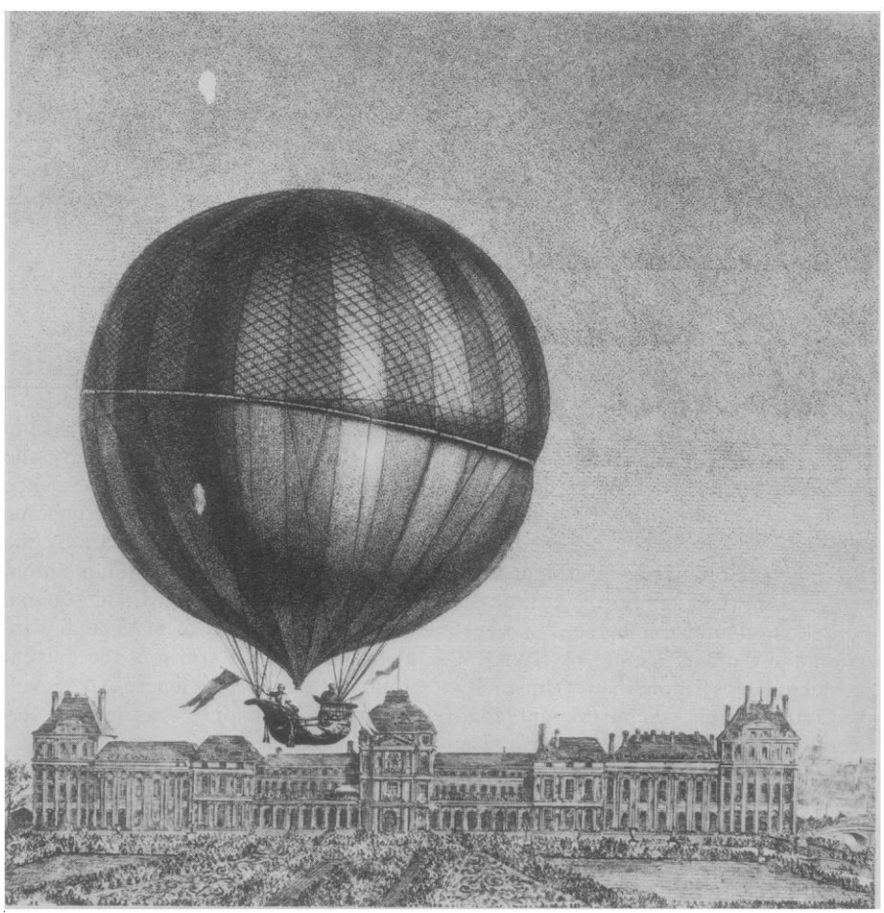
Aviationists 200 Years Ago

The Montgolfier Brothers and the Invention of Aviation, 1783–1784. With a Word on the Importance of Ballooning for the Science of Heat and the Art of Building Railroads. CHARLES COULSTON GILLISPIE. Princeton University Press, Princeton, N.J., 1983. xii, 212 pp., illus., + plates. $35.

This book by Charles Gillispie does indeed deal with the invention of aviation. But it deals with a great many things beyond that. Having had the good fortune of meeting the modern descendants of the 18th-century Montgolfiers, Gillispie has been able to work with a veritable treasure trove of new materials. The result of his research therein, supplemented by his immersion in the original sources in such public repositories as the Musée de l'Air, is a volume that brings together threads from social history and the history of science into a combination that might be characterized as an industry study in the framework of a family history. This interweaving of various sorts of materials is never shown to better advantage than in his original and persuasive thesis on the motivation underlying the construction and release of a craft that quickly came to be known as a *montgolfière*.



