THE ILLUSTRATED ENCYCLOPEDIA OF AIRCRAFT

EDITED BY
DAVID MONDEY F.R.Hist.S.

Over 3000 military and civil aeroplanes... more than 1000 illustrations

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The first fully international guide to list all the world's manufacturers of military and civil production aircraft, this encyclopedia provides the general reader with an authoritative and clear account of almost 1500 companies and the thousands of aircraft they have built to the present day. The aviation expert, too, will find this book an invaluable source of easily accessible basic information; the A-Z directory will certainly become a standard research tool and aid.

Despite the fact that powered flight is still only about three-quarters of a century old, its effect on the history of the world has been far-reaching: aviation has caused wars to be won and lost, while the advent of jet travel has brought the reality of the global village so much closer. To help the reader understand the historical, economic and technical trends which have produced the aircraft of any period, a comprehensive history of aviation has been written to precede the A-Z directory, thus placing the many types of aircraft listed in this book in context.

All the entries in the encyclopedia have been written by well-known aviation experts, and the whole book has been edited and coordinated by David Mondey, F.R.Hist.S., a compiler of *Jane's All the World's Aircraft*. The introduction on the history of aviation is illustrated in full colour, while the A-Z directory is made an even more valuable work of reference by the many black-and-white and two-colour photographs.

Over 1000 illustrations, including more than 50 in full colour.

Jacket front: *Fairey Swordfish II, capable of carrying an 18 in. torpedo, 1,500 lb. mine or its equivalent in bombs. The aircraft illustrated is LS 326 of the Fleet Air Arm, one of the few remaining examples of this historic aircraft still maintained in airworthy condition at RNAS Yeovilton, England.*

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A QUARTO BOOK

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All other photographs from the collection of John W.R. and Michael Taylor.

Frontispiece: **Boeing 747-124 wide-body commercial transport aircraft in the insignia of Wardair**

Opposite: **ANT-9 commercial transport, designed by one of the Soviet Union's most capable designers, the late A.N. Tupolev**

The basic aim, from the beginning of this project, was to produce a single-volume encyclopedia of aviation for a general readership. It was, however, to be very different from any published previously, comprising a comparatively brief survey of aviation history, followed by an alphabetical listing of manufacturers of heavier-than-air, powered, production aircraft. The daunting feature, from the point of creating this alphabetical list, was that it had to extend from the Wright brothers to early 1978. It thus commemorates, by the time of its publication, the first three-quarters of a century of powered flight. So this, in effect, is the composition of this volume; it has, in addition, a brief glossary, and a detailed index of all the aircraft mentioned in the text.

How does one decide which companies merit inclusion: how many aircraft represent a production run? There are many gaps in company records: perhaps the intention was to build and market the XYZ Special, and a prototype was built and flown; but how many, if any, production aircraft followed? Such facts are not always recorded. So the list includes those companies which manufactured aircraft, and companies which it is believed built and sold at least some of their designs.

Inevitably, a major source of reference was *Jane's all the World's Aircraft*, which spans sixty-nine of those seventy-five years; but even this superb reference work has some strange entries and omissions in its earlier years. Unfortunately, there has not been the time available to research these oddities. Those who have worked to compile the volume have made it as accurate and complete as possible, but they are aware that there is scope for improving the detailed coverage. It has become abundantly clear, also, that in addition to its appeal to the general reader, this *Encyclopedia of Aircraft* could be extremely valuable to aviation historians, researchers and writers.

