The Future of the Tank

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Threatened Species

Many dogs are the death of the hare.

At present, it seems that the means to combat main battle tanks (here simply called "tanks") and their armored escorts are accumulating. In the media, people speculate about the "end of the tank". Indeed, Modern anti-tank warfare offers very impressive capabilities. In the following, a rough sketch and an overview are attempted. In doing so, the combat of tanks by other tanks with sub-caliber kinetic-energy ammunition fired from high-performance cannons is left out. The focus lies on other combat elements that make life difficult for the object of our interest.

Tube artillery was already, with "dumb" ammunition lacking special armor-piercing effect, a considerable threat to tanks – particularly when they got into tactical situations in which they had to operate under dense, indirect fire. Apart from accidental direct hits, even a dense shower of fragments could immobilize the fighting vehicles – with effect, for example, against the running gear or sights. But artillery has experienced a revolutionary change: from combat support to a combat element.

This was brought about by three innovations (Kühr 2004):

- Range increase, at first almost by twice, then by more than three times (base-bleed technology and rocket-assisted propulsion), which, through overlapping radii of effect of batteries deployed apart from one another,

allows considerable concentrations of fire and generally increases control of space.

- The development of armor-piercing, "intelligent" (that is, target-seeking) munitions, whose effect is mostly directed against the top side of the vehicles (top attack), which is difficult to protect and
- Close linkage with one's own reconnaissance means (battlefield radar, drones), as well as networking with other data sources that provide target information, which is processed digitally, almost in real time, and forwarded to the batteries.

Rocket artillery has undergone a similar emancipation process to tube artillery: here, too, an enormous range increase and the use of intelligent munitions (top attack). However, the radius of fire cannot be varied as flexibly as with tube systems, and the available projectile types remain limited. One advantage, however, (there is now a ban under international law), was that salvos of submunitions (bomblets and minelets) could be fired with considerable effect against concentrations of armored vehicles.

Top attack: *Sufficient protection by "passive" layered armor would be too heavy, and reactive armor of acceptable weight would be overwhelmed if the incoming warhead (shaped charge or projectile-forming) had a larger caliber or, for example, a tandem configuration. An active projectile defense, finally, is not only costly and, because of considerable complexity, prone to malfunctions, but can also be saturated by multiple threats.*

Infantry (armored infantry – riflemen – parachute – mountain troops) acts against tanks above all with shoulder-fired weapons (shaped-charge warheads, ballistic trajectory) as well as guided missiles on a direct line of sight: with shaped charges and semi-automatic guidance as well as in fire-and-forget mode by means of thermal-imaging sensor technology. Despite considerable progress in protection technology, such systems, even when they attack heavy tank vehicles horizontally (flanks and rear), still have notable chances of effect. Above all, when modern warhead technology is used, which – as noted – can mean caliber increases and/or tandem solutions. The trend is toward integrating a capability for top attack as well. One example: the U.S. system Javelin (Headquarters Department 2003).

As further means of infantry against armored vehicles, tactical drones have come into focus during the war in Ukraine. Particular efficiency is promised by fiber-optic-guided equipment (in top-attack mode) with ranges around 25 km. This solution is not dependent on artificial intelligence (e.g., automatic image

recognition). The human actor remains part of the control loop, and data transmission, unlike radio waves, is resistant to jamming. Already more than 35 years ago, corresponding systems (however, with more elaborate missile technology) were proposed for broad use after successful practical tests (Unterseher 1989: 52 et seq.), but without substantial resonance.

Combat engineers deal with tanks and their accompanying forces primarily by employing mines. Here, too, there has been a revolution. Mines are no longer triggered solely by the pressure exerted by the tracks or wheels of armored vehicles, but by a wide variety of sensors that respond to seismic, acoustic, or magnetic signatures. In this way, the effect can be directed against the entire underside of the respective vehicle. Sensor-triggered directional mines ("automated *Bazookas*") have also existed for several decades. These aim above all at the flanks of the vehicles to be fought.

Tactical air forces, particularly those for close air support, are also well equipped to combat tanks. Guided weapons with automatic image recognition and top-attack mode play a central role here.

