



The M-26 tank, seen here on an M8 tank transporter, did not enter combat in the European Theater until the final days of WWII. Its armor protection, 90mm gun, and modern torsion bar suspension finally put U.S. tankers on a par with their German opponents.

Armor Combat Development 1917-1945

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This article was compiled on behalf of the Directorate of Force Development, and it provides an historical overview of the policies governing American tank design in this early period. Together with two subsequent articles, it is intended to recognize the basic accomplishments of combat developments with respect to the Mounted Force from their infancy in World War I to the sophistication represented by the Future Combat System.

When America joined the Entente in April 1917, it possessed no tanks of its own. Indeed, the tank originated from British and French efforts to end the Western Front trench deadlock. Following a study of British and French tank use, however, the U.S. Army established the Tank Corps, within the American Expeditionary Forces, to organize and train American tank units.¹ Headed by Colonel Samuel D. Rockenbach, the Tank Corps combined the French emphasis on small light tanks to accompany advancing foot soldiers with the British preference for large, heavily armed tanks to breach enemy positions in advance of an infantry assault. Consequently, separate American light and heavy tank units were formed.²

To overcome the absence of American tanks, the War Department endeavored to produce a copy of the French Renault FT 17 light tank, develop a new design through Ford Motor Company, and participate in a combined British-French-American effort to build the Mark VIII heavy tank. None of these endeavors proved successful. Rather than simply mass-produce a copy of the Renault tank, the Ordnance Department modified the design, although lacking tank production experience. Delays and confusion resulted, unrelieved by disagreement whether the speedometer of a tank capable of less than ten miles per hour should show kilometers or miles per hour. Only ten American-made Renaults were built by war's end.³

In an early effort to utilize the mass production capability of the automotive industry, Ford Motor Company received a contract to mass produce a three-ton light tank that it would design itself. Over the objection of AEF personnel who found the vehicle unsatisfactory for combat, the company produced only 15 by war's end.⁴ The Mark VIII represented the first international tank design. It incorporated British and American

concepts and technology — including the American Liberty aircraft engine — in a design that would be assembled in France. Intended to spearhead a planned 1919 offensive, production suffered from the slow rate of Liberty engine development and the priority given to aircraft for those engines produced. The war's end in November 1918 left the U.S. Army with a collection of parts that upon assembly provided it with 100 Mark VIII tanks.⁵

The continuation of wartime tank production into 1919 resulted in the Army's possession of a tank fleet expensive to maintain and mechanically unreliable. Worse, it provided an illusion of tank strength that impaired Congressional willingness to fund the development and production of new designs. Throughout the interwar era, the Army could afford only one new model a year.⁶

The exclusive use of tanks in a trench-breaching role resulted in their association with the Infantry. Consequently, the National Defense Act of 1920 that defined the Army of the interwar period abolished the Tank Corps and assigned tank development responsibility to the

Infantry. The Act precluded experimentation with tank use beyond the narrow mission of assisting the advance of the rifleman and seizing ground.⁷

Under the guidance of Rockenbach, now commanding the Infantry's tank force, tank development focused upon a medium tank. He sought a design capable of accompanying the rifleman in all terrain, able to withstand .50 caliber machine gun fire, carrying close support firepower, and weighing no more than 15 tons in order to utilize highway bridges. Such a balance of armor, mobility, and firepower proved beyond the capability of American tank technology in the 1920s.⁸ Although three tanks were built under Rockenbach's supervision between 1921 and 1925, all proved over 20 tons.⁹

The difficulties of creating a satisfactory medium tank encouraged the Infantry to shift its focus in 1926 to light tank development. The higher mobility and speed of these vehicles also reflected the Army's preference for a war of maneuver over a positional conflict like the Great War.¹⁰ In particular, the Infantry sought a tank capable of 12 miles per hour, possessing a 37mm main gun, and armored against .30 caliber machine gun fire.¹¹

The resulting T1 series was designed as a light, fast tank suitable for portage by truck. The first model represented a collaborative effort between the Ordnance Department and the Society of Automotive Engineers. It embraced the newest advances in automotive technology, including the link type springless suspension and the use of an all-purpose chassis to facilitate standardization. Between 1927 and 1931, Rock Island Arsenal built a succession of pilot models, each one introducing new features but ultimately increasing the tank's weight to seven tons. The reliability of the series, however, demonstrated the viability of the tank's operation without a carrier.¹²

Since their invention, tanks depended upon railways and trucks for transportation to and from the battlefield. The speed of a tank-laden truck column, however, barely exceeded three miles per hour and precluded rapid, mobile operations. A tank that could safely rely upon its own engine, both on and off the battlefield, increased its versatility and permitted a higher tempo of operations. Eliminating carriers from tank units similarly reduced their cost and personnel requirements.¹³

