

<p><b>THE FUTURE OF THE ARMED SERVICES</b> <b>Training for the 21st Century</b></p> <hr/> <p><b>Statement before the Senate Armed Services Committee</b> <b>21 May 1992</b> <b>P. F. Gorman, General, USA (Retired)</b> <b>H.R. McMaster, Captain, Armor, USA</b></p>
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Knowing that this Committee will soon address legislation that will profoundly affect those armed forces that may again have to fight for the United States on some future battlefield, I welcome this opportunity to set forth the lessons for the future, as I derive them, from the slow, painful progress of the armed services in training for modern warfare during the past century. This much younger soldier, with his own, fresh perspective on battle, will add his views to mine.

The somewhat daunting graphic apparatus before you is an instrument of war, a mechanism designed to enable humans to understand the complexity, the kinetics, the chaos of battle. It is no more than that, a catalyst for comprehension, and we shall use it this morning to illustrate General George S. Patton's reminder that it is men, not machines, who fight and win wars. We will also use it to communicate to you three separate, but related narratives: (1) I will discuss the past and future of US military training, and (2) Captain McMaster will address the experiences of his cavalry troop during Operation DESERT STORM. Then, (3) together we will show you the equipment in the rear of the room, and talk about what it portends for the future.

Mr. Chairman, I am going to administer a strong dose of history this morning, but I ask that you regard it as a necessary cathartic: if the Congress and the armed services are to address the future cogently, all must rid themselves of the notion that simulators are a cheap but not wholly satisfactory substitute for flying, steaming, or driving. I am here to urge that all must recognize, rather, that "simulation" is fundamental to readiness for war. Sound training requires it. Fortunately, scientists and engineers have now opened entirely new prospects for simulation.

Our aim is to lay a proper groundwork for Doctor Victor Reis, Director of Defense Research and Engineering, who will follow us to tell you how simulation technologies that have recently emerged might advantage American armed forces in the decades ahead.

When Dr. Reis has testified, we will have available simulation equipment and operators for hands-on demonstration.



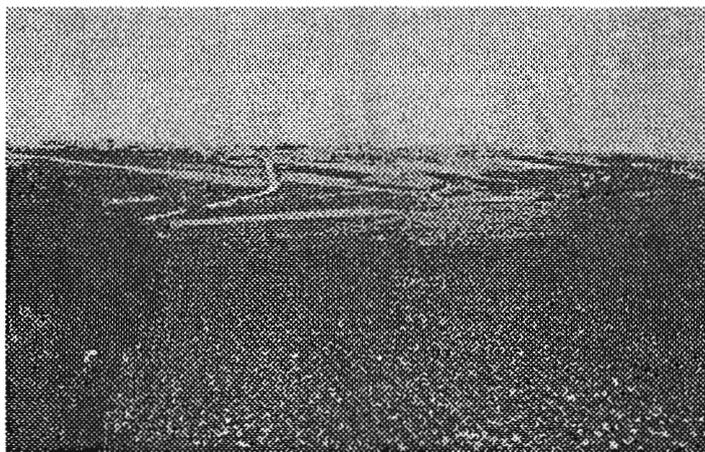
28th Infantry Training, May 1918

Let me invite you backward in time three-quarters of a century, to May 1918. You are looking at a dim photograph of American soldiers of the 28th Infantry Regiment, 1st Infantry Division, undergoing training in assault tactics not far from the French town of Cantigny, north of Paris. The instructor is a French officer, and to the right is a French tank supporting the American infantry.

This is a simulation of warfare, a simulation both in the sense that all tactical training short of combat itself is a simulation of war, and in the sense that this image is a record of reality, but hardly reality itself. We tend to believe a photograph because we know that, at some instant in time, a camera induced a light-governed deposit of silver salt on a celluloid film to reflect the scene before it. Yet what you see today is a much more flexible derivative, made by instructing that computer over there to match dots of light and dark on that screen with the dots of light and dark generated 74 years ago.