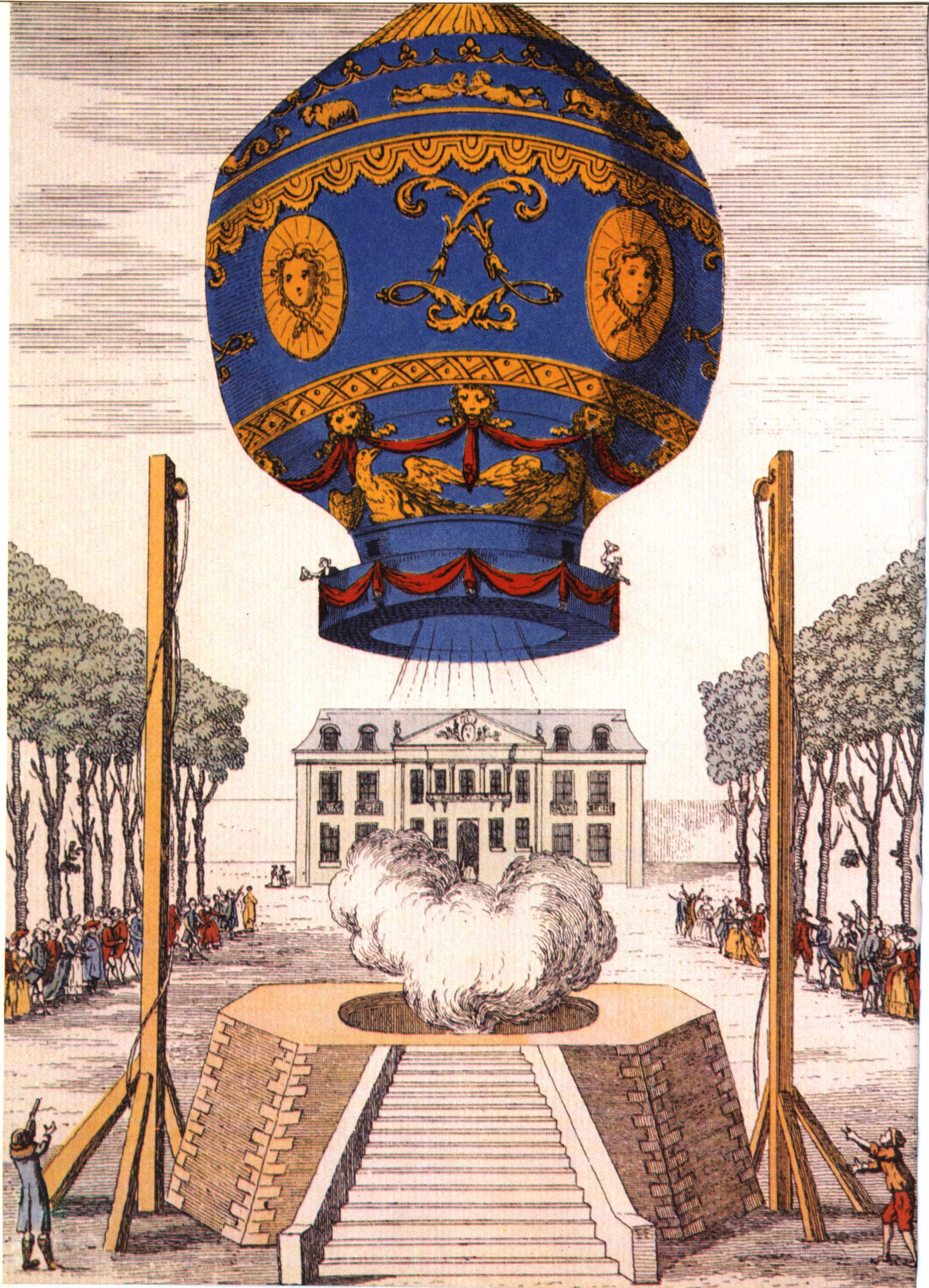
With this latter factor in mind, the Editor hopes that readers will communicate to him new facts and material for inclusion in a future edition that will, it is hoped, become a definitive and regularly updated book of reference.

I am grateful, indeed, for the hard and painstaking work of the aviation writers who contributed the words that you will read. The illustrations, in the main, have been provided by John W. R. and Michael Taylor, and a big thank you is due to them for making available some wonderful and rare pictures from their collection. An enthusiastic team at Quarto Publishing have given shape and 'eye-appeal' to this mass of raw material, and I am very appreciative of their patience and efforts in producing this potentially important volume.

