

BIRTH, DEVELOPMENT AND CONCEPTS FOR THE USE OF AVIATION IN WARFARE BEFORE THE FIRST WORLD WAR

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Abstract: *The following paper examines the emergence of the world's first ideas and attempts to create aircraft and master the third dimension. The creation and first use in warfare of aircraft lighter than air is analysed. The paper further studies the creation and development of the first aircraft heavier than air, as well as the first concepts for the use of aviation in warfare before the period prior to the First World War.*

Keywords: *aircraft, aviation, concepts, warfare*

1. INTRODUCTION

Man's dream to break away from the Earth is a millennia old one. The legend of Daedalus and Icarus, written more than twenty centuries ago by the Roman poet and historian Ovid, is one of the first known written accounts of the human idea to take to the skies. Chinese strategists in ancient times also understood the benefits of the third dimension and invented kites 2,300 years ago. They were even then considered as means of lifting people into the air to observe the actions of the enemy.

The first ideas for creating aircraft heavier than air, and the first practically developed projects and constructed models of such aircraft; however, did not apply to airplanes, but to the embryonic concept of the helicopter. A manuscript of Leonardo da Vinci with a drawing of the first helicopter (Fig. 1) dating from 1475 was found in the library of Milan.

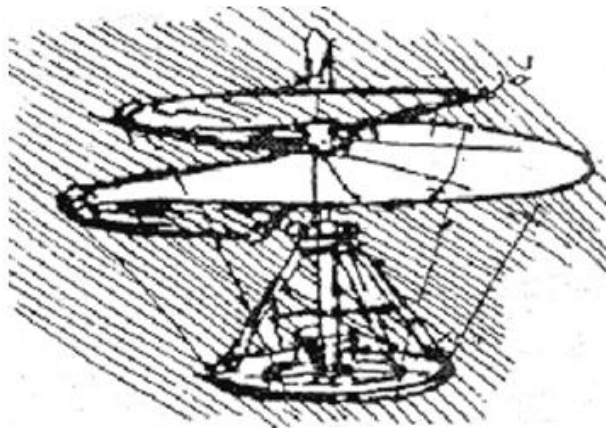


FIG. 1 Leonardo da Vinci's drawing of the first helicopter (1475)

Of great interest from a technical and scientific point of view are the works of Leonardo da Vinci in the field of flight. For about 30 years he studied the flight of birds and presented the results of his observations in an extensive treatise "Codex On the Flight of Birds". Leonardo da Vinci described three types of bird flight, explaining each of them scientifically and supporting his observations with drawings. He also began to build an ornithopter - an aircraft heavier than air, with wing movements like those of a bird. In his project, the wings are set in motion through the motion of the hands and feet. There is no information whether this project had been implemented in practice. In 1475, Leonardo da Vinci made his project for a helicopter and, as mentioned in his notes, managed to lift it into the air, albeit without specifying how he set the propeller in motion.

Whilst the idea of flight is indeed an ancient one, the procedural development of the concept and consequently its application to the military sphere only came centuries later. The following paper has as its *main objective to examine and establish the chronology of the key moments in the birth, development and evolution of key concepts for the utilisation of aviation in the military realm* prior to their full implementation in the First World War. The paper thus examines the contribution of pivotal pioneers in the development of aeronautics and aerial warfare, their work and the general framework of evolution and development of military flight starting from the 17th century henceforth and concluding just prior to the outbreak of the First World War. The paper provides a continuous chronology that encompasses a variety of source material from the respective epochs, visual references and analysis, expressing and affirming the *primary thesis that the understanding and concepts for the use of aviation in warfare existed thoroughly since the French Revolutionary Wars, into the 19th century and going through the rapid advancements in technology and classes of aerial vehicles*, from balloons to airships and finally into the ultimate example of manned flight – the airplane. This evolution of military aviation is expressed in diverse and perspective concepts for their utilisation, albeit with limited implementation, that would later expand into the first Global industrial conflict, which however is beyond the scope of the present paper.