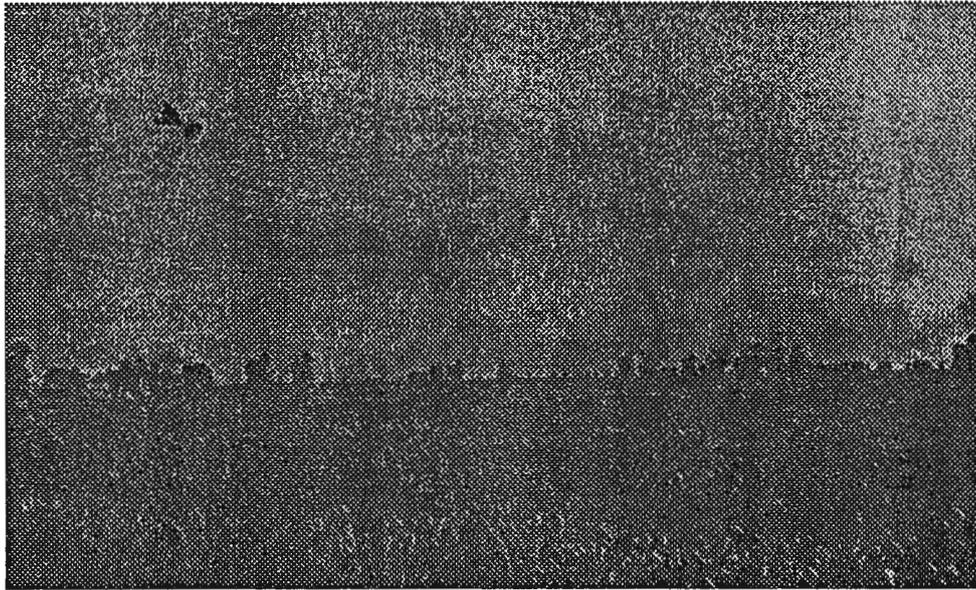
However, our message is not the computer, but the men you are looking at, and what they were doing. These are soldiers of the 1st Division, the presumed elite of General Pershing's American Expeditionary Force —the first US troops to arrive in France, the first to take up defensive duties on the Western Front, the first to suffer casualties in the war. They needed all the training and other help they could get from our principal ally, France, for the 28th Infantry, despite its having been a Regular Army regiment before the war, had lost its experienced officers and sergeants to the mobilization of new regiments. The soldiers in this picture were probably scarcely more than recruits, for the 28th Infantry in May 1918 was composed mostly of men who had entered the Army after April 1917: two out of three soldiers, six out of ten NCOs, five out of ten company commanders had no pre-war military experience whatsoever.

The training exercise depicted was in deadly earnest. The 1st Division had marched to Picardy, to reinforce a French corps occupying a hasty line established at the nose of the salient created by the Germans with their offensive of late March 1918. The 28th Infantry had manned that line, taken a pounding by German artillery, and fended off German raids. The day before the picture, the regiment withdrew from the line, and prepared for the first offensive action by Americans of the war. The training you see underway took place twelve miles to the west of Cantigny, within the week before the 28th went over the top to attack the Germans.



Cantigny, 1918





Cantigny: American Infantry Advancing Under Artillery Fire

Nine French tanks and a platoon of flame-throwers supported the American infantry. Advancing on a front of nine companies, the 28th quickly moved through the town and occupied its objectives beyond by 0735. Casualties were light, but the swift movement of the assault troops left the Regiment's flanks and rear precariously insecure. Fighting within Cantigny continued for several days, during which the French used their flame-throwers to deadly effect against German troops holed up in the cellars of the town. However, the decisive fighting took place along the new front line. The Germans launched determined efforts to drive the 28th back, but the Americans held on — fighting from shallow foxholes and shell craters for the most part— during three days of punishing German bombardment and determined infantry counterattacks. Enemy losses in prisoners, wounded and killed, and German requirements to reinforce an offensive to the east of Cantigny finally led them to break off the battle. The 16th Infantry Regiment relieved the 28th Infantry in place, and properly fortified the line it had won.

Cantigny was a costly win —there were 1,607 US casualties; the 28th lost half its officers, and a third of its enlisted men— but a victory it was, and it sent new expectations throughout the allied forces, for the AEF had at last proven that it could seize and hold ground. General Pershing pronounced that his forces were now ready for offensive action, cabling the War Department that: “The affair at Cantigny on the twenty-eighth was well planned and splendidly executed. Our staff work was excellent...The Allies are in high praise of our troops.”