David Mondey, 1978

THE HISTORY OF FLIGHT

Dassault Mirage F1 single-seat multi-mission fighters and attack aircraft



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MAN BECOMES AIRBORNE

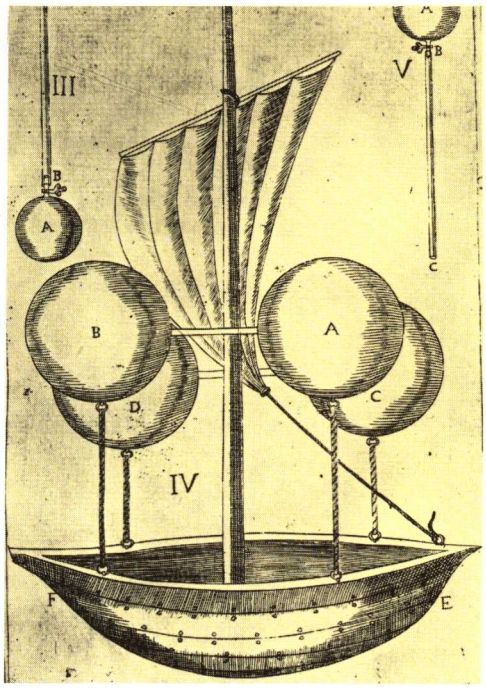
IT IS UNLIKELY we shall ever know the name of the person to first comment that if God had intended men to fly he would have given them wings. It could, quite easily, have been the Chinese spectator of an unsuccessful launch of a man-lifting kite, perhaps one or more centuries before the birth of Christ. That is a realistic date for the first men to become airborne, and the desire to fly like the birds could well stretch back to prehistoric man, conscious of the ease with which winged creatures could elude land-bound predators.

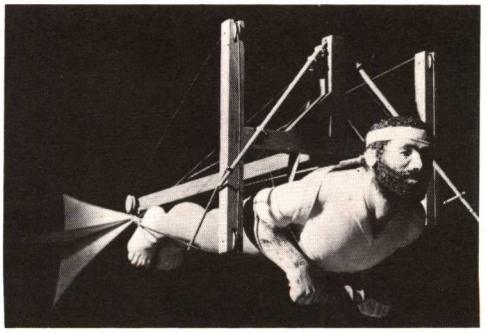
Myth and fantasy fill the years that come between the wishes of those prehistoric ancestors and the first of the thinking men to consider seriously, but unsuccessfully, the mechanics of flight. Leonardo da Vinci (1452–1519), Italian artist-inventor, produced many designs for ornithopter (flapping-wing) aircraft but prudently made no practical experiments. A hundred and fifty years after his death, in 1670, a Jesuit priest, Francesco de Lana-Terzi, had heard of the invention of the vacuum pump. This seemed to him to offer a possibility of flight, based upon the assumption that a thin metallic globe from which the air had been evacuated could be lighter than air and thus would float in the air. He failed to see the simple fact, about which most present-day school children could have advised him, that if his metallic spheres had been light enough to lift they would have been crushed by atmospheric pressure at the moment of evacuation.

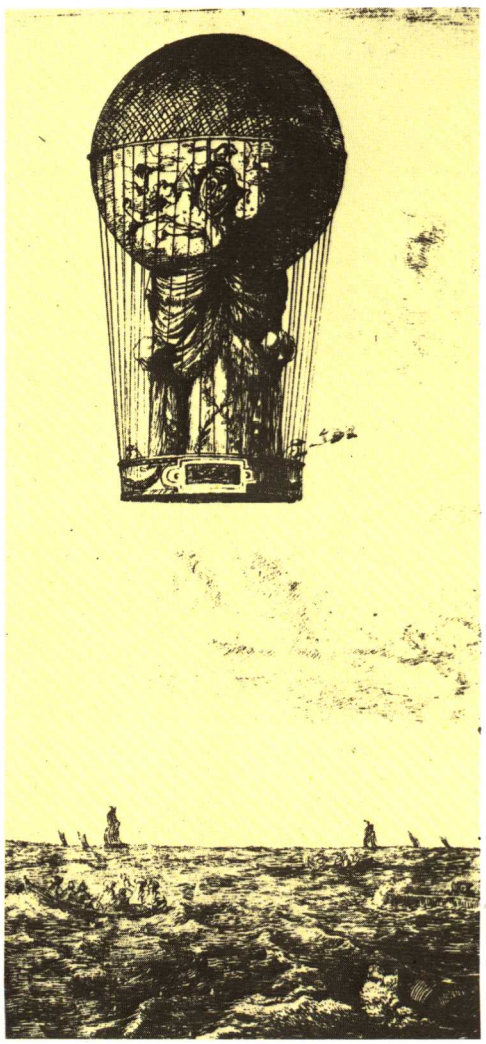
The first lighter-than-air craft

Since schooldays most of us have believed that the brothers Etienne and Joseph Montgolfier were the first to launch a hot-air balloon. Recent research has shown that another priest, the Brazilian Bartolomeu de Gusmão, demonstrated a practical model of a hot-air balloon at the court of King John V of Portugal, in 1709. On 8 August that year, before a distinguished gathering of reliable witnesses, de Gusmão showed the amazed audience that his small paper balloon, with burning material suspended below the open neck of the envelope, could rise in free flight within the confines of the Ambassador's drawing-room. Its brief journey was brought to an end when two servants, fearing it might set the curtains alight, dashed it to the ground. A lighter-than-air craft had thus been demonstrated 74 years before the first flight of a Montgolfier hot-air balloon took place.