2. BIRTH, DEVELOPMENT AND FIRST USE OF AVIATION IN WARFARE

In 1643, the Italian physicist Evangelista Torricelli proved the existence of air pressure. In 1654, the discovery was confirmed by the inventor of physical instruments, Otto von Guericke. He concluded that light spheres of diluted air could rise into the sky.

Based on Guericke's findings, in 1680 the Italian explorer Francesco Lana de Terzi published a treatise describing an aircraft design. According to Terzi, such an aircraft would have been able to launch projectiles and sink enemy vessels and to bombard enemy cities. [1, 2] It can thus be stated that with Terzi's project came the idea of utilising airspace to achieve superiority in warfare.

The Russian scientist Mikhail Lomonosov also designed a helicopter in 1754. His "aerodynamic machine", which was built on the principle of Leonardo da Vinci's helicopter, was designed to raise measurement instruments to great heights. However, Lomonosov's flight experiments were unsuccessful. With this failed attempt, further ventures to create aircraft heavier than air in the next half century were limited to the construction of models.

A turning point in man's attempts to overcome gravity was achieved by Henry Cavendish in 1766 with the separation of hydrogen and the creation of a method for extracting it in large quantities. This was followed by successful experiments and the development of *lighter-than-air aircraft*.

In 1783, the Montgolfier brothers of France lifted hot-air balloons to an altitude of 2,000 meters, which flew for a distance of 2 kilometres, with the same year Jacques Charles building and lifting a sphere filled with recently discovered hydrogen to an altitude of 1,000 meters. [3]

In November 1783, Jean-François Pilâtre de Rozier and the François Laurent d'Arlandes made the first flight with a man-made construct. It had a diameter of 14 m and could fly 8 km in 25 minutes. On January 7, 1785, the Frenchman Jean-Pierre Blanchard flew across the English Channel in a flight that lasted 12 hours.

The balloon also became the first aircraft used for military purposes. In the early 1890s, the eminent French chemist Louis-Bernard Guyton-Morveau set out the basics for using tethered balloons in aerial reconnaissance. On June 2, 1794, the French captain Jean-Marie-Joseph Coutelle made the first reconnaissance of the battlefield and Austrian artillery positions from the air at an altitude of 300 metres. [4] Two days later, with the active help of air observers, the battle was won. Despite the heavy equipment, some of which was stationary and required on-site construction, the balloon proved to be an effective tool, especially when adjusting artillery fire. [1] However, those which are not tethered depended to a large extent on the direction and strength of the wind.

Balloons continued to be used extensively in combat throughout the 19th century, including during the rest of the Napoleonic Wars, mainly for reconnaissance and aerial surveillance, but also for aerial bombardment, artillery fire adjustment and postal services. It was not until the end of the 19th century that the first self-propelled aircraft appeared – the airplane and the airship.

In Germany, after leaving the army, General Ferdinand von Zeppelin began to develop a lighter than air steerable aircraft, which could partake in hostilities. Thus, in 1900, his airship (zeppelin) with a 5-man crew flew for 18 minutes. As early as the advent of the first rigid airships, the German General Staff saw in them a powerful new strategic tool for warfare. The operational plan for conducting combat operations on the Western theatre, developed in 1906 by Alfred von Schlieffen, provided for the use of airships to solve operational and strategic tasks related to conducting airstrikes, conducting aerial reconnaissance and for transporting troops and combat equipment.

The first serious attempts to overcome gravity with *heavier than air aircraft* were made in the second half of the 19th century.

At the end of the 19th century and even before the advent of the airplane, science fiction authors predicted the revolutionary nature of aerial weapons. Albert Robida in his 1883 novel “The War of the Twentieth Century”, and later H. G. Wells in his 1908 book “The War in the Air”, provided for a terrifying description of the destruction that could come from the air. Moreover, the former – artist and illustrator Albert Robida, in 1882, expected that at the beginning of the XXI century the sky would be filled with flying cars and duly presented them in his painting “One Night at the Opera” (Fig. 2) [5].



FIG. 2 The painting "One Night at the Opera" by Albert Robida, 1882

As early as the end of the 19th century, the first experimental flights of man with a device heavier than air had begun.