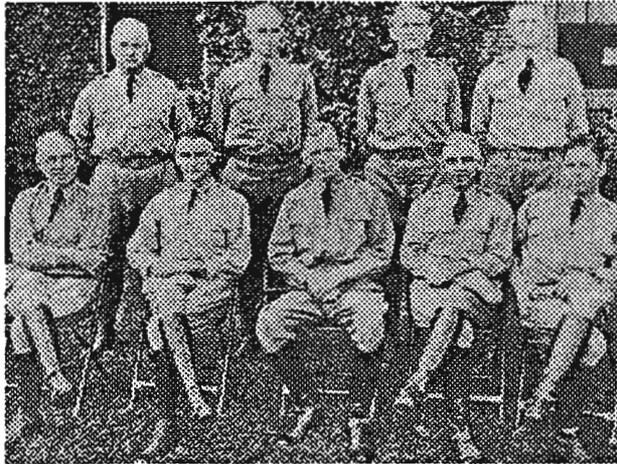


Lt. Col. G.C. Marshall, 1918

Here is the architect of the Cantigny operation, Lieutenant Colonel George Catlett Marshall, then Operations Officer of the 1st Infantry Division. Because the division commander, Major General Bullard, was sick, Marshall organized and directed the attack on Cantigny. The experience taught Marshall two profound professional lessons. The first was the dreadful cost of position warfare, and the imperative it created for a war of movement; these are his own words, from his Memoirs of My Services in the World War 1917-1918:

It was not the ordeal of personal combat that seemed to prove the greatest strain...It was the endurance for days at a time of severe artillery bombardment by shells of heavy caliber, that proved the fortitude of the troops. To be struck by these hideous impersonal agents without the power personally to strike back was the lot of the American soldier at Cantigny. On other fields later on, he overran the enemy, advanced deep into his positions, and suffered far heavier casualties. But the conditions were utterly different and the strain on the individual less severe...

The second lesson had to do with the way the 1st Division planned and executed its Cantigny operation.



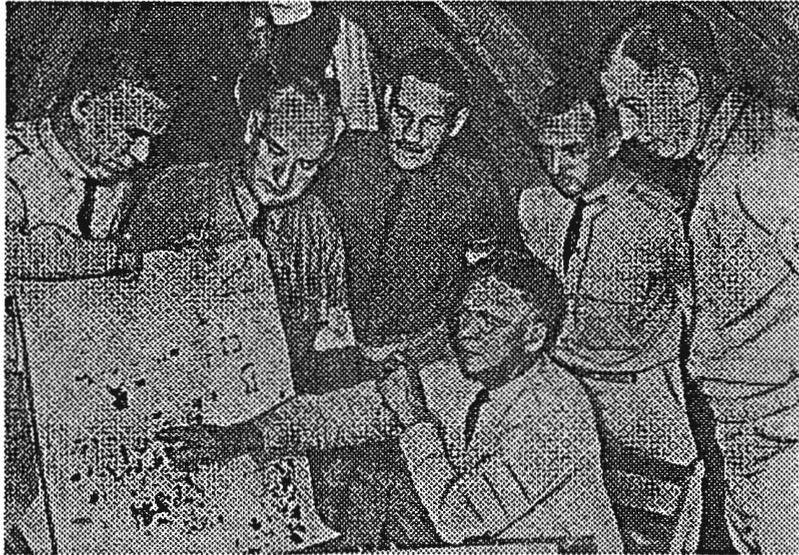
Assistant Commandant Marshall (center) with department heads  
On his right, Lt. Col. J.W. Stilwell; to his right rear, Major Omar Bradley  
Fort Benning, 1931

Here is Marshall in 1931 at Fort Benning, once more a Lt. Colonel, Assistant Commandant of the Infantry School. Marshall sensed that the Army was readying its officer corps for a war that resembled that in France, 1918, and that Army schools were teaching rules and procedures, not tactics and combat-relevant technique. He caused his faculty to compile from numerous combat narratives a book entitled Infantry in Battle, intending that it correct growing misunderstanding about the Army's experiences in World War I. It was hard hitting: the book deprecated the very order for the attack on Cantigny that Marshall himself had written—a voluminous, lengthy, complex typescript that attempted to anticipate every contingency, to leave nothing to chance, or to the initiative of subordinates. As the book put it:

The order for the Cantigny attack is an extreme example of the extent to which minute details may be prescribed in preliminary arrangements for combat. It illustrates the maximum authority a commander can exercise over a subordinate who leads a unit in combat. In war of movement, such an order would be wholly impracticable, but it was well suited to the special conditions at Cantigny. The troops were inexperienced; the objective was strictly limited; there were good maps; there was plenty of time. Therefore the higher commander, having much at stake, exercised the maximum of authority.