Ascent of the second *charlière*, carrying J.-A.-C. Charles and one of the Robert brothers, instrument makers who supplied him with apparatus. The first *charlière*, unmanned, was launched 21 August 1783, burst after traveling about 20 kilometers, plummeted to earth, and was attacked with pitchforks by panicky peasants. The second, launched near the Tuileries in a "moment d'hilarité universelle" on 1 December 1783, landed safely about 40 kilometers from Paris. [From *The Montgolfier Brothers and the Invention of Aviation*; U.S. Air Force Academy Gimbel Collection 1128A]

The Montgolfier family business was the manufacture of paper. It was a thriving enterprise, producing a product that the famous astronomer J.-J. L. de Lalande characterized in 1761 (in his *Art de faire le papier*, a contribution to the Academy of Science's *Description des arts et métiers*) as "very white, very thin and very well sized." It was, however, capable of improvement, at least in the eyes of Nicholas Desmaret, a manufacturing inspector in the Bureau of Commerce, who in the 1770's became the Academy of Science's new expert on the conversion of rags into paper. Desmaret wanted to see introduced into France various techniques and pieces of equipment then utilized in Dutch paper mills. The Montgolfiers, particularly in the person of Etienne (the youngest of several sons of the patriarch of the family, but the one upon whom the direction of the firm had devolved), showed themselves eager to move in that direction. One of the outcomes of their decision to become "the model workshop of Desmaret's program" (p. 20) was trouble with the mill workers, culminating in a strike, which Etienne converted into a lockout, in November 1782. It was at that point that Etienne received a letter from his older brother Joseph, "a dreamer and a maverick, the very type of the inventor, imaginative with objects and processes, impractical in business and affairs" (p. 10). Though an egregiously bad speller (Gillispie has often had to arrive at his meanings by sounding out his words), Joseph was solidly self-educated in the sciences (save mathematics) and given to experimentation. He now informed Etienne that he had just constructed a "machine" that would rise in the air because it had been made lighter than the air it displaced by the expansive power of heat and called upon him for cooperation in developing it further. In analyzing that "invention," Gillispie provides one not only with the usual stories surrounding it but with the important suggestion that flight "appears to have been a byproduct and not the object" (p. 15) of Joseph's search for understanding basic problems concerned with heat and mechanical work. Coming then to the aforementioned thesis, Gillispie concludes, admittedly without proof, that Etienne joined "his fantast of a brother in what might seem a characteristically harebrained venture" (p. 17) in order to repair the family's damaged reputation in the paper-making industry.

Following the first public demonstration of the flight of an *aérostat* at Annonay on 4 June 1783, Etienne, because he was both more worldly and more

comfortable with the mathematical calculation of lifting forces, was off to Paris to make new demonstrations. There he encountered competition from a hydrogen-filled counterpart to his device (an alternative he and Joseph had considered but rejected because of the expense of procuring that gas) built by and popularly named for the physicist J.-A.-C. Charles. Etienne continued on his own projects, however, proceeding from a not very successful demonstration for the Academy to the launching of a rooster, a duck, and a sheep (Etienne's letter to his wife describing this flight is a marvelous addition to the literature) and finally, after several tethered trials (in one of which Etienne himself participated, one of many hitherto unknown details unearthed by Gillispie), to manned free flight. Throughout this period, and for several months thereafter, Etienne attempted to convert the fame of the "machine" to the profit of the paper mill in the form of a "Royal Manufactory" designation. Gillispie chronicles every effort of this provincial in the capital, shedding interesting light on the then-existing networks of communication and patterns of privilege. Unfortunately for the Montgolfiers, Etienne was unsuccessful in that quest, as also in the quest for large government monies to continue the development of the *aérostat* looking forward to its large-scale commercial use.

With those failures, Gillispie leaves the Montgolfiers temporarily in order briefly to pursue the beginnings of "barnstorming" with Jean-Pierre Blanchard and of the more serious business of aeronautical engineering in the ideas and designs of Jean-Baptiste Meusnier for achieving stabilization of altitude and control over locomotion and direction. He returns, in a last chapter, to finish their story largely in an exploration of the other outcomes of Joseph's preoccupation with problems of heat and mechanical work, looking at his efforts in building and employing both an internal combustion engine and a hydraulic ram. That section concludes with a study of the contributions of his nephew, Marc Seguin, to the science of thermodynamics, as well as the construction of both the first suspension bridge and the first railroad in France.