In 1866, the French engineer Clément Ader built his first aircraft, called the *Éole Ader*. The device, resembling a bat, had a lightweight steam engine with 4 cylinders and 20 horsepower (15 kW), a 4-bladed propeller and a total weight of 300 kilograms (Fig. 3).

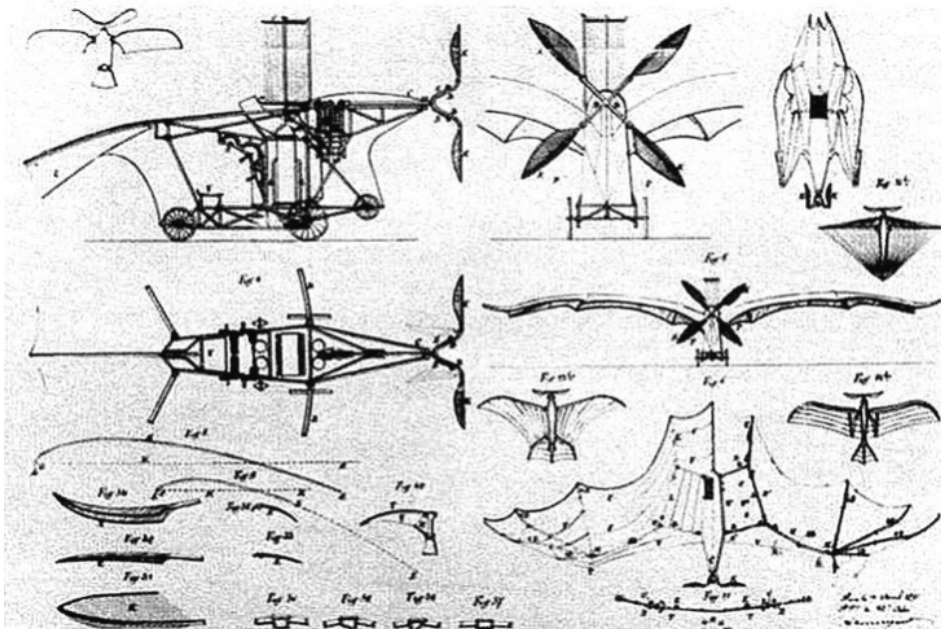


FIG. 3 Drawings of Clément Ader's *Éole* aircraft

On October 9, 1890, with the *Éole*, Clément Ader managed to detach himself from the ground by a few centimetres and fly 50 metres in 5 seconds. This is considered as the first take-off of an aircraft in history, made under the power of its own power. However, Ader failed to achieve maneuverability and flight stability. The Wright brothers succeeded 13 years later.

According to some reports, Ader also built the *Éole II* aircraft (also called the *Avion II*), with which he flew for 200 metres in August 1892, as well as the *Avion III* (Fig. 4), with which on 14 October 1897 he flew 300 metres. Information about these flights is contradictory and unconfirmed. [6]

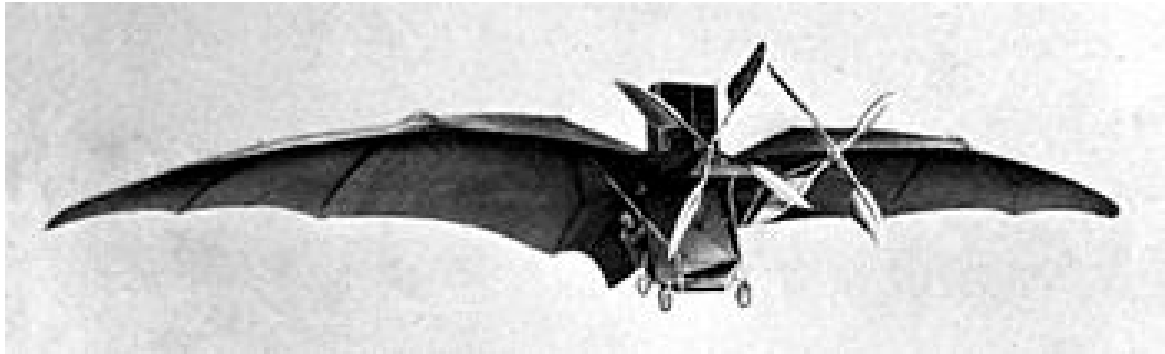


FIG. 4 Avion III aircraft (illustration from 1897)