It is interesting to observe of the Battle of Cantigny that the surviving records relating to it are most numerous before the attack, and dwindle in number and length dramatically hour by hour for the three days of the 28th Infantry's ordeal under fire. The faculty at Fort Benning, therefore, had ample documents on preliminaries, but only sporadic and often contradictory reports on the fight itself. At this late date, even with access to the files of original messages and reports, I found it virtually impossible to ascertain exactly what happened in the close combat at Cantigny.

That lack of accurate records on close combat is not unusual: looking back on my own three years in combat, I can think of no well-documented fight. The tougher the battle, the more sparse the record. Facts that might help those of us concerned with training for the future usually get lost in the mists of personal conceit, obscured by the fog of war.

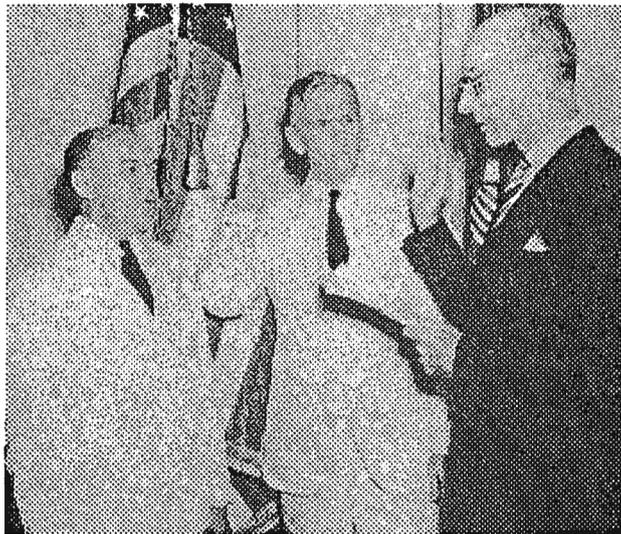


Colonel Marshall (left) on maneuvers with the Illinois National Guard

In late 1933 the Army promoted Marshall to Colonel, and assigned him as the senior instructor, Illinois National Guard. In December of that year he wrote a heartfelt, intense letter to Major General Stuart Heintzelman, Commandant at the Command and General Staff College at Fort Leavenworth, urging Heintzelman to set aside their school-bound staff exercises with detailed maps and Cantigny-like written orders, and to involve his faculty and students in maneuvers with troops. Here are portions of his letter summarizing what he had learned at Fort Benning:

I think we have the best school system in the world, but I also think we are suffering acutely from a lack of practical experience in anything approximating warfare of movement at the outset of a campaign, with inexperienced officers and hastily recruited-up-to-war-strength organizations...[I believe] that warfare of movement...does not admit of orders one half or even one fourth as long as those turned out in our schools. And that, the shorter order, especially if oral, is a much more difficult problem than the elaborate, detailed order...(We learnt that the modern German divisions are sometimes deployed on oral orders)...That the lack of troops, the infrequency of prolonged maneuvers, the tremendous number of desk jobs or non-command jobs now prevalent in the Regular Army, and the frequency of pure command post training, has led us into theoretical misconceptions that do not hold water in the actual business of handling large bodies of troops in protracted maneuvers.

Remember, only 16 years had lapsed from the end of World I, and yet, in Marshall's view, US military professionals were ill-prepared for any international conflict.