This in no way detracts from the achievements of the Montgolfiers. Their first hot-air balloon was launched, prob-







Bladud, (*above*), fabled ninth king of Britain, was an early 'jumper', who fixed artificial wings to his arms. De Lana Terzi's flying-machine (*centre*), was also a non-starter. The work of men like Leonardo da Vinci (*right*) gave a starting point to later thinkers. The first free flight in a *Montgolfière* (*left*) was undertaken by de Rozier and the Marquis d'Arlandes. The engraving (*far right*) records de Rozier's fatal cross-Channel attempt in a composite hot-air/hydrogen balloon. Both de Rozier and his companion Jules Romain were killed.

ably at Annonay, France, on 25 April 1783. Some 12 m (39 ft) in diameter, it climbed to a height of about 305 m (1,000 ft) before the hot air in the envelope cooled and it began its descent. The Montgolfier brothers are said to have been unaware that hot air alone was the lifting agent for their balloons, believing that a specially light gas was generated by the mixture of wool and straw which they burned below the open neck of the envelope.

A second demonstration, at Annonay, was given on 4 June 1783, but just prior to a third, command performance at the Court of Versailles on 19 September of that same year, when a sheep, a duck and a cock became the first living creatures to be artificially airborne, Professor J. A. C. Charles had demonstrated successfully a small hydrogen-filled balloon at Paris, on 27 August 1783.

Events were then to move quickly. On 15 October 1783 Francois Pilâtre de Rozier became the first man in the world to be carried aloft, sole passenger of a Montgolfier balloon tethered to the ground by a 26 m (84 ft) rope. Just over a month later, on 21 November 1783, de Rozier accompanied by the Marquis d'Arlandes, made the first free flight in a balloon, remaining airborne for 25 minutes, during which time they travelled about 8·5 km (5·5 miles) from their launch point. Free flight in a lighter-than-air craft had at last been realised. And although this was a beginning, it was also virtually the end of the Montgolfier balloon, superseded by the infinitely superior and practical hydrogen-filled balloon developed by J. A. C. Charles, in which he and one of the Robert brothers who had assisted in its construction made a free flight from the gardens of the Tuileries, Paris, on 1 December 1783. Their flight was one of 43 km (27 miles), their ascent witnessed by a crowd estimated at some 400,000, their balloon so well designed that it is essentially similar to the gas-filled balloon used to this day.

Making the balloon navigable

The expansion of ballooning as a sport was very rapid: at last man was free of the Earth which had been his habitat for so many centuries. There was no telling what achievements might now be possible. And within days of de Rozier's first flight in a *Montgolfière* had come an appreciation of the potential which such a vehicle held for military pursuits, especially for reconnaissance. But there had to be some method of steering, for the balloon was possessed by the least zephyr. Grandiose ideas involving oars, sails and propellers were of no avail; it had to be understood that if an airborne vehicle was to be steerable it must be capable of independent movement, instead of being carried by the wind, so that movable aerofoil surfaces could impose a chosen direction of travel. From this realisation stemmed the initial airship designs, the envelope becoming elongated instead of spherical, with the provision of a power plant to provide forward motion independently of the breeze. This latter word is chosen advisedly: there was then no question of trying to fly in anything that might be classed as a wind.

The major problem, and the one which was to frustrate the pioneers of heavier-than-air craft, was the non-availability of a suitable lightweight and compact power plant. Thus, Frenchman Henri Giffard, who recorded the first flight of a manned, powered dirigible (Latin: 'able to be directed') on 24 September 1852, utilised a 2·2 kW (3 hp) steam-engine, driving a 3·35 m (11 ft) diameter propeller. The use of the word 'dirigible' in that record is rather open to question, for anything more than the merest suggestion of a breeze would have made it unsteerable. To Charles Renard and Arthur Krebs, officers of the French Corps of Engineers, goes the distinction of flying *La France*, the world's first fully controllable and powered dirigible. In this craft, on 9 August 1884, Renard and Krebs flew a circular course of about 8 km (5 miles), taking off from and returning to Chalais-Meudon, France. Powered by a 6·7 kW (9 hp) Gramme electric motor, driving a 7·01 m (23 ft) diameter propeller, *La France* achieved a maximum speed of 23·5 km/h (14·5 mph) during its 23 minute flight. Increased power had provided the speed necessary to make the vehicle controllable: but this seemingly small improvement had taken 101 years from the first flight of the Montgolfier balloon.