All of this is done not only with many new details but with frequent insights into social structures and personal motivations and occasional large generalizations on the nature of scientific research or the emergence of engineering out of tinkering. Moreover, Gillispie has an eye for the dramatic, a flair for characterization, and a command of both the English and the French languages that enable him to entrance while informing the reader. The whole is further enhanced by a large number of carefully chosen illustrations.

"Madame Blanchard rising above Turin in 1812." Jean-Pierre Blanchard, "the first of the barnstormers . . . put on numerous ascensions . . . before his death of natural causes in 1809. . . . His widow, the first woman to solo, assumed the mantle for another ten years and made sixty-seven flights before falling into Paris amid flames, victim of her practice of varying the spectacle by setting off fireworks from the gondola." [From *The Montgolfier Brothers and the Invention of Aviation*; U.S. Air Force Academy Gimbel Collection 1819]

Not that everything is positive. There is too great a use of such annoyingly trite transitions as "Readers may wish to know. . . ." And there are occasional oversights. Curiously, given his familiarity with the sources, Gillispie seems unaware of new petitions made to the Minister of the Interior by Etienne in 1798 and a resultant report in the First Class of the National Institute less than two months before his death in 1799. Moreover, I should have liked Gillispie to address the matter of Lalande's later claim that Montgolfier had promised to allow him to be the first man to ascend in his "machine." But these are cavils. Overall I find myself as enthusiastic as I expected from the sections on the beginnings of aviation in Gillispie's 1980 *Science and Polity in France at the End of the Old Regime*.

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Oxygen Biochemistry

Oxygenases and Oxygen Metabolism. A Symposium in Honor of Osamu Hayaishi. Hakone, Japan, Nov. 1981. MITSUHIRO NOZAKI, SHOZO YAMAMOTO, YUZURU ISHIMURA, MINOR J. COON, LARS ERNSTER, and RONALD W. ESTABROOK, Eds. Academic Press, New York, 1982. xxii, 664 pp., illus. $48.

This excellent book contains 76 papers presented at a symposium held in honor of Osamu Hayaishi on his 60th birthday. Hayaishi has had major influence on the course of the biochemical study of oxygen. His early work, which was partly carried out during a stay at the National Institutes of Health in the mid-1950's, was on catechol dioxygenase and was the first demonstration that the oxygen atoms from molecular oxygen could be incorporated into products. Previously, the generally accepted hypothesis, advanced at the turn of the century by Wieland, was that biological oxidations only involve the transfer of hydrogen atoms and that any oxygen incorporated into product was derived from water.

Hayaishi's discovery of dioxygenases was a milestone in biochemistry and the beginning of oxygenase chemistry. Howard Mason, who has a paper in this book, simultaneously discovered oxygenase activity in the phenolase system. His finding was the first demonstration of the splitting of the dioxygen molecule, with one atom being incorporated into an organic substrate and the other into water. This process was termed "mixed function oxidation" and, subsequently, "monooxygenation" or "hydroxylation."

In the ensuing years Hayaishi and his colleagues, many of whom have papers in the book, purified and characterized a large number of dioxygenases and monooxygenases and set the tone of research on this subject. Two major symposiums on oxygenases, one in 1966 and another in 1974, led to books edited by Hayaishi that are primary sources for students of oxygenase chemistry and oxygen metabolism.

The present book contains excellent papers on structures and mechanisms of the intradiol and extradiol catechol dioxygenases, enzymes originally discovered by Hayaishi. Genetic analysis, cloning, peptide and gene sequencing, and a large number of physical techniques are being employed to study the nature of these bacterial iron-containing enzymes. Toluene dioxygenase and putidamonooxin, multicomponent oxygenases involved in the degradation of unactivated aromatic compounds, are described. These enzymes are typical of a large number of such oxygenases found in soil bacteria.