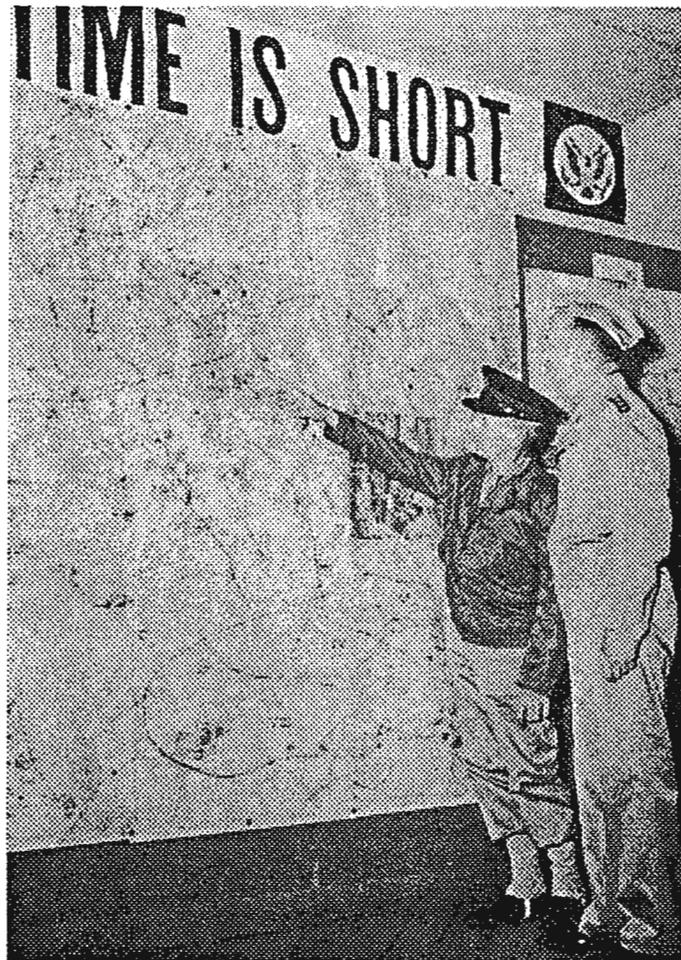


Secretary of War Woodring (l) and the Adjutant General (r) swear in General Marshall wearing mufti per the Administration's ban on uniforms in the Capital

George Catlett Marshall was promoted General, and assumed the office of Chief of Staff of the Army the day Germany invaded Poland, September 1, 1939. That fall he testified before Congress to advocate supplemental appropriations for the Army to support large-scale field exercises:

**Higher commanders and staffs must be given opportunities for training in the technique, tactics, and teamwork involved, and the troops must be accustomed to operating in large groups. The purely theoretical training in Army schools must be supplemented by practical training in the field. There is no known short cut to adequate combat training.**

Marshall's actions matched his words. He suspended classes at the Command and General Staff College and the Army War College, and brought Leavenworth's Commandant, Major General Leslie J. McNair, to Washington to set up a new General Headquarters (GHQ) to direct the US Army in training. McNair, following Marshall's instructions, set about orchestrating a series of progressively larger and more complex maneuvers, leading up to the famous "Louisiana Maneuvers" of 1941.



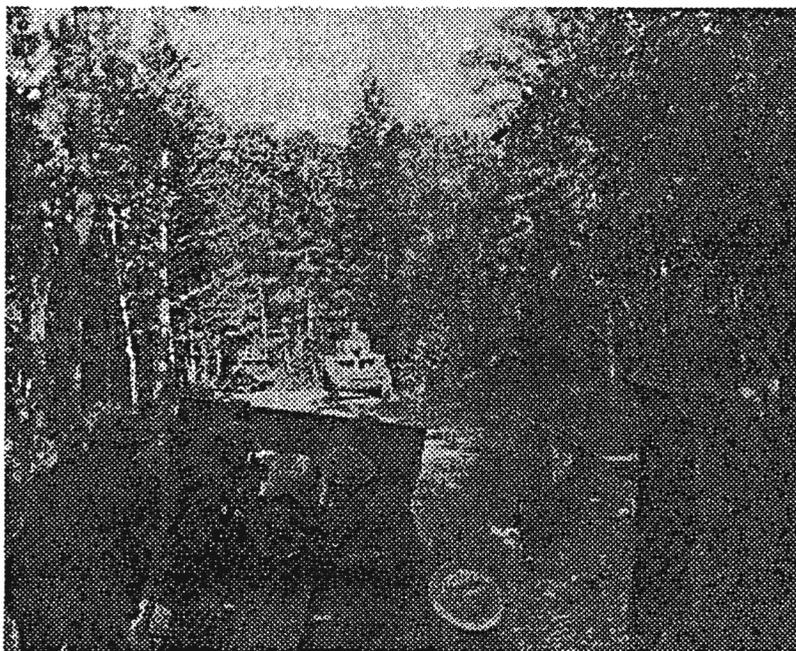
Maj Gen McNair briefs Gen. Marshall, Sept. 1941

