of 600 pounds from the weight. Additionally, the new configuration permitted an engine accessory arrangement that reduced nacelle diameter with a resultant reduction in nacelle drag.

Pratt received a go-ahead to redesign the JT3 early in May, 1949, and design efforts on the cylindrical engine came to a halt. Two of the barrel-shaped engines, however, were well along in assembly, and were completed. The first, serial number X-176, ran for the first time on June 28, 1949, and the test results confirmed the calculated figures on fuel consumption. The X-176 is now enshrined in the National Air and Space Museum of the Smithsonian Institution in Washington, D.C., as the prototype of the JT3.

There were, naturally enough, teething problems with the new design, primarily with bearings and compressor blade vibrations, but they were met head-on and solved. The first wasp-waisted JT3 was run on ground test January 21, 1950, only some eight months after design was commenced. It first flew in a B-50 flying test bed in March, 1951, and three months later the first prototype engine was delivered to Boeing. The engine won out as the heavy bomber powerplant, and by November, 1951, a JT3 production configuration engine completed its company 150-hour test. Eight JT3/YJ57-P-3 engines powered the Boeing YB-52 on its first flight on April 15, 1952.

Ceremonial send-off marked inauguration of U.S.-flag jet passenger service by Pan American World Airways with a Boeing 707 the night of October 26, 1958. First flight went from New York to Paris.

The B-52 was only the first home for the new turbojet. The North American F-100 was the second, and on its initial flight on May 25, 1953, the first of the Century Series fighters became the first production aircraft to exceed the speed of sound in level flight.

It wasn't until November, 1953, that the armed forces lifted security restrictions on the JT3/J57 and disclosed that the powerplant delivered 10,000 pounds of thrust, the first to do so in the non-Communist world. The engine also delivered the lowest specific fuel consumption of any turbojet engine then in production. The new turbojet was quickly designated to go into other military aircraft — the Air Force F-101 and F-102 and the Navy's A3D, F4D, and F8U.

The Collier Trophy Awards Committee — comprised of 28 outstanding figures from all phases of aviation — voted Luke Hobbs the trophy for 1952 for his conception of the JT3 and leading it through to production. The Collier Trophy recognized, as it had for almost two score years prior to that time, "the greatest achievement in aviation in America, the value of which has been demonstrated by actual use during the preceding year." The 1952 award, made in 1953, was the first in 21 years for development of an aircraft powerplant.

The Boeing Company, seeking a successor to its KC-97 aerial tanker/

United Air Lines Douglas DC-8, powered by four JT3s, lifts off on its passenger inaugural from San Francisco to New York on September 18, 1959. Both United and Delta Air Lines shared the honor of introducing the DC-8 into revenue service on the same day.

Model 377 commercial transport, evolved a jet-powered tanker-transport design and initiated work on it in May, 1952, just a month after the first flight of the YB-52. Boeing, using its own funds for the program, chose the JT3 as the powerplant, with four of the engines to be slung under the wings of the Model 367-80, as the prototype of the 707/KC-135 was designated.

The famed Dash-80 aircraft, an experimental model never intended or destined for commercial service, was rolled out by Boeing on May 14, 1954, and first flew two months later on July 15. Pratt & Whitney Aircraft built and supplied eight JT3 prototype engines for the Dash-80. Just like the experimental airplane, the JT3 prototype model was never intended for use in the production run of the 707, but would be replaced by more advanced engines under development. The non-afterburning JT3 prototype was very similar to the B-52 powerplant. It measured 40.5 inches in diameter and 157.7 inches in length, and weighed 4,220 pounds. Its rated takeoff thrust was 9,500 pounds dry, and 11,000 pounds with water injection.

With an actual flying prototype to evaluate, instead of a "paper" airplane, the Air Force first ordered the KC-135 tanker version in September, 1954. Boeing's $15 million investment of its own funds in a jet-powered transport began to pay off. Growth designed into the JT3 evidenced itself as development progressed. When deliveries of KC-135s began in June, 1957, each of the four engines was rated at 13,750 pounds of takeoff thrust with water injection. In all, 820 of the Boeing craft were built in the various military tanker-transport and special purpose configurations.

Douglas Aircraft, too, joined the jetliner competition, announcing in June, 1954, that it would build a passenger transport known as the DC-8. The P&WA JT3 again was designated as the powerplant.