J. Walter Christie's tank designs further reinforced the trend away from tank carriers. During the interwar years, he built tanks capable of moving 40 miles per hour cross country, fording rivers, allowing rapid conversion between wheel and track movement, and equal speeds forward and backward. Although the Army never adopted any of Christie's designs for standardization, it flirted with them throughout the era and purchased several models. It found them unsuited for the stresses of military usage and their de-

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signer unscrupulous in his business dealings.¹⁴

Light tank development also benefited from the creation of the American Experimental Mechanized Force in 1928 and the Mechanized Force in 1930. Both forces sought to combine tanks with other arms and utilize them in a variety of tactical roles. Neither organization could survive, however, in the face of opposition from the combat and service arms that feared the loss of personnel and funding to them.

In 1931, Chief of Staff General Douglas MacArthur authorized a new mechanization policy that permitted each combat arm to control the pace and extent of its own mechanization program. Although this policy decentralized mechanized development, it ensured that mechanization no longer posed a resource threat. MacArthur's policy also engendered the Mechanized Cavalry to test the tank's application to Cavalry functions and implement the conclusions drawn from the Experimental Mechanized Force and the Mechanized Force.¹⁵

The Cavalry mission included reconnaissance, screening, exploitation, pursuit, and raiding operations, and it, therefore, necessitated a more dynamic use of the tank than the simple close support role of the Infantry. Throughout the 1930s, the Mechanized Cavalry's activi-

ties resulted in the development of mobile combat teams of tanks, self-propelled mortars, and riflemen working independently toward common objectives. The mobile, dispersed nature of these actions generated requirements for an armored personnel carrier and self-propelled artillery. A new set of tank specifications also emerged that stressed mobility and reliability over firepower and armor.

The fresh impetus given to tank development by the Mechanized Cavalry coincided with a general desire to jettison the World War I tank fleet of Mark VIIIs and Renault tanks. Such tanks did not permit analysis of the fast moving tactics now advocated by the Infantry and Mechanized Cavalry. Echoing the sentiments of those personnel associated with mechanized development, one Infantry tank officer advised that the "best solution for the present mechanized means of the U.S. Army is to get the biggest transport we have, load it all on, and dump it into the middle of the Atlantic Ocean."¹⁶

The Infantry and Mechanized Cavalry's combined interest in light tanks resulted in the T2-series that became the pattern for the later M3 and M5 Light Tanks. A single chassis served both arms. The series introduced the vertical volute suspension, necessary to handle the 35-mile-per-hour speed. Although intended to utilize a Wright-built Continental aircraft engine, Guiberson diesel engines equipped some models. In 1936, 19 T2s were produced, to be followed by 170 in 1937.¹⁷

The Cavalry version carried only a machine gun as armament, but the Infantry reacted to the growing efficacy of anti-tank guns demonstrated in the Spanish Civil War by seeking heavier armament and armor.¹⁸ The 12-ton M2A4 reflected these concerns, carrying a 37mm gun in a rotating turret and a maximum armor protection of 25 millimeters.¹⁹ Completing trials in September 1939, the M2A4 missed the August Plattsburg maneuvers, and its armor had already been surpassed by the German PanzerKampfwagen II.

The Plattsburg maneuvers demonstrated mechanized cavalry's ability to use its superior mobility to unbalance and envelop a slower force. The maneuver's conclusion coincided with the German invasion of Poland; both events underscored the importance of a powerful tank force.²⁰ The declaration of a limited national emergency resulted in an order for 329 M2A4s from American Car and Foundry Company and marked an

awareness of the importance of a tank force to national survival.²¹ While Poland's prewar inventory included 1,000 armored fighting vehicles, the U.S. Army possessed only a variegated collection of 450 tanks.²²

The fall of France in 1940, however, stunned the War Department and provided the catalyst for changes affecting the design, production, and employment of American tanks. In June, the War Department established the National Munitions Program to govern the mass production of war materiel.²³ Charged with implementing this program, the National Defense Advisory Commission sought to ensure effective coordination of industrial capability and military need. General Motors President William S. Knudsen served on the Commission as the advisor for mechanized equipment. He recommended the abandonment of Ordnance Department plans to utilize heavy engine and locomotive plants to build tanks, advocating instead the building of new arsenals for tank production that exploited the labor, management, and production expertise of the automobile industry. Consequently, Chrysler Corporation built the first such arsenal at Detroit.²⁴

France's defeat also pushed the War Department in July 1940 to create the Armored Force with responsibility for creating the armored formations now deemed vital for modern warfare. The new organization absorbed the Mechanized Cavalry and Infantry tank force, but the former exerted a dominant influence, embodied by the appointment of the Mechanized Cavalry commander, Major General Adna R. Chaffee, Jr., as Chief of the Armored Force.²⁵ The Mechanized Cavalry emphasis upon mobility shaped the doctrine and organization of the armored formations. Despite the European trend toward more heavily armed and armored vehicles, light tanks constituted the majority of tanks in the new armored divisions expected to perform an exploitation role.²⁶