Here is Major General McNair with General Marshall at the Louisiana Maneuvers. Those massive field exercises of 1940 and 1941 were simulations of war, and they were simulations used by Marshall and McNair not only to train the mobilizing Army, but also to test their design of land and air forces for combat in a Theater of War. The Louisiana Maneuvers of 1941 involved over 400,000 men of 18 Army divisions, plus 10 aviation groups that included 8 Navy and Marine Corps squadrons.

George Marshall all his career sought better ways to prepare soldiers for war. I have no doubt that he did his best personally to insure that Army training was as thorough as the technology of the time could support. His choice of chief trainer, Lesley J. McNair, was inspired. McNair made mistakes, but given the technical, analytical and pedagogic tools at his disposal, his system for producing divisions from the raw material of schools, farms, and factories was a benchmark professional accomplishment, and his triangular infantry division, and his flexible field artillery organizations proved strategically and tactically sound in combat. McNair personally earned this praise from the German commander, Field Marshall Erwin Rommel:

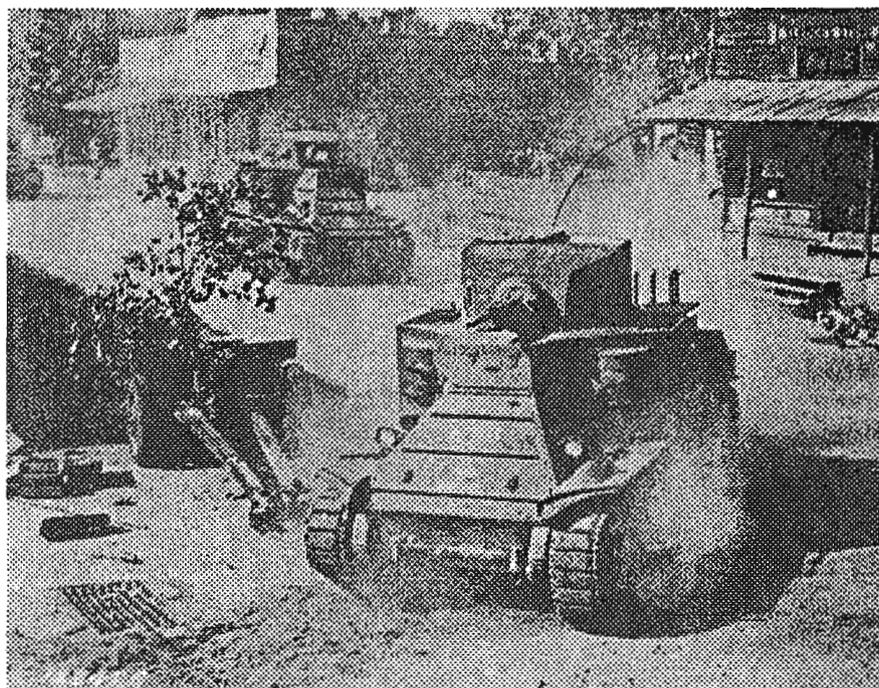
The organization, training and equipment of the US Army all bear witness to great imagination and foresight...[that Army] surpasses anything the world has seen.

The flaws in the GHQ maneuvers centered on mistaken notions of what happened when one force met another in close combat.