Intensive development proved the key to making the JT3 an appealing commercial engine to the airlines, whose operational problems are quite different from the military. An engine judged ideal for military missions is not necessarily the best for an airline. The JT3, however, was honed in development to produce the thrust, fuel economy, reliability, and durability — as demonstrated by an ever growing time between overhaul — that made it both practical and attractive for commercial operations.

Juan T. Trippe, president of Pan American World Airways, after extensive consultation with Frederick Rentschler, made the first commitment that was to open commercial jetliner production lines in the United States. On October 13, 1955, Pan Am ordered both Boeing and Douglas airliners, 20 707s and 25 DC-8s. Other airlines, both domestic and overseas, were quick to get themselves on the order books for the gas turbine-powered aircraft that were, within a few years, to revolutionize world air travel.

Britain, of course, had introduced the jet-powered Comet I into service in 1952, but withdrew it in 1954 because of structural problems. The Comet IV, successor to the Comet I, began commercial service across the Atlantic on October 4, 1958, 22 days before the 707, but limited by its size, it was economically unsuitable for long ranges.

The first commercial 707-100 lifted off on its test flight on December 20, 1957, under the power of four JT3C-4 engines. With water injection, the JT3, originally a 10,000-pound-thrust engine, by then was delivering 13,000 pounds. The initial time between overhaul (TBO) was 800 hours. Development and experience over the years lifted the TBO eventually to 14,120 hours. The DC-8-10 made its maiden flight on May 30, 1958.

The United States entered the commercial jet era with the JT3-powered inaugural flight of the Pan Am 707 Clipper Mayflower on a trip from New York to Paris on October 26, 1958. The DC-8 entered scheduled airline service with United and Delta Air Lines on September 18, 1959.

The effect of the gas turbine-powered transport on travel was virtually electrifying. The speed, comfort, and convenience of the jetliners made conventional piston-engined transports obsolescent practically overnight.

Orders for jetliners mounted to keep apace of passenger demand, with the 707 and DC-8 capturing virtually all of the world's long-haul transport market. The world's scheduled airlines, excluding the Soviet Union and the People's Republic of China, carried 87 million passengers a total of 52.8 billion revenue passenger miles in 1958, the year the 707 was introduced. By 1961, with growing numbers of jetliners flying world routes, the total number of passengers had climbed to 111 million and the passenger mileage to 72.7 billion.

Only 10 years later, in 1971, 325 million persons flew nearly 250 billion passenger miles, an astounding 473 per cent mileage growth since 1958. Some 4,000 pure jet-powered craft are in airline service now, with several hundred still on order.

The JT3 opened the jet era, but inevitably it was to be displaced for the most part in a relatively short span of years. Even before production JT3s began moving out the door at Pratt & Whitney Aircraft's East Hartford plant, design was begun on an even more powerful successor, the JT4 (J75), another dual-rotor, axial-flow turbojet, only slightly larger than the JT3, but with about 50 per cent more thrust. Longer range models of the 707 and DC-8, powered by the more powerful JT4, were ordered by airlines before the JT3-powered versions had gone into actual service.

The JT4, which ranged up to 17,500 pounds of takeoff thrust, was itself succeeded by the JT3D — a turbofan adaptation of the JT3 turbojet that delivers up to 19,000 pounds of liftoff thrust. In many cases, earlier JT3-equipped transports were modified to use the turbofan engine and benefit from its fuel economy, higher thrust, and reliability that virtually eliminated the time between overhaul concept and substituted, instead, a reliability monitoring program that cut unneeded maintenance costs.

Design and engineering on the Pratt & Whitney Aircraft JT3D turbofan began in 1958, and JT3D-powered aircraft went into commercial service early in 1961.

