Farmer's Notes on World War Two tanks
Version 1.1

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What was "the best tank" in World War Two? Was the Tiger "better" than the T34 or M4 Sherman? To understand what made for a "good" tank and what made for a "bad" tank it's necessary to understand the tanks themselves but, more importantly, why they existed at all. It's also helpful to understand the other "tank like" vehicles and why they came about.

An expression attributed to a Confederate General, Nathan Bedford Forrest, is likely not something he said but it describes the tactics he used well: "git thar fustest with the mostest." In modern terms we'd call that "gaining local superiority." General Patton added an expression that is orthogonal to that: "hold them by the nose and kick them in the balls." That is a permutation of a baseball expression common before the war: "hit them where they ain't."

Tank Design circa WW2.

While tank design appears to be not too difficult at first glance it was actually rather difficult. Tanks are a compromise in design and the designers needed to determine what the compromises would result in. While "cannon and armor" may appear to be the biggest concerns what actually was the most difficult part were the power trains and suspensions. Let's look at the issues that the tank designers had to contend with.

Engines.

During World War Two most tank engines were gas engines. The Soviets and the Japanese used mainly diesel engines but most other countries used gas engines (with corner case exceptions like the M4A6). While diesel engines were the better choice in most cases they simply didn't exist. Part of the reason for that is due to the state of the art of diesel engines themselves. To understand this, let's look at the engines and the characteristics of them.

Horsepower and torque. In most of the literature where the power of tank engines is listed it's invariably the horsepower rating and that's really the less useful of the ratings. The engines used in tanks during that war were internal combustion engines all using the conventional "up down" piston design. In a cylinder is a piston. An intake valve opens and the piston travels down – sucking in an air/fuel mix. The valve closes and the piston moves up – compressing the air/fuel mixture. A spark detonates it and the piston is driven down. The exhaust valve opens and the spent fuel is driven out. That is the operation of the four cycle engine and that was the most used. For engines of that type two

things affect the “power” of the engine and that is how fast the operation can take place and how far the piston travels. The piston has a connecting rod which is connected to the crankshaft. The piston rod is a lever and, as physics tells us, the longer the lever the more force which can be exerted. A longer piston rod results in a “longer stroke” for the piston. The longer the stroke the more force experienced. The trade-off which must be made is the longer the stroke the more the force but the slower the engine can “spin.” A longer stroke engine is a lower RPM engine. A higher RPM engine has more “power strokes” per minute than a longer stroke engine, sending more fuel and air through the engine, but each “power stroke” produces less power than a longer stroke engine.

The longer the stroke the more torque.
The shorter the stroke the faster the RPM and thus the more horsepower.

Put another way, torque provides “power” whereas horsepower provides “acceleration.” A bulldozer requires torque whereas a motorcycle requires horsepower. A typical automobile engine, as I write this, can only run to about 6,500 rounds per minute whereas 11,000 rounds per minute is common in motorcycle engines. Diesel generator engines typically run at 1,800 rounds per minute.

With the fewer “cycles” that diesels, normally long stroke engines, provide a way to increase the amount of fuel air mixture was needed and this is why diesel engines are almost always turbocharged. Gas engines can be turbocharged as well but diesel engines benefit from it more.

Without access to turbocharged diesel engines the “clear choice to use a diesel engine” didn’t exist. The T34 offset the lack of a turbocharger via the use of a 12 cylinder diesel engine of 2,367 cubic inches or 38.8 liters. The Ford GAA gas engine used in some M4 Sherman tanks, as a comparison, was 1,100 cubic inches or 18 liters. The gas engine used in the Panther tank, the HL230, had a displacement of about 1,400 cubic inches or 23 liters. The T34’s turret, located further forward on the tank compared to other tanks, was due to the size of the power train. By using a diesel engine of about twice the volume compared to the M4 Sherman engine, the T34 could put the same amount of fuel/air mixture through the engine per minute by using twice the volume inside the engine.

A tank requires torque more than it requires horsepower. To get 50 tons moving from a standing stop requires a huge amount of torque. Faced with the lack of suitable engines, the Soviets used a huge non-turbocharged diesel whereas the Germans and Americans used more compact gas engines. Neither choice was the “best” one but turbo-charged diesel engines weren’t available.

Neither gas nor diesel engines provide torque from a standing stop. This, more than anything, was the main problem in producing large tanks. Ferdinand Porsche experimented with electric engines being provided power by a generator driven by a normal engine, this is the type of power-train used in World War Two American submarines and many railroad engines, as electric engines provide 100% of their torque from a standing stop. Porsche never found a way to overcome the additional weight the electric engines resulted in. “There was no such thing as a good World War Two tank engine.” That is entirely correct.

As a real practical example, as a kid we had a John Deere “A” tractor. Today I own a Cub Cadet garden tractor. The John Deere was rated at 18hp whereas my garden tractor is rated at 19hp. If both are hooked to identical plows in the soil the John Deere will move out certainly, if slowly, but the Cub Cadet won’t move at all. A look at a “horsepower and torque curve graph” for both will show why. The Caterpillar D9 bulldozer is rated at 570 horsepower. The Ford Mustang Shelby GT350 is rated at 526 horsepower. Whereas the Shelby has 429 foot pounds of torque, the D9 has 1,900. Tanks, like

bulldozers, want torque. Often a “horsepower per ton” rating is seen for tanks. That entirely misses the point as it’s “torque per ton” and not “horsepower per ton” that matters. Let’s look at the different models of the M4 Sherman to see the effect:

M4, Continental R975, 353HP, 800lbs Torque.
M4A1, Continental R975, 353HP, 800lbs Torque.
M4A2, G.M. 6-71, 375HP, 1,000lbs Torque.
M4A3, Ford GAA, 450HP, 950lbs Torque.
M4A4, Chrysler A57, 370HP, 1,024lbs Torque.
M4A6, Caterpillar RD-1820, 450HP, 1,470lbs Torque.

Whereas the Ford GAA has more horsepower than the GM and Chrysler engines, both of them have more torque. The M4A6, with the Caterpillar four stroke diesel, exceeds the torque of the rest significantly. The GM engine, a two stroke diesel, isn’t optimized for torque. For the German tanks the following is provided – note that for the Tiger I’ve taken the numbers for the later engine as the earlier engine had less power but I chose to include the figures for the more powerful engine in order to not make the later Tigers appear with the earlier data.

Mark IV, Mayback HL120, 300HP, ?
Mark V, Maybach HL230, 690HP, 1364lbs Torque
Mark VI, Maybach HL230, 690HP, 1364lbs Torque
Mark VI Auf B, Maybach HL230, 690HP, 1364lbs Torque

Power for the tanks, in both HP/ton and, more importantly, Torque/ton is as follows:

M4, 10, 22.8
M4A2, 10.7, 28.5
M4A3, 12.8, 27.1
M4A4, 10.6, 29.3
M4A6, 12.8, 42
M26, 11, 23.1
Mark V, 15.3, 30.3
Mark VI, 11.5, 22.7
Mark VI-B, 9, 17.7

Above is Tank, HP/ton, Torque/ton. The M4A3, with the Ford GAA engine, has the same “horsepower per ton” of the M4A6 but the M4A6 greatly exceeds the M4A3 in “torque per ton.” The M26, with the Ford GAF engine, had significantly less torque/ton than any M4 other than the M4 or M4A1. The Panther is on par with the M4 Shermans in torque with more horsepower. The Tiger with the bigger engine has marginally less torque than the M26 which was considered severely under-powered whereas the Tiger II would be lucky to move out of its’ own way. I couldn’t find the torque figures for the Mark IV but that tank was never considered under-powered and I didn’t include the T34 figures but, with the diesel it had, it was likely greatly superior than all of the tanks above in power.

Next up is fuel consumption. As a rule, a turbo-diesel used in 1950s tanks provided twice the range over a gas engine on the same amount of fuel. A non-turbo charged diesel would likely provide 150 miles of range to a gas engine’s 100. The M26, seriously under-powered, wasn’t as under-powered as the Tiger but the Tiger, with a 23 liter engine, burned more fuel than the M26 with its’ 18 liter engine. The M4A4, with the Chrysler A57 engine, had a displacement of 20 liters and that engine provided as

much torque as the Panther's HL230 at 23 liters. The Panther was thus more powerful, comparing torque/weight, than the M4 but not the M4A4 whereas the M4A6, with its' diesel, was much more powerful than the German tanks regards power/weight.

Tank power plants need to be as compact as possible as the engine will be surrounded by armor. The bigger the engine the more armored needed to surround it, and thus the more weight, and thus yet more engine power is necessary – a vicious cycle. The Soviet solution was to move the turret forward on the T34 and that solved the "engine surround by armor" issue but resulted in a very small and cramped fighting compartment. A small and cramped fighting compartment results in faster crew fatigue. Does that mean the American and German decisions to use gas, and thus tanks with larger crew compartments, was the better one? No. It's a trade-off with both solutions being problematic.

