Bulletin of "Carol I" National Defence University
10.12753/2284-9378-20-50

BRIEF HISTORICAL MILESTONES ON THE EVOLUTION OF UAV SYSTEMS: 1914 - 1939

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Unmanned aerial vehicles (UAV), such as remotely piloted vehicle (RPV), are weapon systems widely used în nowadays armies. It may seem surprisingly, but this weapon has its origins în the beginning of World War I. The aim of this article is to pursue the development of the unmanned aircrafts from the 1914 to 1939. This article represents a continuation of the article published in Bulletin of "Carol I" National Defence University, No. 2/2018.

Keywords: UAV; aerial torpedo; Kettering Bug; Sperry Aerial Torpedo; Argus As 292.

UAV (Unmanned Aerial Vehicle) is defined as an aircraft without a human pilot on board. UAVs are a component of an UAS (Unmanned Aerial System) which includes a UAV, a CS (Control Station), positioned on the surface of the earth or on an aircraft in the air, and a communication system between those two. UAV can fly with different degrees of autonomy as follows: either remotely controlled by a human operator, or independently due to the computers on board. The unpiloted systems have known an exponential development and use in the last two decades, leading to what can be seen as the biggest change of paradigm in the human evolution someday. Military UAV have changed forever the behavior of warfare, offering a permanent aerial surveillance, high capabilities of command and control and high precision capacity of assault without the possibility of human crew loss. UAVs in civil domain are already a permanent component in commercial activities, industrial activities, entertainment and emergency services. Against popular opinion, though, the historical interest for UAV goes far beyond the observations of people because many states had hired military unpiloted systems one century ago, beginning with World War I. This article represents a continuation of the article published in Bulletin of "Carol I" National Defence University, No. 2 (2018).

The history of UAV during World War I

Although the success of unpiloted aerial vehicles in test flights was irregular, during the WWI their potential in the warfare was recognized by the army. So, after just 16 years since the flight of the Wright brothers in 1916-1917, the British army developed Ruston Proctor Aerial Target (AT) using the radio controlling system of A.M. Low[1] (considered the father of radio navigation system). AT is a radio-controlled airplane, without any crew on board, made for two purposes: the defence against Zeppelins (where it should be controlled from the ground) and as a flying bomb (controlled from a piloted aircraft). It was built in the aircraft factory P. Hare Royal from Putman. After a few failed prototypes, the British army chose to give up[2]. But it gave opportunities for similar projects to develop, such as Kettering Bug and it paved the way for modern military drones nowadays.

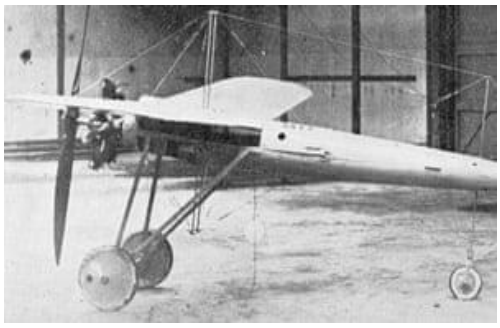

Figure 1 *Ruston Proctor Aerial Target*[3]

In USA on 2nd October 1918, the unmanned aircraft under the name of Kettering Bug, designed by Charles F. Kettering from the General Motors Company had the first flight. This UAV (more precisely a flying bomb) was a small biplan, made of wood and canvas, designed to carry a bomb having the same weight – 300 pounds. The aircraft took off from a wheel trolley and then it detached

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its wings, allowing the hull (the bomb) to vertically attack a pre-programmed target. The USA army ordered big supply of this model in the last months of WWI, but the end of the war lead to the cancelling of this order. Anyway, this type of UAV was the forerunner of the modern cruise missiles[4].