Finally, air and land forces use light to medium machine cannons with kinetic-energy ammunition against tanks: the former primarily against the top of the vehicles, the latter mostly against the flanks and rear.

If, then, the end of the tank is being forecast, that eventuality appears plausible. Yet this – the demise of the tank as an autonomous agent on the battlefield – has been prophesied before, yet lived on.

Are many dogs really the death of the hare?

German-made Leopard Tank flagged to Spain

A Historical Excursus

The Beginnings

When Leonardo da Vinci conceived the archetype of a tank, he lacked a *primo motore*: a power machine that could replace human or animal muscles as propulsion. Only around 1900 did this propulsion take the form of the internal-combustion engine: compact enough to be used in a not-too-clumsy armored vehicle that drove on tracks, which had just appeared, especially on tractors in agriculture (to enable cross-country mobility with low ground pressure).

Quite a number of inventors in different countries arrived at corresponding solutions. Outstanding was the design of a "motor gun" by the Austrian railway officer Gunther Burstyn, which he proposed to his War Ministry in 1911, only to be promptly rejected (Mainig 2009). Features of the vehicle: driver in front, rotating turret with rapid-fire cannon in the middle, and engine in the rear.

New attempts occurred in England and soon thereafter in France. The aim was to bring the war back into motion after it had frozen into trench warfare on the German Western Front in autumn 1914, and to do so through the use of cross-country-capable, protected, and armed vehicles. The first British vehicles, 50 in all, appeared on the Somme in mid-1916. They weighed almost 30 tons, had no rotating turret, and their armament was in casemates protruding from the flanks. A light French model (Renault M 17-18 F.T.), which was mass-produced to

supplement the heavy tanks, then had the configuration of the Burstyn original (Heigl 1935: 281 et seq.).

Renault M FT-17 tank

The German Army could show no more than 20 tanks – for, to bring the war back into motion, it relied on poison gas, flexible artillery fire, and a new, fluid infantry tactic: storm troops (Messenger 1978: 9 et seq.).

France and England used their tanks in growing numbers, integrated into traditional frontal infantry attacks. With this, the German lines could not be pierced deeply, yet the defender paid a high price for his efforts and was pushed back step by step.

Overall, the two Western Allies produced about 5,500 tanks by the end of the war. If the war had continued, large-scale tank attacks, freed from integration into infantry operations, would have had their premiere. The “Plan 1919,” conceived by Colonel J. F. C. Fuller, the spiritus rector of the young British tank force, envisaged the use of about 5,000 tanks: for the breakthrough, the thrust into depth, and the pursuit of scattered enemy troop elements (Heigl 1938: 248 et seq.).

Between the Wars

After 1918, it initially seemed that the idea of an independently operating tank force would be pursued further in England and put into practice. Thus, for example, combat exercises were conducted with mechanized contingents (consisting of tanks, motorized infantry, and artillery on self-propelled mounts) on the Salisbury Plains training area to demonstrate the concept's feasibility (Liddell Hart 1965: 99 et seq., 105 et seq.).

But the representatives of infantry and cavalry were not convinced and defended their claim to scarce armament resources. A central argument was that the tank had already reached the zenith of its career because, after the improvisations of the Great War, an effective anti-tank defense had emerged. What was meant above all were the specialized, light anti-tank guns that were produced in large numbers. Some even spoke of the tank's end. As a result, a compromise emerged: the motorization of the entire force, the integration of light armored vehicles into the cavalry, and the delayed establishment of only one armored division (which was later split into two).

When the Wehrmacht in May 1940 advanced its tanks toward the Channel coast, the 1st Armored Division, which was to be the backbone of the British Expeditionary Force on the continent, was still training in England (Messenger 1978: 191). In France, too, only one tank division was fully operational (commander: Charles de Gaulle). Two others had only just been established. Germany, however, possessed ten. In France, whose army had more tanks than the Wehrmacht, the bulk of these vehicles had been distributed to the infantry divisions for support purposes (ibid. 190).