Gas is subject to fires at a level diesel isn't. "The M4 Sherman was known as the Ronson!" That was a term originally applied by the British during their initial use of the Sherman in North Africa. The British using that term points to a pathetic attempt to denigrate the American equipment to cover their own failing, a review of the British tanks of that era is depressing, with the British troops claiming that having a poor understanding of chemistry – and thus weren't tank crewmen.

"Gas," as we use that term, is in a liquid form. As a child, when I learned the chemical characteristics of "gas," I put some in a "Dixie cup" and dropped lit stick matches in there. While I don't encourage you to do some of the things I did when I was young I will mention they always went out. Why? Because gas in a liquid form does not burn. To burn gasoline needs to be turned into a vapor with the mixture being about 12 parts air to 1 part gasoline. A carburetor on an engine, or fuel injection, is what creates that "optimum mix" for the fuel/air mixture. Too much fuel and it won't burn right and too little fuel and it won't burn right. Gasoline, in its' liquid form, needs to be "emulsified" before it burns. If you light the vapor over a puddle of gasoline it'll then emulsify the liquid gasoline but only at the top – like a candle burning. It takes a while for liquid gasoline to completely burn and it wasn't uncommon for tanks hit in the fuel tanks to burn for over a day. "The M4 Sherman was a Ronson!" Gasoline burns at such a slow rate, when ignited in that form, that the crew would have time to exit the tank, go acquire marshmallows, and return to enjoy the fire. We'll get to the real cause a bit further on. "The M4 Sherman was a Ronson!" Anyone serving in the tanks themselves would have experience with knocked out tanks and know why that's a strange claim. In fact you don't need to have served in tanks at the time as a basic understanding of the properties of gasoline is pretty clear. "Gasoline only burns when emulsified and that only happens at a certain rate."

Packing an engine inside armor is going to lead to a challenging cooling solution. The Panther, as an example, suffered from overheated engines. Running engines at high temperatures typically resulted in leaking seals and gaskets as those were burned out and the Panther suffered from this throughout its' life.

Other drive train components

The power from the engine must be applied to the drive sprockets. This requires a transmission and final drive. The more power the engine creates the stronger the transmission and final drive must be. The Soviet KV tanks suffered greatly from a transmission not up to the task and those had power-train failures with predictable regularity. The Panther, on the other hand, suffered from a high rate of final drive failures. The final drive, in the Panther, was located at the front of the tank and fixing it required the tanks' turret to be removed so the drive could be extracted through the turret ring. Early American

M3 tanks, also prone to final drive problems, had three piece front armor which provided easier service access but that compromised the armor.

No World War Two tank had a “good” power train. What was needed was a diesel engine, turbo-charged, with the transmission being compact and behind the engine driving a final drive at the rear. The closest to that was the T34 so, overall, that had the “closest” to the optimum power-train solution. It came at the expense of an extremely cramped tank. As tank weight increases the power train problems increase as well with the result being “the bigger the tank the more it’s broken.” Serviceability rate of large German tanks in 1944 was under 50%. The American M26, with the Ford GAA mentioned above, had an engine half the size of the T34 and was severely under-powered.

Suspensions.

The heavier the tank the harder it is to get it suspended. Turning a lot of weight on the suspension typically will throw the track. The faster the tank is moving, and the heavier it is, the more likely the track is going to be tossed. A tank missing a track is a tank not going anywhere. Early British tanks were probably the worst in this regard as they rarely kept their tracks on for any distance. The T34 had a good track design, the one used on the Sherman wasn’t nearly that good, and the one used on the Panther was about the best.

Armor.

Armor can be rolled, resulting in good armor which is then welded to form the tank parts, or cast. Cast armor is cast and then normally “face hardened.” Rolled armor, being more dense all the way through, is stronger for a given thickness. On cast armor that’s often offset by making it thicker but that increases weight. Conversely, cast armor can be cast into shapes, instead of nothing but straight angles rolled plate requires, with weight and metal “saved” by not requiring the angles – a circle contains less area than a box and has a much smaller perimeter. Both were used.

Armor was mainly “flat” early in the war with everyone eventually understanding that “sloped is better” as the war progressed. Sloped armor will more easily cause ricochets but that’s not the main advantage as the main advantage is the “deeper” aspect of sloped armor. If one takes a vertical piece of armor, say 4 inches thick, and “tilts” it, and then measures the “width” of a straight line drawn horizontally through it, it’ll be more than 4 inches. This assumes that projectiles hitting it are high-velocity, which cannon shooting at tanks often is, as a projectile coming down to the tank will be hitting flat armor.

Tanks cannot have the same amount of armor everywhere. Effectively a World War Two tank can be divided into seven “zones:” hull front, hull sides, hull rear, hull bottom, turret front, turret sides and rear, tank top. Armor was thinnest on the top and bottom. This made tanks vulnerable to mines (bottom) and aircraft (top). The hull front was normally the thickest with the turret front being second. Sides came after that and rear after the sides. In testing the M10 “tank destroyer” had zero chance to penetrating the Tiger II front hull armor but could penetrate any part of the side out to about 800 meters. An American light tank in the Ardennes found itself behind a Tiger and was able to destroy it by hitting it from behind with its’ 37mm cannon (Triplet’s “A Colonel in the Armored Divisions). Similarly the turret front could more easily be penetrated than the hull front due to the gun mantlet.

Any openings in the armor weaken it and, as the war progressed, “ball mounted” machine gun mounts in the hull were found to be a problem as were vision ports.

Visibility.

Views out of the tank are provided via vision slits or via periscopes. Neither provides a very good view. What’s commonly observed, due to the limited vision, is tank commanders sitting with their heads out of the hatches. During one of the Israeli wars, tank vision hadn’t improved, the number of tank commanders lost as they insisted on keeping their heads out of the turret was extreme. I mention this solely as it indicates that tanks, as often as not, had the turret hatches open. If enemy infantry are nearby you’re likely to get grenades tossed in.

Tank tops have thin armor. Enemy infantry have artillery. Normally “high trajectory” artillery. Infantry with artillery already setup and ranged in are going to be a problem for tanks. Even if they don’t manage to hit the top the incoming artillery is a very high danger to suspension systems and tanks, when artillery started arriving, typically made a hasty retreat.

Cannon

In reviewing cannon used to arm tanks again a trade-off is encountered. To understand the cannon it’s necessary to understand some ballistics. If one was to take three barrels of the same caliber and fire a round of the same size and weight, but at different velocities, with all three barrels perfectly horizontal, the rounds, due to gravity, drop at the same rate. The highest velocity one will travel the furthest whereas the one traveling the slowest will go the least distance but all three will hit the ground at the same time due to the constant of gravity. If, instead, I wanted to hit a target at the same range I’d have to point the barrels at different angles as the highest velocity one will get there fastest with the slowest needing to be pointed higher as it’ll arc higher. The higher the velocity the flatter the trajectory and this matters when shooting at distant targets as the “hold over” is much reduced. German tanks, after Kursk, were in defensive use and their desired solution to the “too many T34s which are a threat only up close” was to take them out as far away as possible.

A round fired out of a cannon at a lower velocity doesn’t require as thick of a shell as one fired from a higher velocity shell as the stress on the shell is less. The two common shells fired, high explosive and high velocity, match the thickness required for the stresses involved – for a high explosive shell one wants a thinner shell to hold more “bursting charge” powder whereas a high velocity shell, needed to penetrate armor, will require a very thick shell and little bursting charge.

A high-velocity shell is typically used for armor piercing. It has a thick walled shell to resist the stresses of the higher velocity firing. A high explosive shell is a thin walled shell holding as much bursting charge powder as possible.

Let’s review three cannon of the same bore. The German Mark IV tank originally had a 75mm cannon which was 24 calibers long. The bore caliber (75mm) times the length caliber (24) is the length of the cannon barrel - 1,800 millimeters in this case or 1.8 meters long or just under 6 feet long. The 75mm which replaced the 75mm L/24 was the 75mm L/43 but that was quickly replaced by the 75mm L/48. The 75mm L/48 has a barrel 3,600 millimeters long or 3.6 meters. 11.8 feet. The 75mm L/70 on the Mark V Panther was 5,250 millimeters, 5.2 meters, or 17.2 feet long. A cannon includes a breech-block and a barrel and I suppose it’d be possible to screw the L/70 barrel onto the breech-block from the early Mark IV cannon but one wouldn’t get greatly increased velocity as the powder charge in the cartridge case wouldn’t be enough. While the three cannon are all 75mm in bore, and thus the cartridge

cases were about the same diameter, the shells fired from the L/70 cannon needed a lot more powder and thus one would expect to see a much longer cartridge case containing a lot more powder. To contain the longer case, containing that extra powder, the breech-block used for the L/70 cannon would need to be longer and heavier to withstand the increased chamber pressure. As turrets used to mount the cannon need to hold the breech-block and still have enough room to load a new round there are limits to the size of the rounds easily carried. On battleships the shell is inserted and then bags of powder are loaded behind that – this is known as "separate loaded" ammunition. When the Soviets mounted the 122mm cannon in the IS-2 tank it was obvious that any single-piece round would simply be too big and thus "separate loaded" two piece shells were used. The so called "Super Pershing" also had a cannon, 90mm in this case, which required separate loading ammunition. Obviously separate loading ammunition is slower to load and the rounds per minute a cannon can fire is reduced.

