

WARFARE AS AN EXPERIMENT IN MILITARY SCIENCE

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Abstract: *Rene Descartes developed the principle of the scientific method as a reasoning that avoids errors of judgment and discovers the truth by respecting four precepts (critical restraint; rule of synthesis; rule of enumeration) that can be applied in any science, therefore also in military science. Using this principle, this article demonstrates that the hypotheses and predictions formulated after the end of the First World War (the Great War) are verified and validated in the Second World War. Therefore, the theory of knowledge developed by Descartes can also be applied in military science.*

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Military science encompasses several fields—such as military history, military geography, military medicine, military psychology, and military topography—collectively known as military sciences; these developed through the integration of scientific findings from other academic disciplines into military science. Some scientists do not accept military science as a true science because it does not employ the scientific method of refuting hypotheses through experimentation, in accordance with the principle of the scientific method formulated by Roger Bacon. This principle was broken down by the English scholar and philosopher into the following stages:¹ 1) observation of the phenomenon; 2) formulation of hypotheses; 3) prediction of new events based on those hypotheses; 4) verification or refutation through experimentation; 5) evaluation (conclusion). However, we believe that this scientific method can also be applied to military science, considering war to be a genuine experiment—with wars serving as experiments, that is, as true research laboratories for military science. Consequently, the five stages of the scientific method in military science would be as follows: 1) observation of the phenomenon of war; 2) formulation of hypotheses; 3) prediction of new events based on

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¹ Francois Reynaert, Vincent Brovielle, Le Petit Larousse. Cultură generală, Litera Publishing House, Bucharest, 2020, p. 317.

these hypotheses; 4) verification or refutation of the hypotheses through the next war (or subsequent wars); 5) conclusion(s).

Much like Roger Bacon (1214–1292), René Descartes—in his work **Discourse on the Method**—formulates the principle of scientific method as a reasoning process that must adhere to four precepts to avoid errors of judgment and to discover the truth in any science. These precepts are: 1) never accept anything as true unless it is evidently known to be so; this precept is called critical reserve; 2) divide each research difficulty into several parts in order to resolve them correctly—that is, to resolve them better; this precept is called the rule of analysis; 3) guide thought in an orderly fashion, proceeding from the simple (the simplest objects) to the complex (gradually ascending to the knowledge of the most complex objects); this is the rule of synthesis; 4) conduct comprehensive enumerations and reviews each time to ensure nothing is omitted; this is the rule of enumeration. Thus, Descartes developed a new theory of knowledge (comprising critical reserve, analysis, synthesis, and enumeration) that is also applicable to military science². Thus, it is benefiting from a genuine scientific revolution that is transforming it into an autonomous and self-sufficient academic discipline³. We will now present several examples of wars—that is, military experiences—analyzed through the five stages of the scientific method for researching the phenomenon of war, or by applying the theory of knowledge developed by Descartes.

Observing the war that unfolded during the First World War (1914–1918), we find that industrialized societies underwent massive militarization (total troop numbers exceeded 50 million, with nine million killed on the battlefield) and that new weapons were tested during the conflict: tanks, armored vehicles, aircraft, submarines, new warships (including aircraft carriers), radar, and so forth. Thus, the First World War was a mass-scale conflict that went global and assumed apocalyptic proportions, characterized by static fronts, the loss of mobility, and the massive use of firepower, all involving complex plans with ambitious objectives and unfolding across vast territories. It encompassed 28 belligerent states with a combined population of over 1.5 billion people. All these concepts align with Descartes's precept of critical caution.

In addition to our existing hypotheses, we must consider the fact that the technical-tactical characteristics of new weapons are continuously improving and evolving, thereby driving innovation in military science. To analyze the evolution of new weaponry and the advancement of military art and science, we will employ Descartes' analytical method, which advocates breaking down the research problem into smaller components.

² *Ibidem*, p. 281.

³ *Ibidem*, p. 317.