The German lead, even though the Wehrmacht's infantry divisions still formed the clear majority of its forces, was due above all to General Heinz Guderian, the pioneer of the tank force (Guderian 1992/1937). In meticulous studies he had drawn lessons from the use of tanks in the First World War and – inspired also by the Austrian General Ludwig von Eimannsberger – had arrived at pioneering conclusions: independent use of this new weapon as much as possible in concentrated form, accompaniment by motorized infantry and artillery under armor protection, cover and support from the air, deep operations against the enemy infrastructure – bypassing local resistance.

The Second World War

The German approach was adopted in the Second World War, with variants, by all sides, including the Red Army, which, while leaving its accompanying infantry unprotected at high cost in blood, learned from the opponent in other respects. (In the 1930s, the Soviets had built up a mighty tank fleet, but because of Stalin's Great Purge, it suffered from weakness in conception and leadership.)

During the Second World War, however, operational approaches were also developed that enabled even the most massive armored thrusts to be met with effective defenses. Examples:

In the summer of 1942, the tanks of the German *Afrika Korps* failed at Alam Halfa against the British defense because they got stuck in a deeply echeloned, chessboard-like system of field fortifications with infantry plus artillery and could thus be successfully caught by enemy tank forces in the flank: prerequisite for the defeat at El Alamein (Dorman-Smith 1962).

In the summer of 1943, the heavy forces of the Wehrmacht in the Kursk salient had their backbone broken – the beginning of the end. Their pincer movement got stuck in the forward zone of a more than 100 km-deep area defense, which relied on infantry well equipped with anti-tank means and artillery. In the event of local crises for the defensive array, tank reserves were kept ready to intervene, augmented by the preparatory work of the defensive forces (Schukow 1969: 442 et seq.).

Critics note that, in intercepting the southern thrust of the Wehrmacht offensive, the Red Army's intervention reserve partially failed, and coordination with local forces was insufficient. This, however, was not a system error but due to the inability of the Soviet leadership on site.

The Cold War

Despite the real possibility of coping with "tanking" by means of "asymmetric" structures, tank-heavy structures nevertheless became the essential feature of the land forces in the Cold War: tank as well as armored infantry divisions on one side and tank as well as tank-strong motorized rifle divisions on the other stood facing one another – structurally quite similar.

Colonel (ret.) Bogislaw von Bonin, head of the subdepartment "Operational Planning" in the *Amt Blank,* the nucleus of the Bonn Federal Ministry of Defense, was ostracized and kicked out. Why? His conception for the new West German armed forces was asymmetric: deeply echeloned infantry, tightly measured armored intervention reserves, concentration on defense, and, given the danger of the use of nuclear weapons, no provocation of the other side by the offensive potential of an army shaped by tank forces (Bonin 1989).

Technology was on von Bonin's side. After the Second World War, light weapons with shaped-charge warheads emerged, from improved "Panzerfäuste" – "Bazookas " to anti-tank guided missiles, which gave infantry forces a "bite" that the armor of that time was not able to withstand and which, if used *en masse* in light formations, could have driven tank forces to the brink of obsolescence. Only from the mid-1970s did armor protection begin to catch up (using composite, layered, reactive, active armor).

It is noteworthy that there were conflicts on the periphery that supported von Bonin's assumption – namely that light forces would be able to neutralize the advances of tank-strong mechanized formations. Examples: China's "punitive expedition" against Vietnam at the beginning of 1979, which with its strong mechanized forces got stuck with high losses in the improvised defense of "construction troops" fighting in guerrilla fashion (Jencks 1979); the 1980 invasion of Iran carried by similarly heavy, armored troops of Saddam Hussein, which was stopped by light, mobile forces (Revolutionary Guards of the Mullah regime) (Razoux 2015); the victory of the desert warriors of Chad, equipped with civilian off-road vehicles and anti-tank guided missiles, over the invading armored troops of Libya 1986/87 (Neville 2018).