Returning to that early Mark IV 75mm L/24 gun and contrasting it to the Mark V's 75mm L/70 gun we see two extremes in cannon. The L/24, a low velocity cannon, would permit the use of a very think walled shell and thus a very good high-explosive capability. What it wouldn't provide for is the velocity needed for a conventional armor-piercing round. The Panther's L/70 cannon, at the other extreme, would provide for a very good armor-piercing round but at the cost of any type of useful high-explosive round. The Mark IV's L/48 would provide for a high-explosive shell, albeit not as good as the early L/24 cannon, and would also provide for an armor-piercing shell but one not as good as the Panther's L/70. Given all of this I tend to use the terms low velocity, intermediate velocity, and high velocity. Low velocity tends to be high-explosive only whereas high velocity tends to be armor-piercing only.

Understanding the "low versus high" velocity angle, that must be intersected with the caliber vector. In other words, a 90mm intermediate velocity cannon is likely to have a more effective high-explosive shell than a 37mm low velocity cannon just based on size. The other place that this can be seen is in the Tiger's 88mm L/56 cannon when compared to the Panther's 75mm L/70. The 88mm L/56, at 4,928 millimeters or 16 feet long, is roughly similar in length to the Panther's longer 75mm cannon. The difference is the 88mm L/56 would have a useful high-explosive round, being closer to intermediate length than the L/70 on the Panther, whereas the Panther's cannon is really too high of a velocity to fire high explosive shells. The Tiger II, with the 88mm L/71, fired a armor-piercing round from a barrel 6,248 millimeters or 20 feet long.

Last point on cannon. During the war the concept of "over-match" wasn't understood. What over-match means is a round with a larger caliber than the armor thickness gets an additional multiplier. Effectively, if a 120mm shell hits an 80mm thick armor plate it has an "over-match" and is thus more effective at penetrating than would be expected. Strangely countering this was inadvertent lamination. The German Mark III tank had 30mm of armor with another 30mm armor plate added later on and, in some cases, that proved more effective than a solid 60mm armor plate would have due to the lamination.

Let's get back to those cartridge cases. The cartridge case for the 75mm L/24 would have been much shorter than the case for the 75mm L/70 cannon. As crews desired to carry as many main gun rounds as possible the inside of the tank was stuffed with them. Whereas gas needs to be emulsified to burn gunpowder doesn't. The powder in the case for the L/70 rounds, as an example, would have been a lot of powder and it needed to burn very quickly inside the combustion chamber of the cannon. When a tank was hit, assuming the shell penetrated the armor, it had a tendency to rip those cases apart and then ignite them. The Panther, as an example, stored a lot of rounds in the sponsons of the armor. If the Panther was hit there the shells would be ripped open and ignited. The powder burned inside the tank would immediately incinerate the crew and, if enough of them burned at the same time, the pressure inside the hull would build up so rapidly that a catastrophic explosion would occur. Most

often this resulted in the turret of the tank being blown off. An Internet search for “destroyed tank” will result in picture after picture of tanks missing their turrets. In the cases of “assault guns” without turrets the “armor box” that is the vehicle will show the results of the rapid internal pressure increase with the armor all being blown out. Early M4 Shermans suffered, as many tanks did, from poor ammunition storage. A tank which burns rapidly when hit is a tank with main gun ammunition ignited – not gasoline. “The M4 when hit burned from the gasoline and was called the Ronson.” Not somebody familiar with tanks. Gasoline must be emulsified and burns slowly. Powder doesn’t need any such chemical change and is designed to burn as fast as possible. The ammunition storage in the M4 was revised and “water storage” was introduced – the main gun rounds were stored in chests containing water. If hit the powder was soaked. The revised ammunition storage resulted in the M4 Sherman not suffering from ammunition burning when hit as much as other tanks and that can be seen by reviewing pictures of M4 Shermans destroyed – they’re rarely absent the turret. As an exercise search the Internet for tanks using “destroyed X” where X is the tank. From a review of the pictures the Tiger had much worse ammunition storage than the Panther. T34s also had pretty poor ammunition storage. The post-war Soviet T-72 seems to hold the record for “worst ammunition storage.” The M4 Sherman was, a review of tank damage will make it clear, a very survivable tank when hit.

Tactics

With the pieces of tank design in place it’s time to review what they’re needed for. If somebody was to design a hammer presumably the first question that would need to be answered would be: “what’s the intended use?” If the need isn’t understood it’s likely roofers are going to be handed a sledgehammer or somebody wanting to drive a big metal stake in the ground will be handed a 16oz claw hammer. Strangely, from what I can tell, the bulk of the Generals and even entire armies really didn’t understand the needs and the tanks reflect that poor understanding.

The “accepted” ratio for a successful attack is 3:1. While it’s possible to succeed with less, and fail with more, 3:1 was the generally accepted ratio needed for local superiority to succeed in an attack. Let’s review that from a World War One perspective as the German tactics, and their use of tanks, was based on their experiences in WW1.

```
Y     Y     Y     Y     Y     Y     Y     Y     Y     Y     Y
=====================================================
X     X     X     X     X     X     X     X     X     X     X
```

In this example neither Y nor X has any local superiority.

```
Y     Y     Y     Y     Y     Y     Y     Y     Y     Y     Y
=====================================================
X       X       X       X       XXX       X       X       X       X
```

Using the same number of units, but concentrating them at the center, X has achieved the local superiority to succeed in an attack.

```
Y      Y      Y      Y      Y      X      Y      Y      Y      Y      Y
=========================================================
X       X       X       X       X       X       X       X       X
```

It's easier to defend than attack. Let's say that a unit has a "strength" of 20 in defense but only 10 in attack as they're not in a trench. The X attack, with three units, succeeded and wiped out the Y unit but lost two X units in the attack. Three X units in attack, 10+10+10=30 against one Y, 20, had an advantage of 10 but 20 was lost on both sides and that's two X units in the attack, 10+10=20, versus the one Y at 20. After the successful attack the Y units would pull back and the X units advance with a new line being established not terribly far behind the initial one.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=========================================================
X       X       X       X       X       X       X       X       X
```

X, having lost two units, had destroyed one Y unit but gained a bit of ground. This is a "war of attrition." A war of attrition counts on getting your own troops killed but with the understanding that you can afford it more than the enemy. Put another way, both sides are going to bleed profusely but you're counting on the enemy bleeding to death before you do. The war of attrition tactical method is that used by butchers and the bulk of the Generals in WW1 were little more than butchers.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=========================================================
X       X       X       X       X       X       X       X       X       X       X
```

Back to the original line with equal units on both sides. What was observed during WW1 was one side, wishing to have an offensive, would build up forces.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=========================================================
X       X       X       X       X X      X       X       X       X       X       X
                        X
```

The other side would notice that as they moved so slowly and they'd add units to the threatened sector.

```
                        Y
Y      Y      Y      Y      Y Y      Y      Y      Y      Y      Y      Y
=========================================================
X       X       X       X       X X      X       X       X       X       X       X
                        X
```

More units was be added by X for the offensive and Y would counter.

```
                        YYY
                       Y  YYY
Y      Y      Y      Y  YYY Y Y     Y      Y      Y      Y      Y      Y
=============================================================
X      X      X      X XXXX X     X      X      X      X      X      X
                       XXXXX
                       XXXXX
```

X would launch the massive offensive, after a equally massive artillery barrage lasting for days, but the attack would run into a solid wall of Y troops – they having held back and then rushed forward after the barrage. Much slaughter on both sides would occur but X, running into that dense pack of Y units, would suffer much more. Butchery taken to a new level.

Montgomery, after repeated failed attacks in Normandy, insisted on a "Broad Front" tactical method and General Eisenhower, no more gifted in the field of tactics than Montgomery, agreed. The "Broad Front" was also heavily used by the Soviets. In the Broad Front tactical method one counts on having massive superiority of forces overall.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=============================================================
X   X  X  X   X  X  X  X  X  X  X  X  X  X  X  X  X  X  X  X
```

As much superiority as X has, it's still not 3:1 so more is added.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=============================================================
X  X X  X X  X X X X XX X X  XX  XX XX XX XX X X XX X X X X X XX
```

X now has the units to attack. The attack is launched all across the front. All of the Y units are pretty much wiped out and Y needs to build a new line further back. Much further back as they're going to have to round up new units. X will suffer as well but they have the numbers. Now it can be said, rightly, that Montgomery insisted that his Army Group get the bulk of the concentration but that isn't really terribly different as that simply means that the line is overpowering if a bit lopsided. The Soviets did the same thing.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=============================================================
X X  X X X XX  X X X X   X   X   X   X   X  X   X  X   X   X   X  X   X
```