Modifications to the M2A4 generated the M3 Light Tank. Lessons learned from France's defeat included an increase in frontal armor to 38 millimeters and enhanced protection of the engine compartment against strafing. Weight rose to 13.5 tons, but the German PanzerKampfwagen III possessed 90 millimeters of frontal armor. Nevertheless, the pilot model completed its trials in July 1940, and American Car and Foundry Company received a large production order.²⁷

The fall of France also stimulated medium tank development, lagging since



The M3A1 Stuart light tank, with its 37mm gun and light armor, quickly became obsolete in the European Theater. This 1st AD example has the unique "flag" markings and yellow turret stripes peculiar to vehicles used in the North Africa invasion of 1942.

1926. Although the M2 Medium Tank entered service in the spring of 1940, its 37mm cannon and eight machine gun armament was offset by a maximum armor protection of only 25 millimeters. It also suffered from being underpowered and unlikely to fare well against the newer models of German tanks.²⁸

The emergence of the PanzerKampfwagen IV, carrying a 75mm gun, led Chief of Infantry Major General George A. Lynch to declare the M2 medium obsolete and recommend developing a new tank carrying a turret-mounted 75mm and heavier armor. Chaffee concurred with these views and, together with the Ordnance Department, determined upon the creation of a new design based upon the M2 chassis but carrying heavier armament and protection.²⁹

The larger weapon required a new turret. While its design began, an interim tank was developed that retained a 37mm gun in the turret but also carried a 75mm gun in its hull. Designated the M3 Medium Tank, it featured a redesigned hull and superstructure upon an M2 chassis and utilized the latter's mechanical layout. In August, 1,000 of the vehicles were ordered and construction began on a new arsenal to build them.³⁰

Issued to the British through the Lend Lease program, the new tank entered combat during the Gazala tank battles of May 1942. These early models suffered from engines that overheated after 25 hours of use and the issuance of the wrong fuses for the 75mm gun. These problems had been corrected before the tank entered combat with American soldiers. Although the M3 proved popular

with the British, the 75mm gun could not be operated from a hull-down position, and its limited traverse precluded tracking a moving target. It proved capable of penetrating the frontal armor of most German tanks encountered at a range of 400 yards, but newer models of the PanzerKampfwagen III and IV repeatedly destroyed it at 1100 yards.³¹ Although the M3 continued in British service in the Far East throughout the war, its use in North Africa and Europe was eclipsed by the M4 Medium Tank, and it was declared obsolete in April 1944.³²

The M3 Light Tanks also suffered from a number of problems despite their popularity with the British. They possessed a high silhouette and their angular hull and riveted armor offered poor protection. Their short cruising range proved an embarrassment in North Africa and resulted in additional fuel tanks being built into the hull sides. Other principal series modifications included power traverse, periscopes for all crew members, and the use of the Guiberson diesel engine to alleviate shortages in the Continental aircraft engine initially intended for the tank.³³

Continual modifications to the M3 resulted in the M5 Light Tank. Maximum armor increased to 51 millimeters, and two V8 Cadillac automobile engines replaced the Continental aircraft engine. Initial Ordnance Department skepticism with the idea ended after a prototype model drove from Detroit arsenal to Aberdeen Proving Ground without mishap. Production began in June 1942 but ended in June 1944, following development of the M24 Light Tank. The M5

remained operational, however, until late in the war, although outclassed by all German tanks.³⁴

Growing dissatisfaction with the M5's insufficient turret space, weak armament, and cooling system resulted in development of a replacement design designated T7. Equipped with a 75mm gun, early trials proved so promising that it was considered a possible replacement for the M4 Medium Tank. The ensuing modifications to the original design, however, resulted in an overloaded and unsatisfactory vehicle. A new light tank design finally emerged in April 1943 that corrected the worst defects of the M5. Designated the M24, it featured a 75mm aircraft cannon, an enhanced torsion bar suspension system that increased stability and flotation, wet stowage of ammunition, power traverse, an electrical firing mechanism, and a Hydramatic transmission similar to that found in taxi cabs. In combat, however, the large floor escape hatch proved vulnerable to mine explosions. The M24 marked a significant advance over the M5, but few saw combat in World War II.³⁵