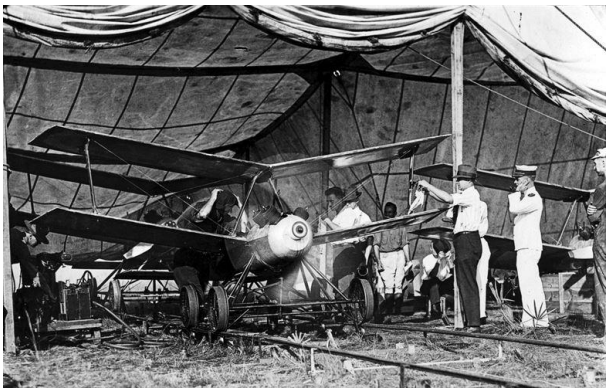

Figure 2 *Kettering Bug Aerial Torpedo*[5]

Meanwhile, in SUA, where the idea of radio-controlled unmanned aircrafts began to take shape more and more, a team of engineers is working on a similar project: the Hewitt-Sperry Automatic aircraft. In 1917, Dr. Peter Cooper and Elmer A. Sperry invented the automatic gyroscopic stabilizer, which helps the straight and horizontal flight of an aircraft. Cooper and Sperry used this technological discover of converting training aircrafts Curtis N9 of U.S navy for the first remote-controlled UAV. The aircraft had the wingspan equal to 6.7 meters, the length of 4.57 meters and it was equipped with a Curtiss OX-5 engine which produces a 22 CP power. The aircraft was able to reach a maximum speed of 70 miles/h. Sperry Aerial Torpedo flew 50 miles carrying a 300 pounds bomb on several test flights, although it was never used in the battle[6].

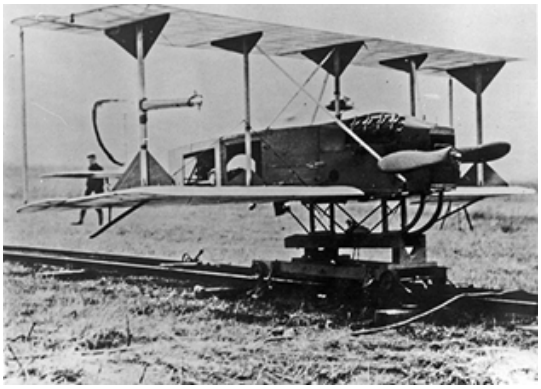

Figure 3 *Sperry Aerial Torpedo*[7]

But France, which considers itself a big military power did not want to be left behind. So, on the 2nd of July 1917, captain Max Boucher managed to fly with a Voison plane "without a human pilot" over 1 km, then the plane landed slowly because it had only 2 liters of fuel. Captain Max Boucher resumed the work of Octave Détable, which took place in 1894, which due to a wing equipped with divergent cones, he brought the automatic stabilization of the plane. This fact pushed George Clémenceau, who was the president of the army senate committee, to launch a competition for an unmanned plane in 1918 because he considered the pilot who needs a long training more important than the plane, which can be rapidly produced in large quantities. Max Boucher managed to improve the system and to fly using a Voisin BN3 plane on the 14th of September 1918 for 51 minutes on a 100 km route. He continued his work with the engineer Maurice Percheron and he was able to put in use an improved radio-controlled plane on the 17th of April 1923 on Etampes air base. But the war was over and the military was no longer interested in this idea[8].

Figure 4 *The unmanned aircraft Voisin BN3*[9]

At the same time, Germany did not stand still. Since the beginning of the war, the German military had shown great interest in remotely controlled vehicles. On the 5th of November 1914, the Ministry of War ordered the Commission for the Evaluation of Transport Technology (Verkehrstechnische Prüfungs-Kommission / VPK) to develop remote-controlled systems that could be installed both in ships and planes. In January 1915, Siemens & Halske company registered a certificate which approached some of the main problems involved in remote control of aircrafts. Thus, the aircraft equipped with wings and control surfaces (helm

and elevator) was going to be launched from an ordinary plane, the commands being transmitted through electric impulses. The electric impulses were transmitted through a wire connected to a device on the board of an aircraft consisted of human crew. Even if at the beginning, the project was based on a monoplane design, with the increase in size and loads, this would be partially replaced by biplane projects. By the end of 1916, a total of 66 aircrafts had been launched. In 1916 a biplane model was launched, called Torpedo Planor (Torpedogleiter). However, the end of the war led to the end of the project too[10].