"Broad Front with 1/3 having the focus." The three Army Groups in France, from North to South, were the 21st (Montgomery), 12th (Bradley), and 6th (Devers). The 21st had the British 2th Army and the 1st Canadian Army. Montgomery was also given the U.S. 9th Army to make a complete Army Group. The 12th Army Group (Bradley) contained the 1st (Hodges) and 3rd (Patton) Armies. The 6th Army Group (Devers) had the 7th (Patch) and the 1st (De Tassigny) French Army. The 11th U.S. Army was Airborne while the 13th was reducing the pockets of Germans along the coast. The U.S. 15th Army, arriving late, was to be assigned to the 12th Army Group resulting in the 12th AG having three armies and the 13th, after having removed the German pockets, likely would have gone to the 6th A.G.. Montgomery, insisting on receiving "the bulk of the force" was given the 9th U.S. Army and thus he had three armies while the 12th A.G. had two.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=================================================================
X X  X X X XX  X X X X   X   X   X   X   X  X   X  X   X   X  X  X
Monty                                Bradley                    Devers
```

The problem was the bulk of the armored divisions the U.S. fielded weren't with the 9th as they were in Bradley's A.G. with Devers seriously shorted. In addition to Devers being shorted armor Patton generally gave Bradley an ear full until he could get "a more equal share" of the 12th Army Group units in order to fight the Blitzkrieg style of warfare. This resulted in the U.S. 1st Army holding a longer line.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=================================================================
X X  X X X XX  X X X X     X      X    X XXX  X  X   X   X   X  X  X
                          (1A–12AG)  (3A-12AG)  (7A-6AG)    (F1-6AG)
Monty                                Bradley                    Devers
```

The German Ardennes Offensive was aimed at the U.S. 1st Army as that was the weakest part of the line, Patton was about to launch an offensive, and the three armies of Montgomery's Army Group could be surrounded as Montgomery was known to move at a snail's pace. The offensive was stopped for two reasons – one due to German forces and the other as Devers shifted over and that permitted Patton to also shift over and attack into the Germans. The Germans then hit Devers with another offensive, Nordwind, but the 6th Army Group held firm. Eisenhower, in a panic, told Devers to retreat in certain areas to shorten his line and one area of retreated would have resulted in the evacuation of Strasbourg. De Gaulle refused for Devers and Devers supported De Gaulle. De Gaulle's was adament that French forces had taken Strasbourg and were not going to just hand it back to the Germans. Devers was comfortable the Germans wouldn't be making any progress and he proved right. The "bad blood" between Eisenhower and De Gaulle dates to this incident, as much as any, and General Jacob Devers had committed career suicide.

Back to World War One.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=================================================================
X      X      X      X      X      X      X      X      X      X      X
```

The initial line.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=================================================================
X       X       X       X       XXX       X       X       X       X
```

The desired local superiority for an attack.

```
Y      Y      Y      Y      Y      Y      Y      Y      Y      Y      Y
=========================================================
X       X       X       X       XXX      X       X       X       X
                              XX
```

What the Germans figured out were that the traditional huge build-up and massive offensive didn't work. They adopted "storm troop" tactics. Unlike the typical attack where, once it succeeded, all the enemy units drop back, and the friendly units move forward a bit, it's better to "just keep going."

```
                              X
                              X
Y      Y      Y      Y      Y      X      Y      Y      Y      Y      Y
=========================================================
X       X       X       X       X       X       X       X       X
```

With the hole ripped into the enemy lines the units making it through should not stop and wait for everyone else to move. Instead the units should stream through that hole.

```
                              X
                              X
                              X
                              X
Y      Y      Y      Y      Y      X      Y      Y      Y      Y      Y
=========================================================
    X          X       X       X       X      X          X
```

The X unit advance can "turn" and the situation for Y becomes even more dire.

```
  X       X       X      X     X

                              X

Y      Y      Y      Y      Y      X      Y      Y      Y      Y      Y
=========================================================
    X          X       X       X       X      X          X
```

The Y units, on the left, are going to be surrounded. Y can counter-attack but, if you review the diagram, they don't have 3:1 anywhere and don't have a likelihood of achieving success. The following considerations for this should be noted:

1) Generals tend to panic about flank attacks. If one goes back to that diagram with the 5 vertical X stream the fear those generals had was a flank attack into that line would cut-off units further on. What this fails to understand is Y needs the 3:1 advantage in that attack and they don't have it – even if they hit the flank from both sides. The Y units on the line near there, in defense, have a "strength" value of 20. Once they go onto the attack they have a value of 10 as they're attacking and the attacked X units have a value of 20 as they're defending.

2) The X units on the old line must engage the enemy Y units to stop them from pulling out and moving back quickly. That is Patton's "hold them by the nose and kick them in the balls." In "holding

them by the nose" the Y units need to be kept engaged so they cannot move quickly. The X units on the line, now weaker than the Y, don't need to attack hard enough to "break through" as they don't have the superiority for that. They simply need to keep Y units engaged as the longer they keep them engaged the slower they can retreat and the more likely they are to be surrounded.

A "war of attrition" is designed to bleed the enemy white while you're bleeding profusely yourself with the understanding that they'll bleed out first. A "war of maneuver" is designed to capture enemy forces. If, in attack, you're typically going to lose 2 men for every 1 of the enemy you're going to lose a lot of men. Even at 1:1 it's too many. A war of maneuver results in massive pockets and thus massive surrenders. If 300,000 enemy troops are captured that's 300,000 friendly forces not killed or wounded.

In the German Spring of 1918 offensive they unleashed the new "storm troops" tactics on the British. The basis of the new tactics were a very short and sharp artillery barrage after building up a minimum of forces – not the ponderous build-up of previous offensives. The storm troops were then to rip a gap in the British lines and, the most important part, not stop. "Keep going!" More German units would be fed through that gap and the Allies weren't to be given the time to simply build a new line a tad further back. What happened is the German troops broke through and "kept going" until they encountered British supply dumps. They then basically sat down and had a party on the captured food and drink. The advantage was lost.

In American Lore the American divisions had arrived in France "just in time" and stopped the Germans. The reality is that four American divisions had made it to France by the Spring of 1918 and the rest were still sitting in the U.S.. The 1st and 2nd had arrived in 1917. The 26th and 42nd arrived in January and February of 1918. The bulk of the rest of the American divisions arrived in June and July. The estimated number of German divisions released after the Russians threw in the towel late in 1917 was 50. 4 American divisions are not going to stop 50 German divisions. The German offensive failed due to the German soldiers having lost their offensive spirit. The German General Staff knew they had the numbers and the tactics to succeed but the troops themselves had, after years of static warfare, lost the offensive spirit required; the Germans were simply out of gas.

After the war a significant book was written. The book was Erwin Rommel's "Infantry Attacks." Note that the title contains "Infantry?" That book needs to be combined with Guderian's "Panzer Leader." Both are necessary to understand the German understanding of tactics after World War One. What the German's understood and what the British understood were two different things and this was demonstrated again and again in WW2. The British, post-war and even today, seem to think they "taught the Germans how to use tanks" via J.F.C. Fuller and such. That view would be more supportable if the British understanding wasn't entirely wrong. That still isn't clearly understood.

"Combined Arms." The idea behind "combined arms" is the various branches work together and form a mutually supporting force. This is required as tanks, if attacked by infantry, are easy targets. While that may shock some it happens to be true. Tanks have very bad vision and infantry can destroy them if no friendly infantry are there to support them. If one needs an example, the German book "Infantry Aces" covers Rudi Brasche on pages 56-58 and he details a German infantry unit "pinning" a line of British tanks in Normandy. They destroyed the first in line and then the last. They then walked the line taking out the rest. A tank must support the infantry and the infantry must support the tanks. By working together they're more effective. If one can get artillery to work with them, along with anti-tank units, then they're even more effective. The British Operation Battleaxe provided a very good

example. The German tanks attacked, without much force, into the British forces and then retreated – drawing the British tanks into their anti-tank cannon screen of 88mm guns. 64 Matilda tanks, with very heavy armor, were destroyed in that offensive. The oft repeated legend is one of the British tank commanders claimed it was “unfair” to use Flak guns against tanks.

“Combined Arms” and Blitzkrieg are two different things. That’s the part that most Generals of WW2 didn’t understand. To understand Blitzkrieg, and the German use of tanks in it, one needs to understand three things and a failure to understand those three was seen repeatedly. First, “combined arms.”

Combined Arms means that all the branches are integrated. Tanks support infantry and artillery. Infantry support the tanks and artillery. Artillery supports the tanks and infantry. With this understanding divisions were formed in most armies with each division have a dollop of the tanks. With the limited number of tanks “handed out equally” they weren’t concentrated. Guderian was clear that the tanks needed to be concentrated and that meant not all units had them.

Types of divisions. Divisions during that war were Armored, Mechanized, Motorized, or simple “foot infantry” divisions. In armored divisions all units, if possible, received armored vehicles with there being a lot of tanks. A mechanized division is very similar to the armored division, in having armored vehicles, but has fewer tanks. A motorized division is a division where everyone has motorized transport but it’s not armored. In other words, in an armored or mechanized division the infantry has armored half-tracks but in a motorized division they’re transported in trucks. The “foot division” has soldiers without transport – the artillery could in fact be horse-drawn. Taking the Panzer Division, the following were observed early in the war:

Main tank. This was the Mark IV with the 75mm L/24. This tank, not really having anti-tank capability, was used to cause general mayhem. If one watches the “train depot” scene in the movie Kelly’s Heroes this type of use is witnessed. Behind enemy lines are supply dumps, trains, unarmored vehicles, cannon, etc., The high-explosive shell the Mark IV had was for general destruction.