It is officially accepted that the airplane itself was created by American aeronautical designers and pilots, brothers Wilbur and Orville Wright. They constructed Wright Flyer (Fig. 5 a, b, c), with which Orville made the first controllable steady flight at an altitude of 2.5-3.5 metres on December 17, 1903. It lasted 12 seconds and flew a distance of 37 metres. In the fourth flight, Wilbur succeeded in keeping the aircraft in the air for 59 seconds and flying 250 metres. The aircraft had a gasoline engine with 12 horsepower.



FIG. 5 (a) The first flight of Wright Flyer on December 17, 1903

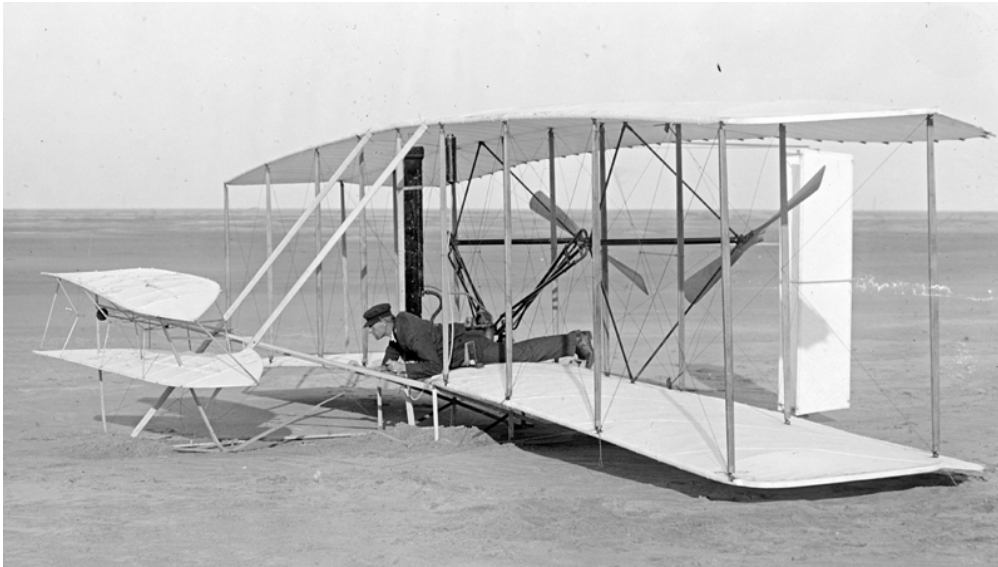


FIG. 5 (b) Wilbur Wright on Wright Flyer in 1903

In 1905, after repeated improvements to the glider and engine, the Wright brothers' plane flew for 38 minutes and 3 seconds and a distance of 39 kilometres. [3]

In 1906, the brothers received a patent for the aircraft, and in 1908 they sold their model to the US military, and associated licenses for it to several other countries. In 1909, they founded the Wright Company, which manufactured aircraft and trained pilots.