The M4 Medium Tank entered production in October 1941, and during the course of the war over 70,000 of all configurations were built. This output was achieved by distributing production between 11 major firms and over 100 subcontractors. Use of the same chassis as the M3 further simplified construction. A variety of models were built around different power plants developed by the automotive industry in an effort to optimize performance and reduce the high demand for aircraft engines. Other modifications included armament of a 76mm gun or 105mm howitzer, the introduction of horizontal volute spring suspension, and the incorporation of wet ammunition stowage. The last feature necessitated over 2,500 changes to the vehicle's layout.³⁶ Later versions also carried a telephone for communication between the crew and supporting infantry.³⁷

In general, however, the M4 proved mechanically reliable, and highly mobile. The tank's principal weaknesses lay in an inadequate main armament and armor protection. Tank crews feared that those M4s equipped with gasoline engines were firetraps following reports of tanks bursting into flames upon being hit. Tests conducted at Fort Knox, however, determined that the cause of the fires was not the gasoline, but the penetration of the tank by ammunition designed to explode inside the tank and ignite its combustible components.³⁸

Field Expedient "Protection"



Testing ways to improve the Sherman's protection, units fired captured German antitank weapons against hulks. Above, a soldier examines the damage done by a 60mm shaped charge that blew away bags of cement before perforating the transmission casting. Spare track sections were also employed, as seen on the Sherman below, at the 1st AD's crossing of the Arno River in Italy during 1944.



Questions concerning the adequacy of the M4's armament began to emerge in 1943 and triggered a dispute between the Armored Force, the Army Ground Forces (AGF) responsible for combat developments, and the Ordnance Department. The Armored Force wanted to mount a 90mm gun on the M4, but AGF opposed this idea. Its commander, Lieutenant General Lesley J. McNair, considered this action unnecessary since American doctrine stressed the use of

tanks for exploitation rather than destroying enemy armor.

He also opposed the Ordnance Department's preference for developing an entirely new heavy tank, because of the decrease in M4 production that would occur while industry retooled for a new tank.³⁹

Adverse publicity concerning the weakness of the M4 in encounters with German Tigers and Panthers throughout



Above, although the U.S. did not field a heavy tank in time for WWII, it developed the 60-ton M6 early in the war. The few that were made never went into combat, the Army relying instead on mass production of the M4 Sherman.

At left, the M24 light tank did join the fight during the final months of the European Theater. Its torsion bar suspension was a big improvement over the vertical volute spring system of the Stuart series, and its 75mm gun was a formidable main armament for a tank of its size.



gun, but overall numbers of the M4A3E2 produced amounted to only 254.⁴⁰

The Ordnance Department continued to advocate a heavy tank, and had already acquired design experience. It had developed the M6 Heavy Tank following France's defeat. None of the 50 vehicles produced entered combat, but the tank's dual main armament of a 3-inch gun and a 37mm gun mounted coaxially, its 25-mile-per-hour speed, its track skirts, and ballistically shaped hull had been innovative for the early war period. Beginning in 1943, the Ordnance Department had also sought to improve the M4 Medium Tank, focusing upon transmissions, suspensions, larger guns, use of an autoloader, and increased armor and fire-power without sacrificing mobility. Independently, the Ordnance Department continued to develop a heavily armored tank carrying the 90mm gun, resulting in the T26-series of heavy tanks. The demonstrated inadequacy of the M4 Medium Tank in combat against heavier German vehicles in 1944 finally provided the

stimulus for AGF, the Ordnance Department, and the Armored Force to agree upon the production of 250 T26s.⁴¹

The 3d and 9th Armored Divisions received the first deliveries of T26s in January 1945. Mixed teams of civilian and military experts provided new equipment training, and their efforts stimulated theater demands for additional tanks. By May 1945, the T26 became standardized as the M26 and 200 had been issued to combat units in Europe. By war's end, only 20 had entered combat, including the capture of the Remagen Bridge. None saw action in the Pacific Theater of Operations, although they were requested for use on Okinawa.⁴²

By the war's end, American tank development had drifted toward more versatile tank designs capable of performing multiple tactical roles and that incorporated a better balance of armor, fire-power, and mobility. Light tanks continued to function in a reconnaissance role, reflecting the American preference for fully tracked vehicles over the cheaper armored cars favored by foreign powers. The M4 Medium Tank and M26 Heavy Tank, however, represented the emergence of the main battle tank concept that would shape Cold War tank designs. Production and design had matured since the confusion of World War I, and benefited from the effective utilization of the

1944 only deepened the three-way rift. The M4A3E2 represented an improvised solution. A 42-ton heavily armored M4, the tank was initially designed for close infantry support during the Normandy campaign, but the U.S. Third Army found them useful in leading armored columns, where their heavier armor increased their survivability if attacked. Some of these tanks carried the more powerful 76mm

automotive industry in all phases of tank development. The controversy over the M4's replacement, however, resulted in American combat troops entering combat with inferior equipment and underscored the importance of coordinating the needs of combat forces with doctrine and technological ability.

Notes

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