Anti-tank. The anti-tank role was fulfilled by the Mark III tank with the high-velocity 37mm cannon. That was upgraded to a high-velocity 50mm later on. If strong enemy tank formations were encountered they were drawn back onto the 88mm Flak guns while being hit with Stuka bombers.

Anti-aircraft. The 88mm Flak guns were towed as it wasn’t possible to mount them on vehicles at that time but the gun was “dual purpose” in that it was intended to have anti-aircraft and anti-tank ability. The Germans didn’t “use the Flak gun against tanks out of need” as they were intended for this role and thus the dual-purpose design.

Light artillery. Howitzers were mounted on obsolete and captured tank chassis.

Heavy artillery. It wasn’t possible to mount heavy artillery on chassis early on so this role was filled by Stuka dive bombers.

Infantry. Mounted in half-tracks.

All units were motorized where possible in armored vehicles. A mechanized division was about the same thing but typically the armored division had its’ main forces in a “2:1” mix whereas in a

mechanized division that was reversed. Think “2 regiments of tanks and 1 regiment of infantry” for armored and “2 regiments of infantry and 1 regiment of tanks” for mechanized.

Combined arms. That’s the first step. Concentrate the tanks in a division. That’s the second step. It’s the third step which wasn’t understood by most.

```
  Y       Y       Y       Y     Y      PYP      Y       Y       Y       Y       Y
==========================================================
X         X         X         X         AXAAXA       X         X         X         X
```

Normandy and Montgomery’s attacks. He did this repeatedly. He attacked with armored divisions. Perhaps this was his understanding of Blitzkrieg as he did it repeatedly. “Combined Arms?” Check. “Tanks concentrated?” Check.

Let’s take historian Stephen Biddle’s take on that attack:

“The British systematically failed to coordinate movement and suppression fires after about mid-morning of the opening day.... The attack had by then moved beyond the reach of the British batteries on the northern side of the Orne River and the congestion in the march columns had kept the artillery from moving forward into supporting range.... The net result was thus an exposed, massed, nearly pure-tank assault pressing forward rapidly without supporting infantry or supporting suppression fires.”

The “nearly pure-tank attack” is a sign of the British lack of understanding.

This gets to the characteristics of an infantry division. We gave an infantry division in defense a “strength rating” of 20. They’re in holes, they have their anti-tank guns setup and camouflaged, they have their light and heavy artillery setup and ranged in. In attack they get a strength rating of 10 as they still have artillery setup and ranged in but the troops are out of the holes and moving. The anti-tank guns likewise need to be moved. Let’s say that the enemy has broken through another unit further along the line. The order to retreat is given. The soldiers either march or board trucks. The cannon are hooked to tow vehicles or horses. The entire division turns into columns in no shape to fight as they’re in movement mode. An armored division is equipped to fight on the move. A mechanized division is equipped to fight on the move. An infantry division, motorized or on foot, isn’t equipped to fight on the move. 20 in defense, 10 in attack, perhaps 1 when moving.

```
Y       Y       Y       Y       Y       Y       Y       Y       Y       Y       Y
==================================================
X         X         X         X         XXX       X         X         X         X
                                      PPPP
```

This is what Montgomery missed – the German form. The gap isn’t torn open by armored division, it’s torn open by infantry. Then the armored divisions pour through. In the example above X will lose two infantry divisions and Y one in the initial assault. Then the four panzer divisions will pour through. Montgomery attacked with armored divisions. The infantry, seeing all those tanks, would wait for them to rip the hole. The tanks, unprotected by infantry, would be destroyed. The number of tanks lost by the British in those attacks was epic. Even if they broke through, which they never did, it

wouldn't have done any good as the tanks were gone. Armored divisions attacking into infantry divisions are going to be destroyed if the infantry division is in a prepared defense.

```
Y     Y     Y     Y     Y     Y     Y     Y     Y     Y     Y
=====================================================
X     X     X     X     XXX     X     X     X     X
                        PPPP
```

The attack is set up.

```
Y     Y     Y     Y     Y     X     Y     Y     Y     Y     Y
=====================================================
X     X     X     X     PPPP     X     X     X     X
                        XX
```

As Rommel's book is clear the infantry attacks. The hole is ripped in the line.

```
                        PP
                        PP
Y     Y     Y     Y     Y     X     Y     Y     Y     Y     Y
=====================================================
X     X     X     X     X     X     X     X     X
```

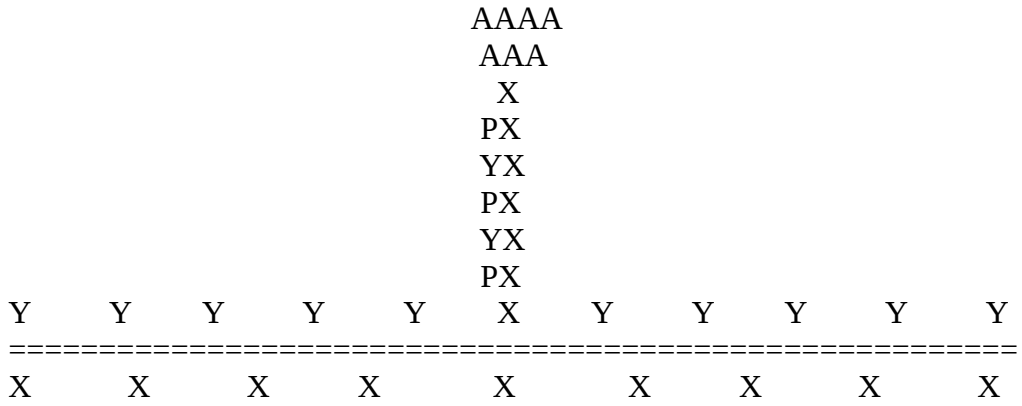
The panzer divisions pour through. Infantry follows them. Strong points are bypassed and the panzer divisions move quickly. The more quickly they move the more ground covered. The infantry on the line keeps the enemy engaged as long as possible. When the enemy units start the retreat they're in "movement mode" and a panzer division running into an infantry division on the march is going to be a really bad experience for that infantry division.

```
            P     P     P
                  P

                  X
                  X

Y     Y     Y     Y     Y     X     Y     Y     Y     Y     Y
=====================================================
X     X     X     X     X     X     X     X     X
```

The panzer divisions move quickly and the quicker they move the more enemy units which will be "bagged." Infantry units follow them. "The flank is exposed!" We covered that. An attack in the flank isn't going to go well.



The above example is basically Operation Luettich. When Patton broke out of Normandy the Germans decided to attack the flank. 3.5 Panzer and 2 German Infantry divisions hit that flank. 5 American Infantry Divisions held that line supported by 3 combat commands or 1 Armored Division. The Germans were "right" in that those American divisions should have been in march mode and, hitting the infantry units streaming behind the armored, Panzer divisions should have caught infantry divisions in movement. Those infantry divisions weren't in movement. Not only did the German attack fail the 112th Panzer Division actually lost ground against the U.S. 30th Infantry Division.

As is clear from Operation Luettich, an armored division attacking an infantry division, when the infantry division is emplaced, is futile; you'll just lose your tanks. The British attacks "broke down to nearly pure-tank attacks." The British saw that as a breakdown in combined arms. That it was but the tank divisions shouldn't have been in the attack there in any event. The armored divisions, as Rommel and Guderian were clear, are unleashed after the Infantry rips the hole. In the British attacks in Normandy one of the few successes was inadvertent – the 7th Armored (British) division was able to move through a gap torn by the 1st U.S. Infantry Division.

Again, the infantry rips the gap. The tanks are unleashed and move behind enemy lines hitting soft targets and units on the move. Strong points are bypassed and left for infantry to reduce.

At the start of WW2 a country really needed two tanks. The first tank needed was the "exploitation" tank as used in a Panzer division of the time. The main requirements were range, speed, reliability, and a good high-explosive round for the soft targets it was meant to encounter. The German Mark IV was designed for this role. As the L/24 cannon on that tank couldn't handle the random tank encountered the Mark III with the 37mm cannon accompanied it. The Germans received all the Czechoslovakian tanks when they were handed that country and the Czechoslovakian tanks were good reliable tanks but, mainly having 47mm guns, were somewhere between the German Mark III and Mark IV. The British analog was the "cruiser" tank but those invariably mounted the "2pdr" making them similar to the German Mark III albeit not nearly as reliable. The French had a bewildering array of tanks but, having sunk the bulk of their defense spending into the Maginot line, none of them were much to write home about. The Americans, seeing the Char B, took that design idea and created the M3 with a high velocity 75mm cannon in the hull, this cannon was in the same class as the 75mm in the German Mark IV, and put a high-velocity 37mm in the turret. The U.S. had purchased 37mm guns from Rheinmetall and, while not a direct copy, the 37mm in the M3 was pretty much the same gun as found in the German Mark III. The M3 at least had the advantage of a reliable drive train but, in sheer size, it was more of a "moving gun armed pillbox" than a tank. After the fall of France, Jacob Devers, later to command the 6th Army Group, was instrumental in "altering" the M3 into the M4. The M4

“lengthened” the 75mm cannon into an “intermediate” gun and that had useful high-explosive and, for the time, the necessary anti-tank ability needed. The main field gun of the Soviets was the 76mm field cannon and that basic type of gun was selected for the T34. The Germans, after encountering T34 and other Soviet tanks, installed a bigger cannon in the Mark IV and the Mark III and Czechoslovakian tanks were then available for other uses.