Consequently, we will examine the specific contribution of each new combat asset to the development of military art and science. We begin with aviation and the emergence of air strategy, focusing on how aviation transformed the configuration and nature of warfare by introducing a three-dimensional theater of operations. Italian Air Force commander General Giulio Douhet (1869–1921) authored **The Command of the Air**, in which he articulated the future role of aviation and the aerial dimension of warfare, as well as the necessity of aircraft production and an air fleet capable of defending national territory against air attacks and supporting land and maritime operations. He predicted that, in the future, the skies would be filled with thousands of combat aircraft; indeed, everything he foresaw as early as 1909 has come to pass. "In preparing for national defense, we must follow a completely new path, for the nature of future wars will be radically different from that of wars past"⁴.

So, there is a new prediction.

William Mitchell (1879–1936) was also a visionary regarding the role of aviation: "Humanity stands on the threshold of the aeronautical era, during which the destinies of all nations will be decided in the air"⁵. He wrote that "air power is the ability to do something in the air or across the air, and since the air covers the entire world, airplanes can be anywhere on the planet"⁶.

Aircraft compress time and eliminate distances and borders. They fly over all nations from every direction, both day and night. Alongside maritime and ground personnel, flight crews have emerged. Aerial strategy has developed, dealing with the preparation and employment of air forces (force-based aerial strategy) and air assets (asset-based aerial strategy), as well as the planning and execution of offensive actions and defense against attacks from the ground, sea, and air (operational aerial strategy). Aviation is an offensive weapon; the appearance of aircraft in the strategic space and on the tactical battlefield offers a vast array of opportunities and possibilities. Air supremacy is a key factor for success in future warfare. This is yet another prediction.

The goal—and the outcome—of operational aerial strategy is the achievement and maintenance of air supremacy. This principle of the art of war will never be challenged. However, not all states can build an effective and efficient air power, as creating such a fleet requires: 1) patriotism and love of country, enabling pilots to stoically endure the heavy losses incurred during wartime; and 2) a robust industry and sufficient raw materials to

⁴ Gerard Chaliand, *Anthologie mondiale de la strategie des origines au nucleaire*, Edition Robert Laffont, Paris, 1990, p. 1139.

⁵ *Ibidem*, p. 1140.

⁶ Popescu M., Arsenie V., Văduva G., *Arta militară de-a lungul mileniilor*, Vol. 2, Centrul-Tehnic Editorial al Armatei, Bucharest, 2004, p. 169.

manufacture aeronautical equipment, engines, and aircraft. If a state with global ambitions were to gain an early aerial advantage in a future war, it could dominate the planet even more easily than any nation in the past ever dominated a continent⁷.

British Marshal Hugh Trenchard (1873–1956) created the Royal Air Force, thereby realizing the visions of his predecessors and contemporaries. The Air Staff held that the objective of air operations was to paralyze the enemy's war-munitions production centers and disrupt its entire transport and communications network. In the new Royal Air Force manual, this objective was defined as follows: "the mission of the air force is to crush the enemy's means of resistance through attacks on targets selected as best suited to achieving this objective"⁸. It was, therefore, a new method of defeating the enemy. Trenchard held the view that bombing enemy military targets was not illegal, regardless of where they were located. The advent of aviation completely transformed the philosophy of warfare—not only by expanding the theater of conflict (the battlespace) but also by severely and irreversibly affecting the entire population, effectively drawing it into that sphere. With the rise of national armies, the entire population became involved in war in one way or another, because:

- national armies require the contribution of the whole nation to generate the manpower and material resources needed to prepare for and wage war;

- wars could no longer be launched over just any issue, but only to defend vital national interests;

- armed conflict transcends the battlefield, as the objective of war is to defeat the enemy state—not merely its army—using every possible means.

Thus, air power emerged as the third dimension of warfare; it compressed time and incorporated economic targets (including industrial facilities), transport networks, and telecommunications infrastructure into the theater of operations. Air strategy revitalized warfare, opened up new horizons, and expanded the scope of military art and science. These were some of the hypotheses and predictions concerning the role of aviation.

The era of armored warfare (tanks) was ushered in by World War I and became known as the age of "iron warfare." The first armored vehicles were armed with a machine gun even before the outbreak of the war, as the transition to an industrial society had already taken place. These armored vehicles weighed 2.5–3 tons, featured 6–8 mm armor and a 30–40 horsepower engine, and ran on solid rubber tires. The French army was equipped with the Charon Mle 1904 armored car; it carried two 1.6-meter

⁷ *Ibidem*, pp. 170-171.