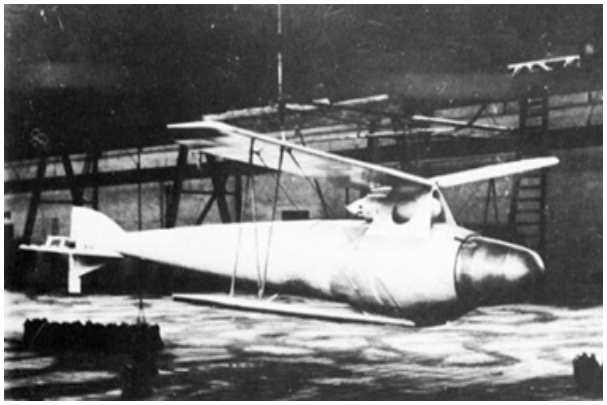

Figure 5 *Torpedo drone realized by Siemens-Schuckert in 1917-18*[11]

The interwar period 1919-1939

After World War I, there was much interest in producing and improving remote-controlled flying weapons. In 1925, the British Royal Navy developed and tested aerial torpedo projects, such as RAE Larynx (Royal Aircraft Establishment Larynx). This was an unmanned aircraft that was going to be used as a guided anti-ship weapon. It was a small monoplane powered by a 200 CP Armstrong Siddeley Lynx IV, it reached the maximum speed of 200 km/h (320 km/h) being guided by an automatic pilot, developed on the fundamentals of the professor Low Archibald. After two years of development, the first launch was done by a catapult from the HMS Stronghold destroyer in the Bristol Channel. Subsequent tests were performed in the English Channel and at the Portland Bill. The tests extended until 1928 and a complete series of tests was performed in 1929 using six aircrafts in Mesopotamia[12].

Figure 6 *Larynx No3, the catapult from the HMS Stronghold destroyer on the 19th of October 1927*[13]

The early successes of unmanned aircraft led to the development in the UK and US in the 1930s of certain unmanned aerial vehicles. After the war, three standard E-1 biplanes were converted into UAVs. In 1931, the British stayed in the aircraft or controlled the radio under the name of Fairey Queen from the Fairey IIIF seaplane, building a small three-aircraft aircraft. It is a recreational base for the Queen Bee, the first modern UAV model. In the mid-1930s, Queen Bee emerged as an important tool for training air defence crews. It was the first returnable and reusable UAV, a charging concept for rapid air use during the operation of anti-aircraft training missions. Made of spruce and fast plywood biplane and flown for the first time in 1935, they were equipped with wheels or floats. D. H. Queen Bee were to be controlled by radio, being able to do so within 17,000 feet and the maximum range of 300 miles at speeds of over 100 km / h. A total of 380 D.H. Queen Bees served the country's drone in the Royal Air Force and Navy Royal until they retired in 1947. Practically, it was the first modern radio-controlled UAV[14].

Figure 7 *The radio-controlled plane D.H.82B Queen Bee*[15]

The British Army tried to replace the D.H Queen Bee with a modern aircraft. Therefore, the Aircraft AS 30 Queen Wasp appeared as a British target plane with no pilot designed by Airspeed Limited at Portsmouth. In May 1936, two prototypes were ordered, one of which had wheels for Royal Air force and another which contained floaters especially made for Royal Navy. 65 is the exact number of the prototypes that were ordered depending on the success that the testing program was going to have. The aircraft was a single Armstrong Siddeley Cheetah engine biplane constructed from wood with sharp tapered wings and fabric-covered control surfaces, with a range of 9.45 m, a total length of 7.42 m and a total weight of 1,588 kg. The first take-off from the ground took place on 11 June 1937 and from the sea on 19 October 1937. In November 1937 it was successfully catapulted from the HMS Pegasus hydroplane warship. The flight tests found that the aircraft had low power and difficulties regarding water landing, which required redesigning the floaters. Although it was intended for use by both Royal Air force and Royal Navy, the aircraft did not start to be mass-produced[16].