Mark IV. 75mm L/24 originally and then the 75mm L/43. From 1943 the 75mm L/48 was used.
T34. 76mm L/40
M4. 75mm L/40.

All three of the above tanks were reliable, had a useful high-explosive shell, and could handle enemy tanks within limits.

As mentioned an infantry division in defense was quite effective. In attack they needed a “direct fire” ability to complement their indirect fire artillery. If anti-tank ability was also present that would be even better. Thus the “infantry” or “break through” tanks. Whereas an exploitation tank needed to be fast and have good range the “infantry” tank didn’t need to be particularly fast. What was valued was very heavy armor for the work it’d perform. The British “infantry tank” was the Matilda. With the 2pdr gun that was a very strange choice. The Soviets developed the KV series but those suffered from transmissions not up to the task. The Germans developed the Tiger tank for this role. As a rule the “infantry tanks” were very heavy, had very thick armor, and had a large cannon needed for direct fire duties (pillboxes, bunkers, etc.,). These were needed to “break through” the enemy lines on the initial assault and then were needed to help reduce the strong points the armored divisions had avoided. Due to the weight of the armor they were typically under-powered and had reliability issues. The American “infantry tank” was the M6. Like the KV it mounted a 75mm cannon but the M6 was looked at with serious misgivings by the using branches and never saw combat.

The Germans never had enough tanks. With the enemy forces swimming in tanks, but the Germans not having the production capacity, the Germans created a lot of “ersatz” vehicles to leverage the obsolete chassis they had available. The StuG, as an example, was the mounting of the 75mm cannon, as used on later Mark IVs, in the Mark III tank. As the turret wasn’t large enough for that cannon it was removed and the cannon mounted in an “armored box” on the hull. This provided the advantage of a lower overall height but at the cost of the entire vehicle having to be aimed. Was it useful? Incredibly so. It provided the Germans with about 10,000 vehicles they wouldn’t otherwise have had. When one considers the tank designed for that role, the Tiger, was simply too expensive and consumed too many resources to build, only 1,347 were built, those StuGs filled the gap, and well at that, but they were a poor replacement for the Tiger in that role; if the Germans had had the ability and capacity the Tigers would have filled the role the StuG did as, having the turret, thicker armor, and bigger gun it was purpose designed for that. About this time Guderian was recalled and, noting what the saw, things were even worse than expected as those StuGs weren’t just being used as “assault guns” but were being used as “substitute tanks” in counter-attacks and that role they weren’t very good for.

Guderian was a “war of maneuver” type of guy. After the infantry rips a hole in the enemy line, at a single point, the Panzer Divisions pour through and “keep going” - what the German units had failed to do in 1918. Moving as fast as possible, with infantry following, they bypass strong points and form “pockets” of enemy troops. In the 1941 offensive, in one pocket alone (Smolensk) 310,000 Soviet troops and 3,205 tanks were taken. At Kiev it was 667,000 troops while at Vyazma-Bryansk it was 663,000. Stalling in front of Moscow for the Winter, Guderian continued has “war of maneuver” and gave up ground in order to conserve forces. Hitler, a “war of attrition” type of guy, fired Guderian.

The 1942 offensive stalled at Stalingrad, which should have been bypassed, and the Germans started losing. The 1943 offensive, at Kursk, was more of a World War One battle than WW2. German forces were gathered, ponderously, while Soviet forces were brought to the obvious point of attack. It was "the Battle of the Somme" "but with tanks." The result was as expected. Guderian was brought back in. His initial observation? "German has no offensive tanks." In fact Hitler had ordered production of the Mark IV to cease in favor of assault guns.

Mark V. 75mm L/70
T34-85. 85mm L/52
M4. 76mm L/55

The Panther has been called "the best tank of the war" by many. "Best defensive tank" is more accurate as it had no offensive capability. The 75mm L/70 is really a pure "anti-tank" cannon. The T34-85 had a 85mm cannon, but at L/52, fired an effective high-explosive round. The American 76mm L/55 had started to replace the 75mm L/40 and that was a regression. The 76mm L/55 had inferior high explosive ability, compared to the 75mm L/40, but didn't gain much for anti-tank as it wasn't really big enough for that. If provided with tungsten cored rounds it was effective but those were reserved for the "tank destroyers." The Germans had gone from a good exploitation tank, the Mark IV, to an awesome anti-tank tank but at the cost of offensive ability. The Soviets had moved from a great exploitation tank, the T34-76, to an even better exploitation tank, the T34-85. The Americans had moved from, what was when introduced the best exploitation tank in the world, to a poor anti-tank tank. The 76mm L/55 had a much more effective high-explosive round than the Panther, obviously, but it was a regressive move.

An exploitation tank is used to "hunt birds." Soft targets that likely won't fight back as they're trying to flee. The gun needed is a "scatter gun" or cannon with high explosive shells. If a large bear is encountered one simply carries slug shots for dire need but they're best avoided. The Panther was provided with a cannon more analogous to a high velocity hunting rifle. That works great for bears but it's not particularly effective when hunting birds. If birds are what you're after, you'll go hungry.

In 1918 the last big German offensive in the West, in 1918, petered out as the Germans were out of gas. The last German offensive in the West, in late 1944, petered out as they had no exploitation tanks. The Tigers and Tiger II tanks could, in the role of break-through tanks, help infantry rip the gap but that is where they stop. Too slow and likely broken down near the front line. The Panther had the speed to advance but the cannon it carried was only effective against tanks. Guderian had noted it. Germany had no offensive tanks in the latter half of the war. It can be argued that, the Allies having so much more for forces and an incredible number of tanks, the Germans had no choice but to make nothing but "anti-tank tanks" and there is much merit in that. Conversely, "the best defense is a good offensive." Defense doesn't win wars. The German tanks, late war, were purely defensive and the Germans hoped for a "miracle" from "V weapons" and the such. Roughly 6,000 Panthers were built. The number for the T34 and M4 were over 50,000 each. In fact the number for the M4 is lower than it could have been. With the M4s pouring off the line additional contracts had been given but, as it was clear that more than could be used were going to result, contracts were canceled. M4, M4A1, M4A2, M4A3, M4A4, M4A6. M4A5? The designation given to the M4 contracted for out of Canada but canceled as production capacity exceeded need.

Guderian was clear that the tanks needed to be concentrated. Combined arms was all the various parts working together so, for armored divisions, artillery needed to be mobile as did the troops. Blitzkrieg is a war of maneuver. The British, in claiming that "the Germans learned it from us" fail to

understand Blitzkrieg and that was seen repeatedly during the war. Blitzkrieg doesn't require tanks. Let's take four invasions and see the result.

1) Southern Italy. Montgomery and the 8th Army landed in Italy on September 3rd, 1943. The nearest German unit of any size, a Regiment, was 25 miles away. On the 9th Montgomery halted his slow advance to "regroup." On the 10th General Alexander sent him a message to get moving: "it is of the utmost importance that you maintain pressure upon the Germans so that they cannot remove forces from your front and concentrate them against Avalanche." What "German forces" were on his front is a mystery as there weren't any. On the 12th Alexander sent his Chief of Staff to see if he could get Montgomery to move. Between "Sitzkrieg" and "Blitzkrieg" is "Bummelnkrieg." That "regroup after landing" and very cautious advance would be seen again.

2) On the 22nd of January, 1944, General Lucas proved that an American General could match Montgomery in Bummelnkrieg. The troops landed at Anzio and "consolidated." German troops, some from as far away as Yugoslavia, were given time to travel to the invasion site and the Germans joked that Anzio was the largest prisoner of war camp the Germans had as they were guarding a huge number of enemy troops and those weren't moving any time soon. "Land, consolidate, regroup, then move out" is simply Bummelnkrieg.