The first heavier-than-air craft

The beginning of heavier-than-air flight is the story of many men working towards a common goal. As in most combined and international projects, there are men who stand out because of their advanced thoughts or brilliant innovations.

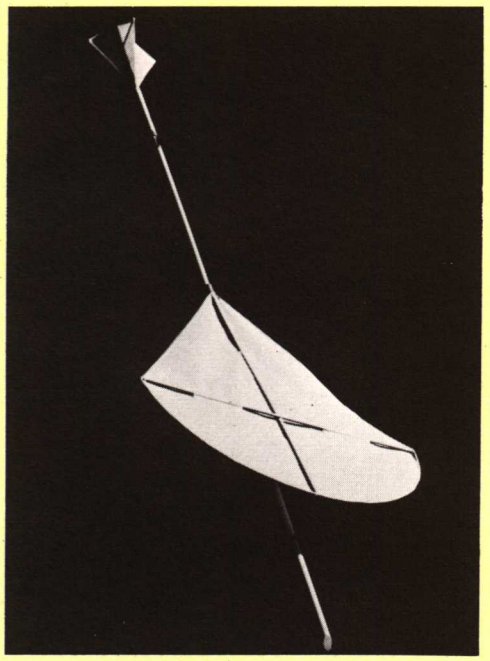
First must come the man now regarded as the 'Father of Aerial Navigation', the English Baronet Sir George Cayley (1773–1857). Back in 1804 he built what is generally regarded as the first successful model glider. This consisted of little more than a broomstick to which was mounted a kite-shape monoplane wing; at the aft end of the 'fuselage' were vertical and horizontal tail surfaces to provide control. With this device he was able to confirm that the principles of heavier-than-air flight were entirely feasible, and it was able to demonstrate stable flight over quite long distances.

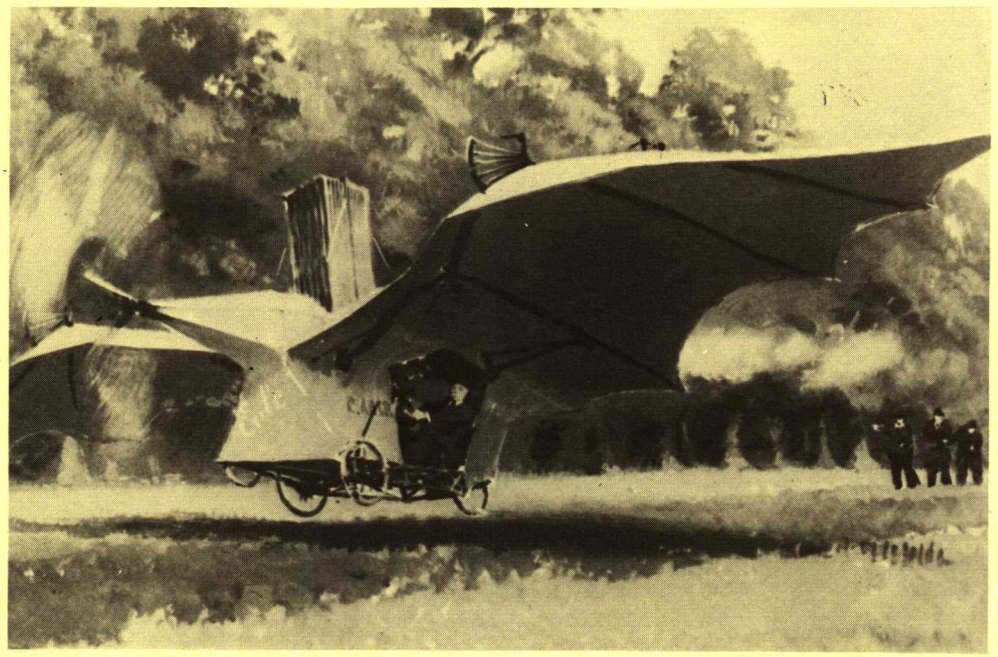
From this first model he evolved gliders capable of carrying a small schoolboy in flight (1849), and his reluctant coachman during 1853. Both were passengers only, with no means of controlling their aircraft in flight. But in addition to his practical work, Cayley suggested the use of an internal combustion engine for powered flight, demonstrated how a curved aerofoil surface provides lift, and pointed out that biplane or triplane wings would provide maximum lift from a lightweight, robust structure. Cayley's 'Father' title was well-earned.