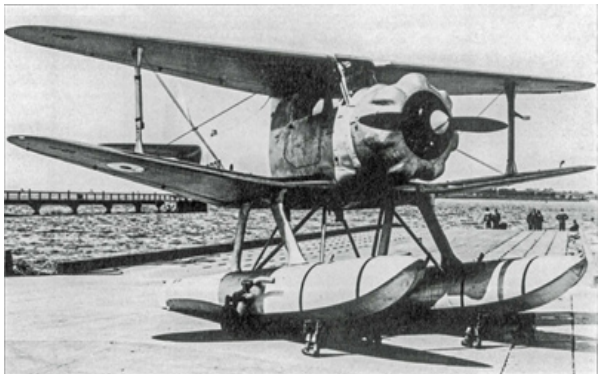

Figure 8 *A. S.30_Queen_Wasp*[17]

During this time, the Luftwaffe was presented under the direction of Dr. Eng. Fritz Gosslau at Argus Motoren GmbH a UAV model under the name Argus As 292. Work on the drones began in 1937 at the Argus-Flugmotorenwerke (Argus aircraft engine factory) in Berlin-Reinickendorf. Initially called the Flakzielgerät 43 (Flak-Target Apparat 43), it was used as a training target for anti-aircraft defence. The body of the aircraft was of simple tubular construction and the detachable high dihedral wings were detachable for transport.

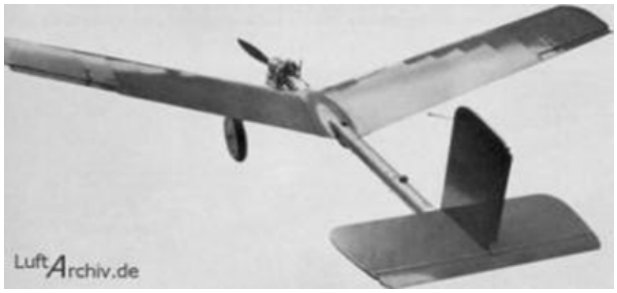

Figure 9 Argus As 292[18]

The first unguided flight was on June 9, 1937 and was remotely controlled on May 14, 1939. But German forces considered the aircraft a loss (debris) after being shot at by anti-aircraft gunners. To find a new destination during flight testing, two cameras were mounted on an As 292 prototype. The design of the original drone was slightly changed; the engine, radio control equipment and camera were covered. Secondly, the engine was more powerful and provided an autonomy of 30 minutes. The recovery of the aircraft was done by sending a command to stop the engine and open a parachute. But Nazi Germany started the war and the Argus Company was busy fulfilling orders for aircraft engines. Therefore, the manufacture of the drone somehow managed to start only in 1942[19].

Figure 10 *The recovery of a research aircraft As 292*[20]

In parallel with the Argus project, in 1937 Nazi Germany attempted to develop a radio-controlled target drone the size of a large aircraft. Fieseler designed and built the Fi.157 target aircraft in a short time. It was a single-engine, low-power plane with two-blade metal propellers and fixed gear. The aircraft was about to be suspended under a carrier bomber and detached in flight from it. In 1937, three prototypes were built, which were soon destroyed for various reasons[21].