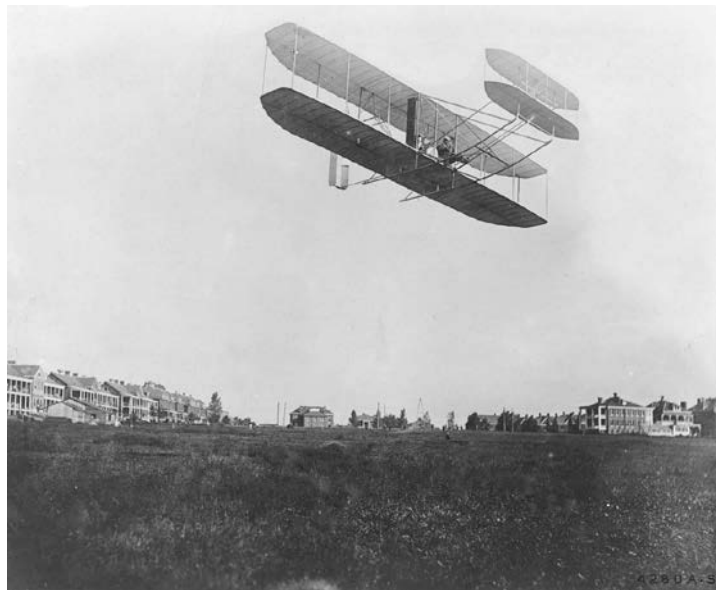


FIG. 5 (c) Demonstration flight of Orville Wright in September 1908

The first successful flight attempt in Europe with a heavier than air aircraft was made by the Romanian inventor and aviation pioneer Traian Vuia, who lived in France, and created the so-named "flying car" – the first monoplane with an engine. On March 18, 1906, the aircraft constructor flew for the first time with Vuia I (Fig. 6) and managed 12 meters, rising one meter above the ground. [7,8]



FIG. 6 Trajan Vuia in his flying machine Vuia I in 1906

The tense political situation at the beginning of the 19th century forced the military to more realistically assess the capabilities of the not-yet-reliable aircraft. An important sign of the potential of states was expressed in the constant efforts in ever-expanding achievements and record setting in the field of aviation. In January 1909, Louis Bleriot completed work on the creation of the Blerio-11 aircraft, with which on July 25th of that year, he flew over the English Channel. This flight is considered an important moment in the development of aviation, as it proved in practice its great future potential.

Serious successes in aircraft construction before the First World War were the creation of the high-speed monoplane Duperdusin (reaching a speed of 203 km/h), the multi-purpose biplane "Albatross" (which flew 1400 km without landing) and the four-engine Russian large strategic reconnaissance aircraft Sikorsky Ilya Muromets, which provided the baseline of possibilities for future use in armed combat of aircraft heavier than air.

Also of importance is the contribution to the development of aviation of the Romanian aviation engineer Henri Coandă, who after a series of aerodynamic studies in 1910, built the first reported jet aircraft called the Coanda-1910. The aircraft was presented at the Second International Air Show in Paris in the same year.

3. FIRST CONCEPTS FOR THE USE OF AVIATION IN WARFARE

Although the plane was still viewed with a certain level of distrust, in all countries the military was willing to use it for military purposes - especially for intelligence. This is how the first airplane services were formed.

Undoubtedly, the *pioneers of aerial weapons* were *Giulio Douhet* (1869-1930), *Clément Ader* (1841-1925) and *William Mitchell* (1879-1936). They saw the new opportunities offered by the aerial dimension and saw the aeronautical factor as a key tool for the implementation of global strategy. Breaking with centuries old for when the war was fought purely on land or at sea, they proceed from two axioms – the superiority of the air factor and the need for independence of the air force.

One of the greatest theorists in the field of military science, who has stated his view on the great changes that are to take place in the conduct of hostilities precipitated by the advent of aircraft, is the then unknown Italian artillery major *Giulio Douhet*.

In 1909, he wrote: "It may seem incredible that the sky should become a battlefield, no less important than the land and the seas. But it is better from now on to seize this opportunity and prepare our services for the new conflicts that lie ahead. The struggle for dominance in the air will be tough..." [1]

Giulio Douhet predicted that aviation would be a decisive weapon in the offensive role. According to him, there was no effective protection against aviation and that bombings can seriously degrade the spirit of the population ("Command of the Air", 1921). [9]

The aforementioned Frenchman *Clément Ader* was another individual actively involved in the development of aviation. In 1909 he published his work "Military Aviation", which became extremely popular and was published in no less than 10 editions in the five years preceding the First World War. The work is of especially high importance with its presented views on air warfare and the presented concept of modern aircraft carriers with a flat deck for takeoff and landing. Ader maintained that aviation will radically change the foundations of the existing strategy. According to him, the time of land battles had passed and in the future great victories or great defeats will take place in the air. Ader was convinced of the defensive strength (unlike Douhet) of a powerful air fleet.

His concept of an aircraft carrier was handed over to the American naval attaché in Paris, and the first attempts to create an aircraft carrier in the United States began in November 1910.