⁸ *Ibidem*, p. 171.

steel bars for crossing trenches. Following the Battle of the Marne, several civilian vehicles were up-armored and fitted with machine guns. The Russians demonstrated ingenuity; the Tsar's chauffeur invented a track system for movement across muddy terrain, snow, and the like. The front wheels were steerable, while the tracks were located at the rear. In winter, the front wheels were replaced by a pair of skis (skates).

The British used the American Holt tracked tractor to build the first tank. In France, General Joffre procured 400 Schneider and 400 St. Chamond (tracked) tanks. Meanwhile, the British manufactured the Mark I tank (the first tank). Subsequently, they produced several tank models, culminating in the Mark V. In contrast, the French manufactured the Renault FT—the first tank with a turret; it weighed 7 tons, featured 6 mm armor (20 mm at the front), and was powered by a 35 hp engine. This tank was equipped with a 37 mm caliber gun and reached a speed of 7.7 km/h. The French produced 3,144 Renault FT tanks, while the British produced over a thousand tanks. Tanks were necessary to destroy field fortifications, ensuring that infantry had powerful, continuous fire support throughout their advance. Thus, the tank served as a means of infantry support and a tool for destroying and terrifying the enemy, while remaining invulnerable to infantry weaponry.

Regarding the confrontation between tanks and artillery, the odds favored the guns if tanks attacked in isolation; however, if they attacked in massive formations, field artillery stood no chance against the tanks' mobility. Because the Renault FT featured a rotating turret (360°), it is considered the true ancestor of the modern tank. After the war, Renault received numerous tank orders from various nations. The tank had a small turret that accommodated only the tank commander. The first tank-versus-tank battle took place on April 24, 1918, when three Mark V tanks engaged an A7V; the latter, armed with a 57mm gun, destroyed two of the Mark V tanks. Subsequently, the third Mark V—also equipped with a 57mm gun—destroyed the A7V.

The Germans had neglected tank production, though they did manufacture a few dozen tanks toward the end of the war—but it was too late.

The British, on the other hand, introduced tanks into battle prematurely on September 15, 1916, though the tank's true effectiveness was demonstrated later. During the First World War, the tank was used solely to support the infantry. Tanks were equipped with machine guns and short-range cannons, and their speed was comparable to that of an infantryman (5 km/h). By 1918, it was realized that, beyond providing fire support, tanks could also assist with logistics by transporting water, food, and ammunition. In 1917, Fuller (1878–1966) organized a surprise tank attack at Cambrai, marking the first combat deployment of armored

vehicles. Tank forces reshaped the philosophy of mobile warfare (mobility) on a new foundation. They transformed the nature of the battlefield—a process that began in the First World War and reached its zenith in the Second. Fuller argued that tactics—the art of moving troops on the battlefield—evolve in response to available weaponry and means of transport; every new or improved weapon and method of movement alters the art of war. The advent of the tank revolutionized this art by: 1) increasing mobility, 2) enhancing protection, and 3) boosting offensive and destructive power, while allowing for operation across all types of terrain (thanks to caterpillar tracks).

As the tank was further refined, it substantially altered the theory of combat tactics. Tanks, supported by aviation and motorized infantry, revived the war of movement. The "tank terror" at Cambrai and Amiens precipitated the German defeat on August 4, 1918. Tanks were the land forces' most effective offensive weapon, thanks to their armor, mobility, and firepower. On September 15, 1916, during the Battle of the Somme, the British deployed 48 tanks distributed among 12 divisions (two divisions received 10 tanks each, six divisions received 2 tanks each, and the others received 3 or 4 tanks each). Each division advanced a distance proportional to the number of tanks it had received as reinforcements.