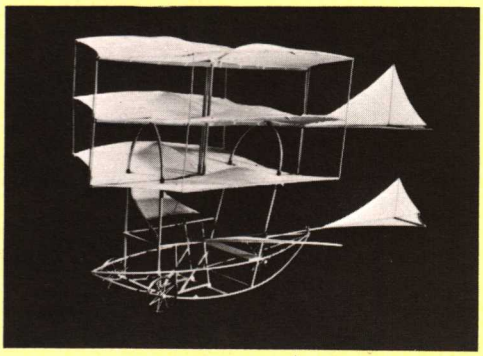
Cayley died in 1857, and in that same year a French naval officer, Félix du Temple, constructed and flew the world's first powered model aeroplane. This record was achieved with a clockwork motor, and subsequently du Temple's little monoplane was powered with a steam-engine. Seventeen years later this same inventor was flight testing a full-size man-carrying aeroplane, which was powered by either a hot-air engine or a steam-engine. Piloted by an unknown sailor, at Brest, this aircraft was the first in the world to achieve a short hop into the air, following launch down an inclined ramp.

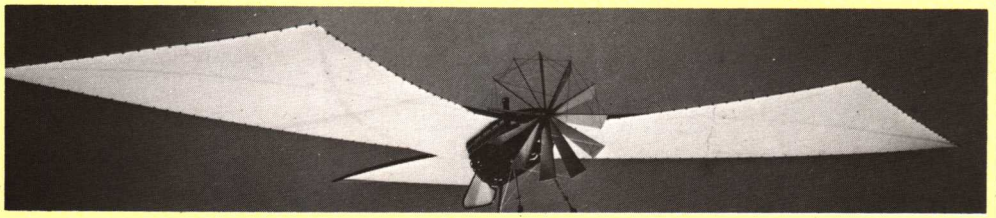
Although men were beginning to learn how to construct a fixed-wing aircraft that could fly, their problem was now the same as that of the balloonist who wanted to steer his vessel: both needed a suitable power plant. A practical working layout for a suitable power plant was to be demonstrated by the German engineer Nicholas Otto, in 1876. The four-stroke cycle of operations for an internal combustion engine, which Otto evolved at that

THE EARLIEST DAYS









Cayley's model glider (*top, left*), with its adjustable aerofoil surfaces, enabled him to experiment with the problems of gliding flight, leading to the 'boy lifter' of 1849 (*left*). Clément Ader's *Éole* steam-powered monoplane (*top*) was the first aircraft to lift itself from the ground, but failed to fly. Félix du Temple's monoplane (model *above*) made a short hop after launch down a ramp, powered by a hot-air or steam engine.

time, is still the basic principle upon which most piston-engines work, especially for motor cars and aircraft. But Otto's invention was in the future. The more practical among the pioneer aviators accepted the reality of the situation, and spent the period most profitably in improving airframe design, learning the best means of lightweight construction, and trying to discover practical means of controlling the aircraft when it became airborne.