3) At Normandy the British under Montgomery failed to take their first day's objective of Caen. In waiting for the tanks to come ashore, needed for his "combined arms advance," German units were permitted to once again pin the invasion force. British historians like to point out that German armor pinned them in but that German armor wasn't near the beach during the invasion as it was held back so it could respond to an invasion along the entire coast. When it was given time to advance it stopped Montgomery cold, true, but, based on what's seen again and again, German Infantry could have done the same thing. Armored divisions attacking emplaced infantry divisions means losing the tanks. The British, again and again, failed to maintain "combined arms" but that misses the point that the gap should have been torn in the German lines by Infantry. Instead the Infantry, seeing the tanks, left them to it. The "nearly pure-tank attack" that Biddle mentions. While the British were trying to "fix the combined arms" they lost sight of "fix it by not using the armored divisions until the hole is there." Patton, in his breakout, understood this which is why those American Infantry divisions were there to stop Operation Luettich. Land, consolidate, regroup, and then the enemy is there so "advance" doesn't come. Especially after repeated attempts to break through with tanks. Caen is 17km from the beach. That was an objective for D-Day itself. It fell on the 20th of July. That the German units opposing Montgomery were Panzer Divisions is often pointed to by British Historians but they're clearly missing the point and do not understand the tenets of Blitzkrieg. Montgomery, in making those futile attacks, clearly didn't understand it either. Infantry needs to rip that hole in the line and then the tanks are unleashed to hit the soft targets behind the line, and using their superior speed, move quickly to bag as many enemy as possible. "A breakdown in combined arms" is often cited by British historians with "well, the bulk of the German tanks were concentrated on that side" has been offered. If the Germans concentrated the tanks on that side that meant they felt that was the easiest place to punch through to make the invasion fail. Piling on that, if the German tanks were concentrated on that side that would simply mean that an attack there was the least likely to succeed and Montgomery's insistence in getting the bulk of the supplies for his attack there was, like the Germans at Kursk, an offensive no different from the failed offensives of WW1: "Somme, with tanks." Montgomery didn't understand WW2 tactics but clearly did understand the WW1 tactics of failure; which at least put him a level above Eisenhower who didn't understand tactics of any type from what can be detected.

4) On the 15th of August, 1944, the invasion of Southern France, Operation Dragoon, took place. American divisions were on the outskirts of Grenoble, 326km or 202 miles, away on the 22nd of August. One week for infantry divisions to land and cover 200 miles. "But there were more Germans at Normandy!" Not during the invasion. The difference was the 7th Army didn't wait after hitting the beaches – they moved and moved quickly. One month after landing the 7th Army was at Vesoul France – a distance of 703km or 436 miles. The 7th Army, part of Dever's 6th Army Group, hit the beaches with three Infantry divisions. "Motorized Infantry" in the terms of the day. They moved fast enough to trap the German 19th Army and surround them. That's Blitzkrieg as done without armored divisions. Armored divisions are better equipped for it but Blitzkrieg doesn't require tanks and tanks aren't always used in Blitzkrieg. The rapid advance of the 7th Army resulted in the German 19th Army, sent to stop them, being surrounded. 150,000 German troops were captured. Blitzkrieg done with Motorized Infantry divisions as the 7th Army was shorted on armor – Patton had that. A "war of attrition," as seen in Normandy, was avoided and the 150,000 German troops captured via the war of maneuver resulted in a lack of 150,000 casualties on the American side.

The Tanks

German

Mark III. The "anti-tank tank" originally but, when enemy tanks got larger, it was no longer able to perform that role. The "Panzer" branch had "tanks" and the "Artillery" branch had "Assault guns" so the Panzer IIIs were sent to the Artillery and they made assault guns (StuG) out of them. In trade the "Infantry tank," the Tiger, was basically handed over to the Panzer branch as they needed them more. The StuG was an incredibly effective weapon, no doubt of that, but it wasn't a tank and Guderian was clear on that.

Mark IV. As mentioned this started as the "high explosive cannon armed" tank. When enemy tanks couldn't be handled by the Mark III the Mark IV received an "intermediate" cannon and was the best German "exploitation tank" of the war. When Germany switched to "defense only" they tapered back and the Mark IV chassis was used in a variety of roles. Yes, some "tanks" were made to the end of the war but production was tapered back – especially when the Borsig factory in Berlin, the maker of the StuG, was bombed.

Mark V. The Tiger, the Mark VI, preceded this. The strange "number is backwards" thing is due to the "Neubaufahrzeug" which was produced in limited numbers and, presumably, would have been the Mark V if produced in quantity but that didn't take place. The Mark V Panther was, without a doubt, the best "defensive" tank of the war but the very high velocity gun prevented it from being a true "exploitation tank" in Guderian's usage. Again, this can be seen in the fact that the German were unable to succeed in any offensive while the Panther was their main tank. "They were outnumbered" won't wash as, at the Ardennes, they had local superiority. If one was to go back to early 1943 and have a long talk with Guderian one suspects the 88mm L/56 from the Tiger would have been the better choice of cannon for the Mark V. With that cannon it very well would have been "the best tank of the war."

Mark VI. The Tiger was designed as the "break through" tank and it was a very good tank. As with all heavy tanks it had an over-tasked drive train and that limited range and caused maintenance problems. As the Panzer divisions "took them over" they were used in "fire brigade" mode but lack of range and reliability issues meant the Tiger could never be an "exploitation" tank. By design.

Mark VI Auf B. The “Tiger II.” Like the Panther it was “anti-tank” only. The first unit deployed in the Soviet Union had the first three ambushed by T34s, the next 6 were destroyed by IS-2s, and the 4 broke down and were captured intact. No Soviet tanks were lost. Two of the captured tanks, mind they were brand new, were designated by the Soviets for study and it was quickly discovered that they couldn’t make it more than about 10km without breaking. Serious over-tasking of the drive train made these very unreliable. As the Tiger and Panther could handle any enemy tank these were really a dumb idea but Hitler was a “war of attrition” type of guy and really liked “land battleships.”

One last note on German tanks. With the increased focus on the heavy tanks, which were the least reliable of the two “tank types” due to weight over-tasking the drive train, the Germans were spending crucial resources in building very expensive tanks which, given they were always in a state of retreat, created a doubly negative situation as a tank broken down in retreat is lost – either captured by the enemy or destroyed by its’ own crew. I suspect that if an accurate total accounting of the losses for the Tiger II could be made likely ½ were lost from breakdowns during retreats.

Soviet

T34-76. The T34-76 was a very good tank. The two man turret was a weakness, the crew was over-tasked, and the Soviets were made aware of that. The need for tanks was considered a higher priority and that wasn’t addressed until it was clear, 1944, that the Germans weren’t able to do anything significant any longer.

T34-85. The T34 with a three man turret and bigger gun. Still an “intermediate length” gun. This is the best “exploitation” tank of the war. Period.

KV. There were two of these but they’re both early “break through” tanks which were unreliable.

IS-2. The KV was developed into the IS-2. The drive train was now reliable and this was a very good tank. The 122mm cannon, being so big, required two piece rounds and thus the rate of fire was pretty slow. Regardless that huge cannon, being intermediate length, could fire a huge shell. Not designed for “armor piercing” the size of it meant if it didn’t penetrate the armor of the enemy tank it would likely rip the turret off, destroy the suspension, or simply kill the crew inside due to concussion.

British

The British had “cruiser” and “infantry” tanks. Quality was such that M4 Shermans were used instead. A review of “British made” tanks witnesses tanks used for mine clearing and other “interesting” tasks all of which point to tanks useless in the role of tanks. Most early tanks had the “2pdr” gun and that was pretty much useless in the anti-tank role and not big enough for the high explosive role. Having moved to the “6pdr,” or 57mm, they finally noted that the M3 gun on the Sherman was simply a better idea. The Cromwell then received the 57mm bored out to use the American shells. The Cromwell had flat armor, not sloped, with that armor being weakened by various portholes and such cut into it. Various bolts and huge rivets abound, the American M3 had shown in North Africa that rivets, when hit, fly around the inside of the tank doing awful things to the crew, and it’s just not much of a tank. The last British tank fielded, the “Comet,” still has lots of flat armor and sports a 77mm gun when

everyone else was moving, or had moved, into the 90mm+- class. Much is made of the use of discarding sabot rounds, “making it superior to the Panther,” but those were wildly inaccurate at the time. So, yes, they were moving in the right direction but not quite there. Post-war the Centurion appeared and that was a good tank. With the 105mm cannon it received later I’d even call it a great tank. Even with the earlier 84mm it was a very good tank. That’s not WW2 though. The British tank program during World War Two was a miserable situation.

American

M3.
Ignoring the “light” tanks as those would have been “armored cars” in any other army, the first “tank” is the M3. It was reliable and had the two cannon and those wonderfully deadly rivets.

M6.
The M6 was the “American Breakthrough Tank.” The Ordnance Department kept trying to get the Armor Branch to take them but the Armor Branch was having nothing to do with those. Today the story is they were an “early war development” but they were not finally declared “obsolete” until December of 1944 by the Ordnance Department so we can at least say that the Ordnance Department was persistent if nothing else. They’re still in the “Standard Ordnance Items Catalog” as of April 1st of 1945.

M4.
Much has been written on the M4 and each further book seems to confuse the issue even more. Having reviewed a lot of material the following is what really happened. In order to really understand it one cannot take the post-war accounts as those have lots of 20/20 hindsight by all involved. In walking the documents produced through the war the picture does finally emerge.

After producing the M4 the Ordnance Department started testing all types of different things in order to figure out what the “next tank” would be. The Ordnance Department was part of the Army Service Forces.