The Western military, however, remained undeterred. Although it saw itself as the defender, it lacked an alternative to tank-heavy forces. It was customary to compare the numbers of divisions and tanks to bolster the claim of a conventional superiority over the other side. Since the Eastern bloc had more divisions and tanks than the Western bloc, the equalization of combat power by tactical nuclear weapons was easily promoted by NATO nations. This rationalizing formula was used to justify the USA's political dominance in Central and Western Europe. In the 1980s, this justification for employing nuclear weapons to 'balance' against the East was subjected to systematic criticism and falsified by various analysts who took qualitative variables into account (Epstein 1988, Chalmers/Unterseher 1988).

The specter of a tank avalanche from the East lost further credibility when Mikhail Sergeyevich Gorbachev, in 1988, initiated a comprehensive structural reform of the Warsaw Pact's armed forces stationed in Central Europe (Gorbachev 1988). This strengthened defense (more artillery, engineer equipment, and anti-tank weapons) and rendered thousands of tanks superfluous – no longer required for the protection of one's own territory. That was the decisive prerequisite for the success of the 1990 Vienna arms-reduction talks (CFE).

The Time Thereafter

With the end of the bloc confrontation, the era of "interventionism" began. Alliances of states of the First World endeavored, in the alleged chaos of the Third, to create order by military means, for humanitarian, but above all, also geostrategic and economic motives. Tanks were marginalized in this business.

What counted was the operational and strategic mobility of lighter, protected vehicles. The appearance of tank-strong mechanized forces in the war against Iraq (2003) should not deceive: it had, for lack of an opponent to be taken seriously, rather a symbolic character. Now, the time of the great military interventions seems to be over, for these were, all in all, a political disaster.

Once again a renaissance of the old East – West confrontation is developing: with the war in Ukraine at the focal point. There is the impression that tank forces have also, in this context, lost importance. Tanks support the infantry or conduct attack actions at the lower tactical level. Under ubiquitous threat from tactical drones, however, there is little room for maneuver. The dynamics of events are determined rather by light, fluid troops that act in coordination with the fire of precise artillery (DER SPIEGEL 2022: 85 et seq).

Mechanized Warfare: A Casuistry

1. a) Party A has broken through the border security of D with strong mechanized forces and strives rapidly, with tank formations in front, into the depth of D. This party throws against the invader similarly structured armored troops. It comes to an encounter engagement (or an encounter battle). From this, a melee can develop, a dissolution of the formations into duels. Then it depends above all on qualitative variables: the professionalism

of the crews and the capability of their combat platforms. Yet it remains a gamble. During the battle in the Kursk salient, in the southern sector (near Prokhorovka), such a confrontation occurred (Töppel 2017). The German Bundeswehr during the Cold War saw opportunities for success with corresponding tactics against an opponent perceived as numerically superior.

2. b) Party D seeks no collision with the mechanized forces of A. Instead, an attempt is made to slow the opponent's advance or temporarily stop it. For this, forces (armored infantry, combat engineers, and, if available, tank destroyers) are detached from one's own potential and assigned to create echeloned defensive positions. If one succeeds in binding the invader in this way, the bulk of the armored forces is set for an energetic blow into the flank (or the back) of the opponent. The British tank expert Richard Simpkin saw in such an approach, which he called "hammer and anvil", an essential recipe typical of German tank combat in the Second World War (Simpkin 1986).
3. c) Party D opts for an alternative to hammer and anvil that consists of tank forces forming a flexible phalanx: one alternates, in principle holding a line, between covered, camouflaged positions and in doing so uses the advantage of crossing the T in order to strike the attacking forces (A). This pattern can be recognized in the fight of the one-and-a-half Israeli tank brigades that, during the October War of 1973, on the Golan Heights held out for four days against two mechanized divisions (with almost 600 tanks) of the Syrian army, until reserves arrived (Konzelmann 1974).
4. d) The British military theorist Basil Henry Liddell Hart thought nothing of exposing tank forces to the risk of encounter engagements (according to him, these were too precious for that). While in most modern armies the conviction holds that tanks are the best means against tanks, he pleaded for raids striking into the depth of the opponent's area, whereby the path of least resistance should be sought (Liddell Hart 1962: 347 et seq.). The operation "sickle cut" of the Wehrmacht during the campaign in France in May 1940, that is, the thrust to the Channel, corresponded roughly to this approach. The aim of such deep operations should be to take strategically important positions. The defender (D) would then have to attack these, whereby the attacker (A) would have the inherent advantage of the defense. In doing so, he could, for example, apply the methods of b) or c).