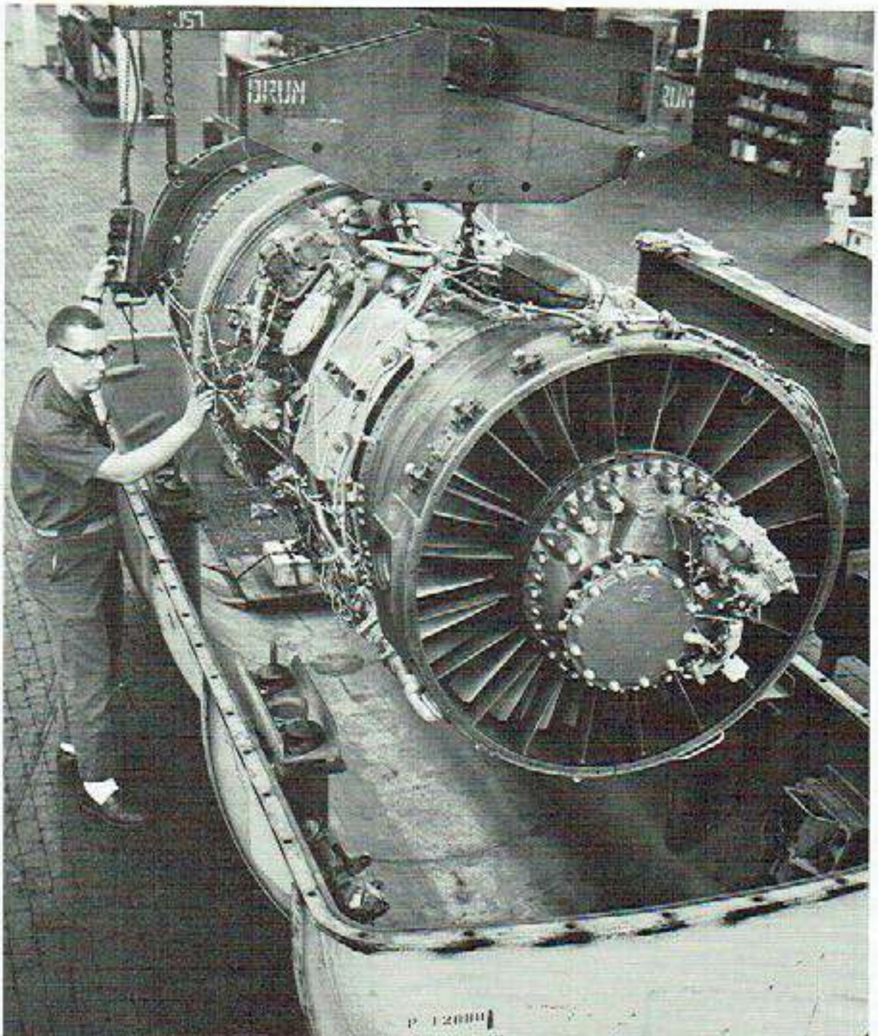
More than 21,200 JT3s were produced for commercial and military use over a span of nearly two decades before the last engine was shipped in 1965. The Ford Motor Company built 6,200 of the total under license to help meet the great demand in its introductory years in military aircraft, and the remaining 15,000 were assembled in East Hartford. Some 17,000 of the engines still are on active status, with the high-time JT3 having flown more than 38,750 hours, or the equivalent of more than four years aloft.

Perry Pratt was named engineering manager of Pratt & Whitney Aircraft in 1957, and the following year he was elected to the United Aircraft post of vice president and chief scientist. He retired from the corporation in 1971. His significant contribution to development of gas turbine engines was recognized in 1969 when he was selected as co-recipient of the Goddard Award of the American Institute of Aeronautics and Astronautics. He was cited for his independent and sustained major contributions to the development of the aircraft gas turbine, and for imagination, competence, and persistence which "have made these engines outstanding in human transportation."

Luke Hobbs was elected vice chairman of United Aircraft in 1956, and remained in that post until his retirement on April 1, 1958, less than seven months before the JT3 engine that was his conception led the United States into the commercial jet era. Hobbs remained a member of the board of directors of United Aircraft until 1968.

Hobbs' and Pratt's years of deep involvement with propulsion, particularly in that era of transition from reciprocating engines to gas turbine powerplants, exemplified the broad base of talented technical leadership throughout this nation's aviation community that put the United States into the preeminent position in the world as a builder and supplier of high-performance, dependable, and economical commercial aircraft.

The JT3, as conceived by Hobbs, refined by Pratt and brought into being by the hundreds of engineers, scientists, technicians, and production workers engaged with them in the program, thrust the world into the era of jet transport as it exists today.



An era ended with shipment of the last production model of the Pratt & Whitney Aircraft J13 in 1965. More than 21,200 of the turbojets, embracing 14 different models for commercial and military applications, were built in the '50s and '60s. Some 17,000 of the engines still are on active status.

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