On April 16, 1917, the Allies deployed 132 tanks on the Craonne plateau along a 40-kilometer front. Fifty-seven were set ablaze, and 12 were severely damaged. Only 35% of the tanks remained operational, yet infantry losses were lower in divisions equipped with tanks compared to those that were not. It was concluded that tanks should be used en masse on a limited front—creating a multitude of targets for enemy artillery—while the tank guns focused primarily on neutralizing that artillery. Each tank was to be accompanied by infantrymen whom it would protect, and who would assist the tank crews by pointing out enemy targets requiring destruction.

The submarine was invented by Robert Fulton, yet his invention was adopted by neither France nor the UK. Napoleon III supported the construction of a 400-ton, 42-meter-long prototype. By 1914, 50% of French submarines were steam-powered, though they also featured diesel engines. In 1899, a 200-ton submarine was built featuring two engines—one for surface travel and the other for submerged operation—a speed of 12 knots (8 submerged), a range of 100 miles, and two torpedo tubes. Starting in 1900, the USA built 20 submarines. In 1902, the UK built the *Holland* submarine, followed by the construction of C-class (coastal) and E-class (semi-oceanic) submarines.

Germany began submarine production in 1901, though the first *U-9* series was produced in 1910. Subsequently, it built coastal and oceanic submarines with a range of 25,000 nautical miles.

In 1912, the Italian Navy built several 300-ton *Meduza*-class submarines, followed by a 510-ton vessel in 1915. Russia produced its first submarine in 1911. In 1917, German submarines inflicted such massive losses on the Allied merchant fleet that their ability to continue the war was jeopardized.

World War I was thus marked by four characteristics: 1) the use of railways for the mass transport of troops; 2) the use of automobiles and early armored vehicles; 3) the use of submarines and 4) the advent of aviation—and thus the third dimension of warfare. These would continue to develop and rapidly become more sophisticated.

All the aforementioned hypotheses and predictions were brilliantly verified and validated during the Second World War.

While tanks, aircraft, aircraft carriers, and submarines were first tested during the First World War, it was in the Second that they demonstrated the capabilities predicted during and after the Great War. The Second World War was a continuation of the First in almost every respect—military policy, strategy, means of combat, and so on. However, this time, instead of mere tank subunits, armored divisions—massively supported by air power—were employed.

If the First World War was an industrial-style conflict driven by an unprecedented technological revolution, the Second was of the same nature, with that technological revolution continuing to unfold.

World War I, like World War II, was revolutionary in terms of the technology employed and the scale of the theaters of operations. No prior conflict had generated as much innovation in weaponry and its application as the two world wars. By 1918, France possessed 5,200 pieces of heavy artillery and 5,600 75mm guns. During the offensive at Verdun in August 1917, three million shells were fired, while on September 26, 1918, 1.375 million 75mm projectiles were fired—representing 75% of the entire 1914 stockpile. These quantities were vastly exceeded during World War II. While there were no tanks at the beginning of 1914, France had 3,400 by 1918, and tens of thousands were deployed during World War II. This major revolution in weaponry shaped tactics and strategy throughout both world wars, with technical surprises constantly emerging in the theaters of operations. A key difference was the frequency of offensives: there were far more in World War II than in World War I, which saw only two or three offensives in 1918. Although the frontal breakthrough maneuver—achieved by combining the actions of artillery, infantry, aviation, and tanks—was utilized in the First World War, it became a frequent tactic during the Second. Thus, the character of the Second World War was foreshadowed during the First, based on breakthrough operations that made massive use of artillery and the tank-aircraft combination. In both wars, fronts stretched across hundreds or even thousands of kilometers, and the clashes were

terrifyingly ferocious, resulting in millions—indeed, tens of millions—of deaths. Both conflicts involved grand coalition strategies, necessitated by the vast theaters of war. The difference was that, from September 1914 to March 1918, the Western Front remained static, largely because the defense effectively balanced the offense.

After the Battle of Verdun, aviation raised the prospect that future victory would hinge on air superiority. Pétain believed that air power should extend the reach of artillery strikes by continuously targeting objectives deep behind enemy lines—such as troop and logistical columns, reserves, and depots—while also demoralizing enemy forces. This prediction would prove true in the major war that followed. Thus, the new aerial warfare strategy was being prepared.

In conclusion, the hypotheses and predictions formulated during the First World War were validated during the Second World War.



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