In the United States, General *William "Billy" Mitchell* believed that aviation could be the primary means of an attack. At the conclusion of the First World War, he also proposed the idea of a large air landing operation in the rear of the German armed forces.

Although they spared no small amount of effort, the efforts of these aviation pioneers were often either limited or wholly fruitless, and they themselves had profound troubles with the higher echelons of command. Ader's loan was suspended. Mitchell ended up in court. Douhet, having criticized the Italian army and its high command too much, was deprived of any command functions. As a result, the actions of the Italian Air Force were completely traditional and in line with those of other states of the period. Thus, bombing forces were limited in quantity and quality.

The ideas of these pioneers were difficult to impose at the time, facing the administrative sluggishness, the conservatism of the military corps, and especially the desire of other branches of the army to keep aviation in a subordinate, auxiliary position.

To illustrate the opposition that military aviation faced in its early development, a few examples from France can be examined. "It's all a sport, but for the army the plane is a zero," said then-General Ferdinand Foch, commander of the Higher Military School, in 1910. According to him, aviation could only play an auxiliary role in war. In 1914, Captain Faure, who reported on his experiments with a 37-millimeter cannon on a Voisin aircraft, said that "this is something interesting, but more in common with Jules Verne than with reality." Only aviation for direct assistance was of any interest to the ground forces, which saw aviation not as a weapon, but as supplementary asset, at best. When it comes to eliminating bomber aircraft, infantry and sailors further justified their position. For General Maurice Gamelin and Vice Admiral Georges Durand-Viel, "the removal of the air force for bombing would not affect the conduct of land and sea operations." Admiral Raoul Castex and the academia at the Naval School did not question the effectiveness of the massive air attacks, but were sceptical about the decisive nature of the air war concept. [10]

Unlike Ader, who had limited followers, Douhet's influence was significant in France and Germany. His doctrine aroused the fear of the French (they applied the Douhet model to their eventual opponents, Italy and Germany) and the admiration of the Germans. His ideas strongly influenced the development of the future Luftwaffe in Germany.

Since 1909, there had been a strong interest in England in the ability to carry out air strikes and bomb strategic sites and cities.

Despite resistance, as early as 1910 in France, England, Russia and the United States created the first formations of military aviation, armed with airplanes.

The formation of larger structures followed, and in 1911 an air battalion was established in England, and in 1912 – the Royal Air Corps. [11] In 1914, the French Directorate of Military Aviation was founded. [10]

Aviation was quickly attracting the interest of the military with the opportunities it provided.

During the *Tripolitan War (1911-1912) and the Balkan War (1912-1913), the aircraft was first used in military operations*. Thus, shortly after its appearance, aviation filled specific military roles.

In 1913, Giulio Douhet, now a lieutenant colonel, defended the view that there should be an independent air force and stated: "The airspace will be independent. A new weapon is born - the weapon of the air. A new battlefield opens - the air. The history of war is filled with a new factor, the principle of air warfare is born".

4. CONCLUSION

The development of industrial technologies and motorisation in the early twentieth century gave a powerful impetus to the evolution of land and naval forces and led to the creation of a new kind of armed forces branch – the Air Force. The capabilities of armies by land, sea and air lead to changes in perceptions of their use, which also changed the nature of war.

As soon as they appeared, the first aircraft quickly found application in armed struggles. Balloons had been used since the end of the 18th century, with the later arrival of airships at the conclusion of the 19th century. The creation of the airplane caused a kind of revolution in the conduct of the war with the provision of indisputable advantages from the utilisation of the third dimension.

Simultaneously with the birth of aviation, the first theories of air warfare appeared, where the airplane was considered a weapon crucial to the battle on the ground.

Later in the 1920s, the tactical characteristics and armament of aircraft, the organizational structure and combat use of aviation were to be improved and refined. Military theory developed the problems of gaining supremacy in the air as a prerequisite for successful military action on land and sea. Some of the basic principles for the use of aviation were also to be substantiated.

By the end of the 1920s, aviation in the leading countries would begin the process of becoming a branch of the armed forces.

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