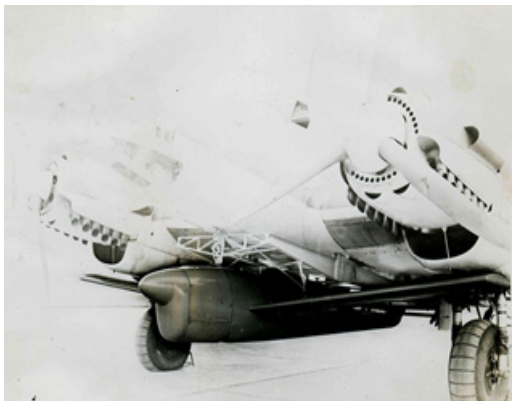

Figure 11 *Fi.157 drone attached to an He 111*[22]

In the late 1930s, the United States returned to the stage of unmanned aircraft, with the development of a target for training US Navy anti-aircraft gunners under the name Curtiss N2C-2. This unmanned aerial vehicle was remotely controlled from another manned aircraft, which made the design revolutionary. With the help of this biplane, the deficiencies in the naval air defence were discovered (The Utah battleship did not take down any N2C2-2 drone). The US Navy named this class of drones NOLO (No Live Operator On Board). The USAAF adopted this concept and began to improve it. However, as America prepared for war, the research was redirected for use in combat[23].

Figure 12 *Curtiss N2C-2*[24]

But the most famous drones of that period, both due the large number of pieces built and the advertisement with Marylin Monroe, were those made by the Radioplane Company led by Reginald Denny. In this article I will present only some of the drones made by this company. The interest of Reginald Denny, former British pilot in WW1, a Hollywood actor for the remote flight began one day in the early 1930s, when he offered to help a neighbor's son to play with a radio-controlled toy plane. The plane crashed and Denny insisted on building a new one for the boy. That experience led the actor in 1934 to open an aero models store selling models with their own design. It quickly expanded into a business, Reginald Denny Industries, through which he marketed its own aircraft models under the name Denny Plane. Denny also sold miniature petrol engines for aircraft designed and built by Walter Righter. In 1936, Denny and the financier Paul Whittier founded the Radioplane Company with the goal of developing radio-controlled aircraft for being use by military as air targets. The first controlled air target from Denny Industries was RP-1 (Radio Plane 1), a 42-kilogram monoplane with a 3 hp engine, two-strokes and 2-cylinder engine built by Walter Righter.

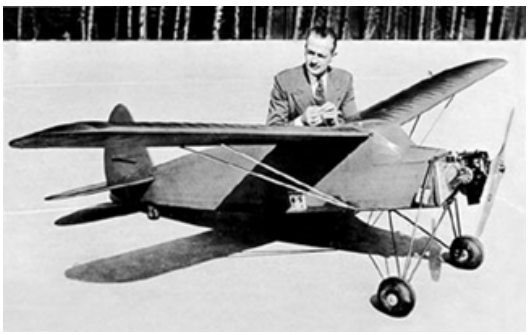

Figure 13 *Reginald Denny with the drone RP-1 (1935)*[25]

After a demonstration in front of the army in February 1938, the military became interested in the model. After a series of improved models, the army accepted the RP-4 model, a number of 53 of these were ordered in May 1939 under the name OQ-1. The drone was launched by a catapult and, although it was equipped with a landing gear with wheels, the recovery was usually done with a parachute[26].

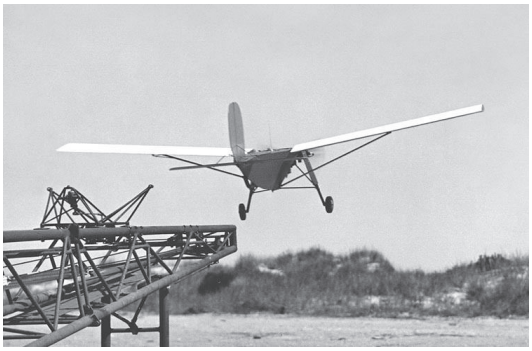

Figure 14 *The QQ2 model*[27]

Conclusions

• Less than 16 years after the Wright brothers' first flight, the major military powers began considering unmanned aircraft systems, initially as air bombs, then as training targets for air defence and then as reconnaissance systems.

• The capabilities of each version of generated UAVs have contributed to the evolutionary process, not the revolutionary one, of target-to-reconnaissance aircraft systems and, ultimately, attack platforms.

• Unmanned on-board systems have been continuously developed offering a major advantage: the ability to operate in hazardous environments without human risks.

NOTES:

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