The Army Service Forces worked for the Army Ground Forces. Essentially, the ASF and AGF were both within the U.S.. The Army Ground Forces was responsible for the “combat” side of the house and Army Service Forces was more “development and supply.”
Understanding the relationship between AGF and ASF, within AGF were the Armor and Artillery branches. Artillery was in control of the “tank destroyers,” which were manned by artillery troops, and armor was in charge of “tanks.” A side-note: in looking at pictures of “tank destroyers” used late in WW2 they’re often seen in groups with raised barrels. Artillery gunners were trained in all artillery type fire and thus the gunners on those vehicles were trained in “indirect fire” whereas tank gunners were not. The downside to this was the tank destroyers, for a lack of German tanks, were often used as artillery and that was a waste of those assets as high-velocity barrels wear out quickly.

Within the AGF the artillery, in this case the tank destroyer people, felt that destroying tanks was their area. The armor people disagreed. As the war ended the armor branch “won” that battle but that’s post-war.

Ordnance, in Army Service Forces, wanted to develop a new tank.

AGF, being lead by an artilleryman, General McNair, supported the tank destroyer concept. In this concept the M4 is just fine as tanks are destroyed by tank destroyers.

AGF, the armor side, had tens of thousands of M4 tanks. They understood that the Ordnance Department wanted to develop a new tank but the armor side of AGF was fearful that that Ordnance Department would cease development of the tank they already had.

The Ordnance Department, post-war, spread the message that Armor stopped them from developing a new tank. This is partially true. They conveniently ignore the reason. The Armor branch was fearful, rightly, that the Ordnance Department would stop development of the M4.

The M4, with the 75mm gun, could take a bigger gun. The Ordnance Department, while working on a new tank, sent M4 tanks with 76mm guns. These guns, as I've mentioned, weren't useful. The 76mm gun was developed and fit inside the M4 turret. As was seen with the M36 tank destroyer the M4 could take a bigger turret. That permitted the 90mm intermediate length gun to be used in the M4. The Ordnance Department resisted this. Army Ground Forces wasn't big on the 76mm as that's more of a tank destroyer gun. The 90mm, on the other hand, is a general purpose gun. AGF's "tank destroyer" arm really couldn't argue with a 90mm "intermediate length" cannon but the 76mm, being the gun used in the M18 tank destroyers they were developing, was not looked on with favor. The 90mm is in fact the gun used on the M26 - "tank" and not a "tank destroyer."

As was seen with the early war German Mark III/Mark IV mix, a tank doesn't need to do both roles but it's desirable. With the 75mm in the M4 no longer able to handle both roles the British mounted a bigger "anti-tank" cannon in some tanks. This was a better solution than the 76mm American gun but, due to turret size, was not a really good solution. Better than the alternative, which was nothing, but the gun needed to be mounted sideways. The existing turret simply wasn't large enough. The Armor branch in the U.S. wanted a bigger turret and gun – the dual purpose 90mm. That was resisted. The result was the 76mm and that was the least favorable outcome.

M26.

Under-powered. In Korea they pulled the M26s and deployed M4s. A new engine produced the M46 but the engine was too big for the chassis. That was "upgraded" to the M47 by installing a new turret but the hull was still wrong. The M48, a new design, was then introduced.

When introduced the M4 was the best "exploitation" tank of the war. It had sloped armor and it was thicker than the T34. The M4 had a three man turret crew to the T34's two. The M4 had a gyro stabilized gun. So "better" but not by a lot. The German Mark IV, the Soviet T34, and the American M4 (75mm) were very good tanks. The Germans took a "wrong turn" with the Mark V. The Americans took a wrong turn with the M4 (76mm). The Soviets took a right turn with the T34-85 and that was then the best exploitation tank of the war.

M4 with T-26 turret and 90mm cannon at Detroit Tank Arsenal. Instead of shipping M4s with 76mm guns, or M26s, this is what the Armor Branch was after.

The M4 with the 90mm “intermediate length” cannon would still have good high-explosive ability and an improved ability to destroy the larger German tanks. That said, let’s maintain our understanding of Blitzkrieg. The bulk of the M4s still had the 75mm with increasing numbers getting the inferior 76mm. In either case the exploitation tank, in Blitzkrieg, isn’t really designed for heavy tank against tank action as the enemy tank units should be bypassed or handled by the other parts of the combined arms team. M36 tank destroyers, with the 90mm cannon and tungsten carbide rounds (can destroy the Panther, Tiger, and Tiger 2 from the front with that last being turret only), could handle the big German tanks – the troops called the M36 the “Tiger tamer.” The really big German tank, the Tiger II, was made in such limited numbers that encountering it was rare. The M10 and M18 with the 76mm class cannon could take it out from the side with that being an option. Bypassing it would be another as it very well couldn’t chase you as it’d break down quickly. As soon as one focuses too closely on tank versus tank combat in that war one is drifting further and further away from a war of maneuver and back to a war of attrition with the only difference from the failed WW1 offensive being the use of tanks. “The Battle of the Somme, with Tanks.”

The Summary

A war of attrition is fought by butchers. A war of maneuver is fought by real Generals. Rommel and Guderian publicly put out the blueprint. People either didn't read, understand, or agree with it. From the inception of the war to the halt in front of Moscow the Germans, with very small reliable tanks, fought a war of maneuver. Hitler, over-impressed with his own abilities, fired his best General and a war of attrition was then fought. As the German war of attrition was fought the Germans moved away from "exploitation" tanks to purely defensive tanks. With those tanks they no longer had the ability to conduct offensive operations. After Kursk, a "WW1 war of attrition – with tanks," Guderian was called back in but it was too late. German didn't have the equipment and the enemy had been permitted to build up too much of an advantage. A couple of years of defensive war were fought with those German tanks being very deadly in defense, admittedly, but the unreliable nature of them also meant losses were predictable and the tanks were "destroyed to prevent capture" all too often.

The British historians for ages to claim they'd invented it all. At no point did anyone on the British side show this knowledge in action. Even today it's clear that they don't understand it. Montgomery, not understanding it, was permitted by Eisenhower, who also never understood it, to keep performing the "WW1 offensive – with tanks" offensive with the predictable tank losses. I guess it could be said that a British war of maneuver could have followed a penetration of the line but that was never accomplished and, if it had been, the tanks would have already been lost.

Patton understood the war of maneuver. As did Bradley. Shorted on supplies, due to Eisenhower's focus on Montgomery, the 1st Army was shorted to enable the 3rd to conduct a war of maneuver. That, in the Fall of 1944, presented the Germans with an opportunity in the Ardennes but, without exploitation tanks, they couldn't leverage it.

In that war two tanks were needed: exploitation and breakthrough. The first needed to be reliable, have good range, have a good high-explosive shell for targets of opportunity, and was intended to not get bogged down, like was done at Stalingrad, in taking useless ground or strong points. The other tank needed, the break-through tank, was desired to be heavy and was intended to help the infantry rip the gap for the armored divisions to be unleashed and then to help in reducing the bypassed strong points.

Due to shortages and cost Germany never had enough tanks. Obsolete tanks and captured tanks were used to good effect in providing chassis for assault guns and artillery needed for combined arms operations. In spite of how well some of it worked those were "ersatz" measures due to production limits.

As was seen in the 7th Army's incredible speed of advance after hitting the beaches in Southern France, Blitzkrieg doesn't necessarily require armored divisions. Mechanized and motorized infantry can do it but that's really a high level of operation. The divisions involved were all three veteran divisions and the Army Group commander there, General Devers, understood armor and the war of maneuver. Shorted on armored divisions he simply made due with what he had.

"The Tiger could handle five Shermans." Whenever that statement is encountered it's from a real war of attrition kind of guy. One who doesn't understand combined arms and doesn't understand war of maneuver. The KV could handle five Panzer IV tanks. In both cases what was more likely is the heavy tank would break down or be bypassed and then handled by the infantry following the armor. If exploitation tanks are spending most of their time looking for tank versus tank combat they're doing something wrong. Typically, if that is observed, we'd expect them to be under a German general with Hitler calling the shots or, on the other side, under Montgomery with Eisenhower comfortable with Montgomery's skills as Eisenhower, like Hitler, didn't really understand any of it.

Mark V. 6,000 produced.

Tiger I. 1,347 produced from 1942 to 1944. Assuming a life of a year that's less than 500 per year. From St. Petersburg (Leningrad at the time) to Rostov is 1,800km or 1,100 miles (rounding). That makes for an allocation of one Tiger per every two miles of front if one ignores other fronts. Of course they concentrated them in units of 25 or so. The odds of encountering one were limited.

Tiger II. 492 produced. Odds of encountering one was slightly lower than encountering Marlene Dietrich in person.

T34. 57,000 produced.
M4. 49,234 produced.

IS-2. 3,854 produced.
M36. 2,324 produced.

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27 pages with high-quality graphics no less. Written pretty quickly so if there are nits with something feel free to send them. If you're more interested in an argument don't bother. Reasoned debate is good but emotional argument is pretty pointless.

This isn't an "academic paper" or a book for sale so I'll not bother with the footnotes and such. It was written rather quickly and is simply a paper to illuminate some of the aspects of WW2 and the use of tanks therein. Unlike the Tiger II, I'm not big on "over engineering." If some minor technical details are messed up send a note and I'll maybe correct them but if they're just myopic matters which, while somewhat off, don't really affect the overall points then I'll probably not bother.