The beginning of free flight

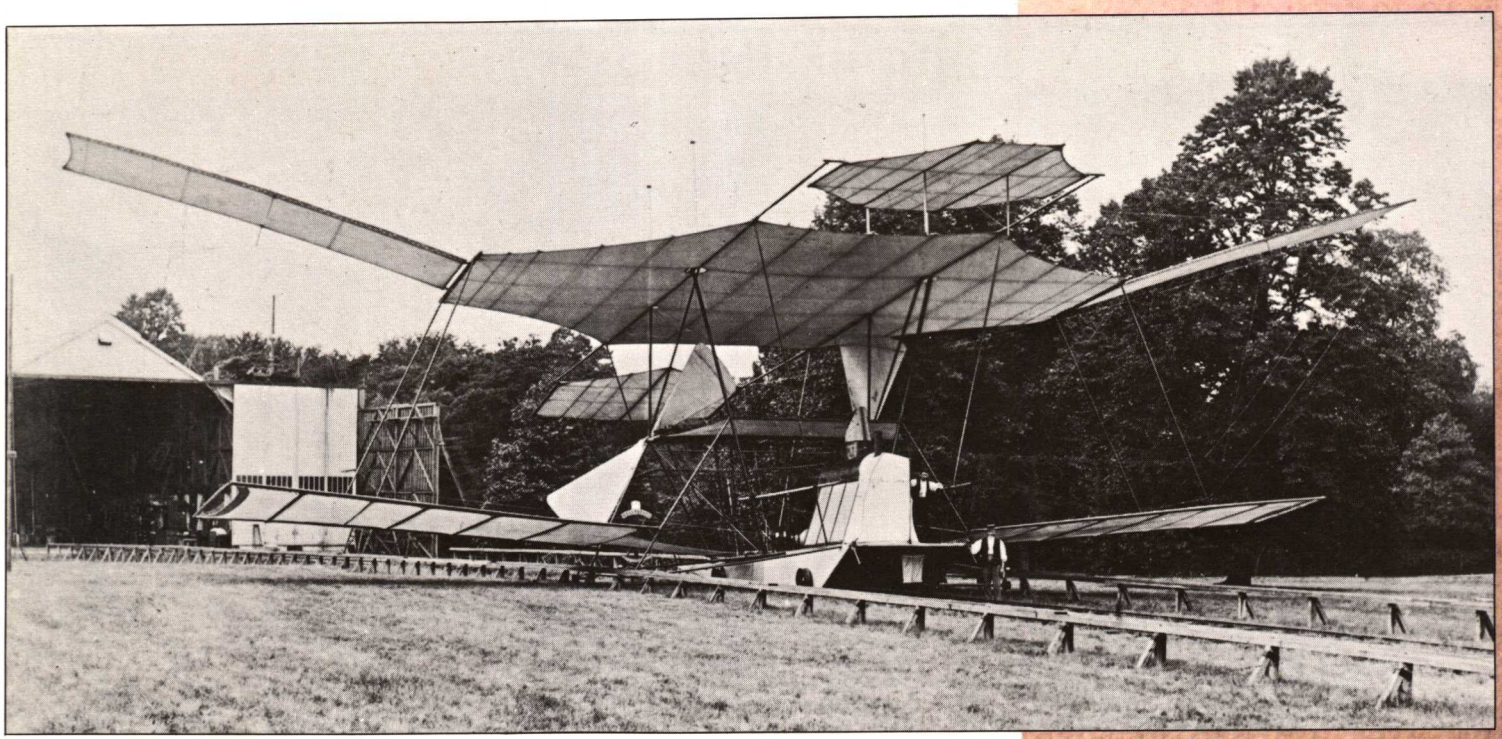
The most important of this group of pioneers was the German Otto Lilienthal (1848–1896), whose beautifully built lightweight gliders enabled him to make many thousands of flights. These were not just pleasure flights: Lilienthal was a practical researcher, building, modifying, improving, and at all times recording meticulously the results of his experiments for the benefit of other researchers.

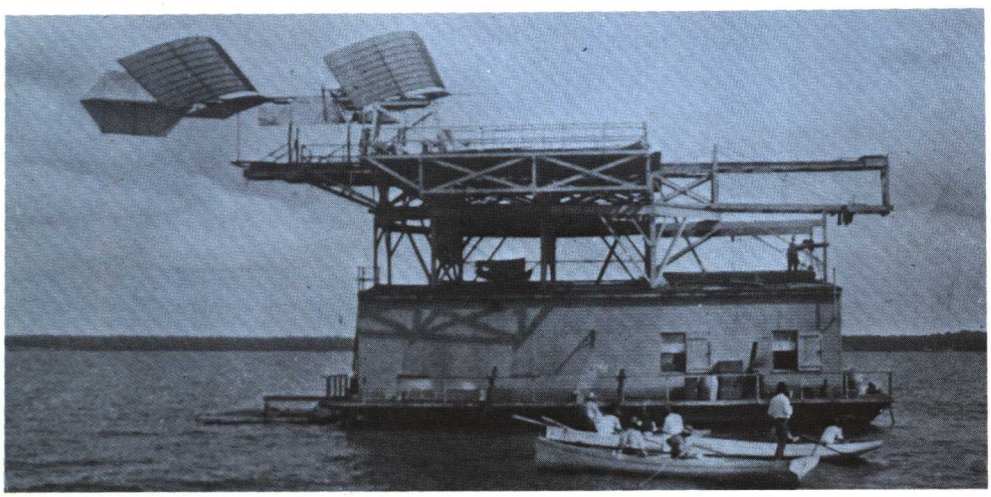
Lilienthal's gliders were of the configuration which we would now call hang-gliders, designed so that the mass of his body was disposed about the aircraft's centre of gravity when the machine was in a stable flying position. By body movements he could influence a degree of control on the craft's flight but, unfortunately, this did not allow rapid response to changing flight conditions. Despite his experience, Lilienthal was gravely injured in a flying accident on 9 August 1896, brought about by a control problem which could not be resolved quickly enough, and he died on the following day.