Discussion: In the following, it is assumed that Party D partially or fully protects its area using net-like structures (approaches exist in Ukraine). The – protected and camouflaged – nodes of such a net could be formed by precise tube artillery and teams with tactical drones (along with the corresponding reconnaissance means).

Because of the wide range of fire assets, the defensive net can be relatively wide-meshed, helping spare scarce military resources. And since this defensive system may be regarded as a force multiplier for counterattack forces operating within its framework, these can be kept rather modest in total scope and unit size.

a1) In view of area surveillance by precise fire, a rapid advance of strong mechanized forces (A) is hardly realizable. If such a thrust, with losses in combat power, nevertheless succeeded, heavy elements (D) entering an encounter engagement would have clear advantages because of support by the defensive net. However, these, while exposing themselves, would offer the invader's long-range anti-tank assets worthwhile targets.

b1) If it is about repelling a massive attack by means of the hammer-and-anvil method, it likewise holds that the forces used for this (D) enjoy advantages through the defensive control of space. These are, however, to be seen rather on the side of the anvil elements, which – adapted to the terrain – hardly expose themselves, than with the tank-dominated troops that carry out the flanking thrust and thereby are vulnerable to the effect of the longer-range anti-tank means of the attacker (A).

c1) The flexible phalanx of tanks (D), which fights alternately from covered positions (actually, tank destroyers would suffice for their task), likewise benefits from the area-controlling defense – however, only if one has already established oneself on the spot. The allocation is problematic: how do the heavy defensive forces get into their positions without being caught by A's long-range weapons?

d1) Finally, the raid into depth (A), which is supposed to seek the path of least resistance, becomes more and more unrealistic with increasing coverage of the area by defensive fire.

Way Out: Possible Substitution

It is evident that heavy armored forces that go into independent battle in larger formations have, today, in view of new defense technologies, lost effectiveness and survivability. Are we thus at the beginning of an era in which the movement of troops will be replaced – largely – by that of fire? Hardly. Structures and modes of operation can be recognized that will continue to enable dynamic combat actions, both for the attacker and the defender, in counterattack.

Reference was already made to a corresponding development in the war in Ukraine: in principle, it is about tactical cooperation between precise, flexible tube artillery (mechanized, operating from covered positions) and light, fluid infantry.

In the ideal case, this infantry could be constituted as follows: it is highly mobile and operates in loose swarms, rides on motorcycles and quads, and uses light, armored wheeled platforms as supporting weapon carriers (10 - 12 t, 4x4 or 6x6, top surface one third of that of modern tanks). These wheeled vehicles, compared to heavy tanks, offer greater strategic and operational mobility, making them particularly suitable for out-of-area missions. Their tactical agility/compactness may be regarded as a functional equivalent of stronger armor protection.

Even if an attacker can partially bypass the weapons effect of the defender, the latter nevertheless retains typical advantages of defense (as long as he fights on his own territory): better information from the area-covering reconnaissance system, air (drone) defense integrated into the system, network of indirect fire (artillery - tactical drones) and shorter routes for logistical support as well as the backing by possible home-defense structures (*Homeguard*).

The cooperation of powerful artillery and light infantry provokes a reminiscence. The German spring offensive ("Michael"), France 1918, saw storm troops, within a few days, achieve enormous penetration depths into a solid system of trenches and defensive fire, making use of an artillery innovation developed by Colonel Georg Bruchmüller/*Breakmueller (nom de guerre).* He had created the prerequisite for this outcome by structuring flexible concentration of fires. Soon, however, the offensive slackened because the artillery of the time and the reserves were unable to keep pace with the advance (Stedtmann 2001). This may look different under modern conditions.

What did Rabbi Ben Akiba say in the stage play "Uriel Acosta" of the Prussian poet Karl Gutzkow? "*Everything has happened before.*"

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