

**THE DYNAMICS OF MECHANICAL  
FLIGHT: LECTURES DELIVERED AT  
THE IMPERIAL COLLEGE OF  
SCIENCE AND TECHNOLOGY,  
MARCH, 1910 AND 1911**

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The Dynamics of Mechanical Flight: Lectures Delivered at the Imperial College of Science and Technology, March, 1910 and 1911 by Sir G. Greenhill

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**SIR G. GREENHILL**

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Lectures delivered at the Imperial College of Science  
and Technology, March, 1910 and 1911

BY  
SIR G. GREENHILL



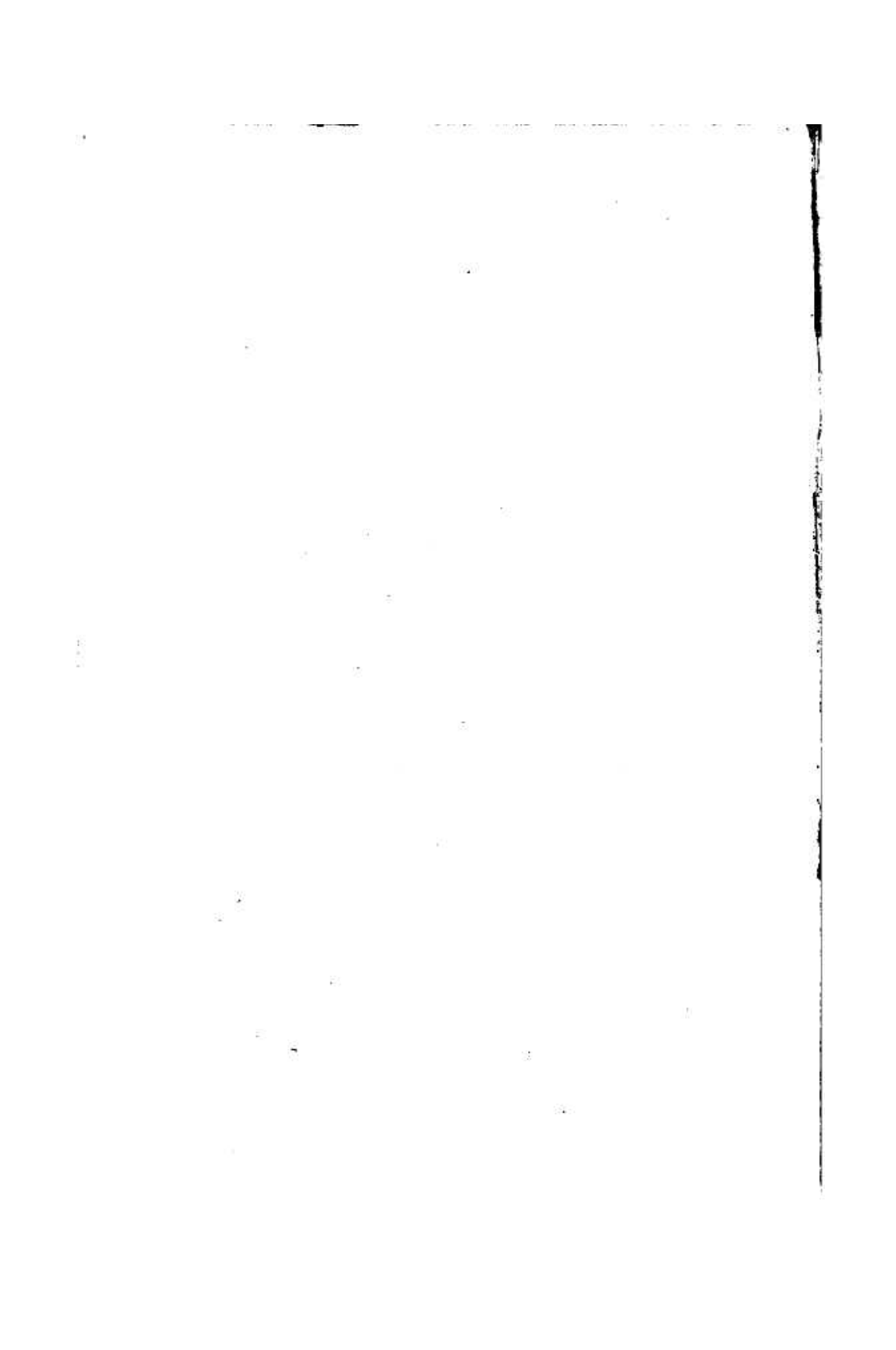
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# THE DYNAMICS OF MECHANICAL FLIGHT

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## INTRODUCTION

THE lectures were delivered in the Imperial College of Science and Technology in March 1910 and 1911, under the title "THE DYNAMICS OF MECHANICAL FLIGHT," and they are given here in the form in which they were delivered.

The subject was then beginning to take hold of the public imagination, consequent on Blériot's feat of crossing the Channel on July 25, 1909, and the great strides made in the interval since in Mechanical Flight.