Lilienthal had been a source of inspiration to many, but influenced especially the work of the British pioneer builder/pilot Percy Pilcher (1866–1899), who flew his first glider in 1895. Pilcher travelled to Germany to meet and talk with Otto Lilienthal, from whom he obtained a great deal of practical advice. But Pilcher, too, was to die on 30 September 1899, when his *Hawk* glider crashed to the ground at Market Harborough.

There was a third important glider pioneer—a builder not a flyer—who collected information from every possible source, publishing this *pot-pourri* under the title *Progress in Flying Machines*. American railway engineer, Octave Chanute (1832–1910), the compiler of this book, was to develop the Lilienthal-

Hiram Maxim's giant steam-powered craft (*below*), spanning 31·7 m (104 ft) developed so much lift that it broke away from its safety rails. At the same time Germany's Otto Lilienthal (*right*) was flying well-built hang-gliders. Despite an advanced engine, Langley's *Aerodrome* (*bottom left*) failed to fly, both attempts at flight ending in the river.





type craft into a classic glider. More importantly for powered flight, his book, his advice and his friendship, were to inspire the brothers Orville and Wilbur Wright.

There are many links in the chain of progress towards the realisation of powered flight, some big and many small. All contribute to the end result, and it is unfortunate that space will not allow us to relate them all. One of the final links was undoubtedly Germany's Gottlieb Daimler, who in 1885 developed the world's first single-cylinder internal combustion engine. This utilised the four-stroke principle of operation devised by his fellow countryman, Nicholas Otto, and used petrol as its fuel. As it was developed to provide a power-to-weight ratio far superior to any other form of engine then available for aircraft propulsion, the would-be aviators realised that the necessary power-plant had arrived.

But this was to be of no avail to American Samuel Pierpont Langley, the man who so nearly made the Wright brothers just aviation pioneers. Langley was a scientist, Secretary of the Smithsonian Institution, and his collaboration with Charles Manley to build and fly his *Aerodrome* aircraft resulted in the creation by

Manley and his associate Stephen Balzer of a remarkably advanced five-cylinder radial petrol-engine. Despite this advantage, Langley's aircraft failed to become airborne on two occasions. Both times—7 October and 8 December 1903—the aircraft crashed into the Potomac River. Most observers believed the *Aerodrome* fouled its launching device on both dates, but it has been suggested that the aircraft's structure disintegrated. Either way, the stage was clear for the Wright brothers.

Powered flight becomes reality

The achievement of that cold Thursday, 17 December 1903, has been told so many times that much of the excitement has gone. Except, perhaps, for those who have learned to fly: who understand that moment of magic when the aircraft loses contact with the ground and becomes a living creature, free in three-dimensional space: so very nearly a bird in flight.

The brothers Orville and Wilbur deserved their success, because of their determination to overcome the very real difficulties that beset them. If they hadn't got it they made it; if it didn't work, they found out why and changed their design.

And when the *Flyer* was dismantled on that historic day it was an end to the first phase of powered flight. The world's first powered, sustained and controlled flight had been accomplished. It was also a beginning: the expansion of aviation to facilitate world travel and inaugurate a hoped-for era of peace.

The historic picture (*below*) is of the first flight of the Wright *Flyer* on 17 December 1903. Orville Wright, who was at the controls, later wrote: *The course of the flight up and down was exceedingly erratic. The control of the front rudder* (elevator) *was difficult. As a result, the machine would rise suddenly to about ten feet, and then as suddenly dart for the ground. A sudden dart when a little over 120 feet from the point at which it rose into the air ended the flight.* Three others followed, the last and best of that day covering 260 m (852 ft), but ended with the elevator being damaged when the *Flyer* landed. When it was overturned by a gust of wind more damage followed. The ironical feature of these flights was that the world failed to learn that a man had been airborne and in control of a powered heavier-than-air craft. It was not until three years later, in November 1906, that the little Brazilian Alberto Santos-Dumont electrified aviation progress in Europe by recording a first flight in his No. 14-*bis* of nearly 61 m (200 ft). Both aircraft were really dead-end designs, but their achievement and influence inspired new ideas and efforts. In the short-term, more powerful engines were the key to success.