The possibility of Human Flight has been an obsession of the imagination of Man from the earliest times recorded, for which an extensive article should be consulted in the *Denkschrift der I.L.A. (der Internationalen Luftschiffahrt Ausstellung) Frankfurt, 1910, Band I, p. 118, Flugprobleme in Mythos Sage und Dichtung.*

In the Greek Mythology, Demeter rides in a car drawn by flying dragons, and Homer describes the flight of Hera in her chariot, *Iliad V., 750*; and then there is the legend of Icarus and his father Dædalus "who taught his son the office of a fowl, and yet for all his wings the fool was drowned"; and another legend of Archytas of Tarentum, "*aeris tentasse domos*" with his invention of a flying mechanical bird.

Æschylus in his *Prometheus* has described the arrival in a flying chariot of the chorus of the Ocean Nymphs, followed by their father Oceanus on a four-legged bird, anxious to return in a single flight from the Scythian desert and the Caucasus to beyond the Pillars of Hercules and over the Atlantic.

The fabulous Life of Alexander the Great, by the Pseudo-Callisthenes, was a favourite book of the Middle Ages. Alexander is described here to have placed a yoke on the neck of two strong eagles that had been kept fasting for three days. When Alexander took his seat on the yoke, the eagles flew up with him in the air, wherever he pointed his spear, because the head of it carried a large lump of liver. This flying machine of Alexander is illustrated in manuscripts with four or eight eagles or griffins, shown in the vignette on p. 7, and representations in sculpture are to be seen in St. Mark's, Venice, and the cathedral of Basle.

The Tartar and Chinese legend of the Bronze Horse is reproduced in the Squires Tale of Chaucer—

" Him who left half told  
The story of Cambuscan bold,  
And of the wondrous horse of brass,  
On which the Tartar King did ride " :

known to us more recently in the operatic version of the *Cheval de bronze* of Scribe and Auber; parodied also by Cervantes in *Don Quixote II.* in the description of Clavilefio.

Chaucer goes into detail of the Magic Steed, but he did not realise the difficulty of the mechanical problem in his jaunty description—

" This same stede shall bere you ever-more  
With-outen burn, til ye be ther yow leste,  
Though that ye slepen on his bak or reste,  
And turn ayeyn, with wrything of a pin.

But whan yow list to ryden any-where,  
Ye moten trille a pin, stant in his ere—  
Bid him descend, and trille another pin.

Trille this pin, and he wol vanishe anon.

He that it wroughte coude ful many a gin."

So Hecate, too, in *Macbeth*, reaching for her stick, a broomstick, and saying, "I am for the air"; like Abaris on his arrow, putting a girdle round about the Earth between meals.

But Dr. Johnson's "Rasselas," Chapter VI., "A Dissertation on the Art of Flying," anticipates very accurately the gliding experiments of Lillienthal and Pilcher, now resumed by the Wright brothers. The description is so curiously apposite that an extract may well find a place here:—

Among the artists that had been allured into the Happy Valley, to labour for the accommodation and pleasure of its inhabitants, was a man eminent for his knowledge of the mechanic powers, who had contrived many engines, both for use and recreation.

This artist was sometimes visited by Rasselas, who was pleased with every kind of knowledge, imagining that the time would come when all his acquisitions would be of use to him in the open world.

He came one day in his usual manner, and found the master busy in building a sailing chariot. He saw that the design was practicable for a level surface, and with expressions of great esteem solicited its completion.

"Sir," said the master "you have seen but a small part of what the mechanic arts can perform. I have long been of opinion that instead of the tardy conveyance of ships and chariots, man might use the swifter migration of wings, that the fields of air are open to knowledge, and that only ignorance and idleness need crawl on the ground."

"The labour of rising from the ground will be great" said the artist "as we see in the heavier domestic fowls; but as we mount higher the earth's attraction and the body's gravity will be gradually diminished, till we arrive at a region where man will float in the air without any tendency to fall; no care will then be necessary but to move forward, which the gentlest impulse will effect."

"Nothing," replied the artist, "will ever be attempted if all possible objections must first be overcome. If you will favour my project I will try the first flight at my own hazard. I have considered the structure of all volant animals and find the folding continuity of the bat's wing most easily accommodated to the human form.

"Upon this model I will begin my task to-morrow, and in a year expect to tower into the air beyond the malice and pursuit of man."

The Prince visited the work from time to time, observed its progress, and remarked many ingenious contrivances to facilitate motion and unite levity with strength.

The artist was every day more certain that he should leave vultures and eagles behind him, and the contagion seized upon the Prince. In a year the wings were finished, and on a morning appointed the maker appeared furnished for flight, on a little promontory; he waved his pinions awhile to gather air, then leaped from his stand, and in an instant dropped into the lake.

His wings, which were of no use in the air, sustained him in the water, and the Prince drew him to land, half dead with terror and vexation.