Umpire flags down advancing tank engaged by antitank gun

General McNair's maneuvers were large scale, free play, force-on-force mock-battles structured around a set of rules written by McNair himself, and enforced by umpires. The basic rules applied to relative combat power, calculated by the umpires' adding up factors for each unit involved in any direct confrontation. If one side's score exceeded the other's by a ratio of at least two to one, the umpires permitted the superior force to advance, and required the inferior force to retreat. McNair drew up special rules for engagements of tank against tank —losses to be inversely proportional to the numbers of tanks on either side— and for engagements of tank against antitank gun —he assigned guns preternatural range and armor-penetrating power, and reckoned tank losses when within range at 1 per gun per minute. He penalized the tank for its presumed inability to locate and hit a well-positioned gun: to win, it had to charge the gun, assault the gun with infantry, or direct artillery against the gun position.



Tanks overrun an antitank gun, Louisiana 1941

McNair believed that the antitank gun had proven itself as an offensive weapon. Because during the maneuvers antitank guns, when used aggressively, handily defeated tank units, Marshall approved forming 53 battalions of "tank destroyers" within a new combat arm so designated, to be supported by its own school and training center. The weapon system of choice was a low-velocity 75mm gun mounted on a half-tracked carrier:



Tank Destroyer, Carolina Maneuvers, 1941

In the Battle of Kasserine Pass (late 1942), the first encounter with Rommel's Afrika Corps, American tank destroyers proved to be under-gunned and under-armored. The Army never thereafter learned to employ them offensively, as McNair's doctrine had intended. Ultimately many of the Tank Destroyers units raised, equipped, and trained at significant cost were disbanded, and the others used mainly to supplement artillery for indirect fire.



Infantry close combat, Louisiana, 1941

One of the more egregious shortcomings of McNair's simulation of war was its vacuity for instructing infantrymen on what lay ahead for them on the battlefields of Europe and the Pacific.

The picture shows what happened in 1941 when one infantry unit clashed with another in Louisiana. Umpire teams in the middle distance have raised flags to halt all participants in place so that they can compute firepower scores. On the basis of the results of that calculus, they will make a decision on who can advance and who must retire, and how much to dock the firepower score of each unit to reflect the losses each might have sustained. Soldiers were not privy to any of that aspect of the simulation. Few participants could derive from this ballet-like encounter any notion of what worked tactically in close combat, or did not work. As a result, thousands of infantrymen went through the maneuvers in a daze of fatigue from endless marching, and emerged with little or no better understanding of how to fight and to survive under fire.

At the time, Marshall and McNair recognized the deficiencies of the large-scale maneuvers in providing training for close combat either for mounted or for dismounted troops, but did not alter McNair's simulations to any significant extent because they judged that they provided "good training" for higher commanders and staffs, and they were willing to use lower echelon formations as training aids for higher. Further, they believed that the only proper way to train small units for close combat was use of live fire ranges —moving, shooting, and communicating, typically against an enemy force portrayed by arrays of pop-up targets.

It is important for you to understand that those very presumptions governed US Army training until the end of the Viet Nam War. I have here a copy of Field Manual 105-5, Maneuver Control, dated December 1973, that repeats virtually all of McNair's umpire rules for the Louisiana Maneuvers, and prescribes live fire exercises almost the same as those in use 40 years earlier, in 1943. In 1978, Lt. Gen. A.S. Collins wrote a book about Army training that articulated what most younger officers understood very well: large field exercises of the conventional sort benefit only the highest headquarters participating, and two echelons beneath; all others taking part are stage props.

However, the relatively poor performance of the services in the Viet Nam War did lead to improvements in tactical training. It was the Navy that pointed the way. In the later stages of World War II, Navy pilots enjoyed exchange ratios as high as 15:1 flying against the Japanese. Over Korea, the US Air Force maintained kill ratios higher than 7:1. Over North Viet Nam, however, during the early portion of that war, neither service did much better than 2:1. This performance caused the Navy to convene in 1968 a study group to ask hard questions about its materiel, and about the rules of engagement. The study director, Captain Frank Ault, went beyond to call for better training in air-to-air combat, a "PhD." program in weapons and air combat maneuvering. Ault's recommendation led to the celebrated TOP GUN school in San

Diego, and to the infusion into the fleet of truly skilled aerial hunters, trained through simulation of tactical engagements against expert adversaries, in which there was a declared winner and a loser, followed by a detailed review of what went right or wrong.

Once TOP GUN graduates reached the fleet, there was a significant change in the statistics of decisive combats:

<b><u>Tactical Engagement Simulation Pays Off in Air-to-Air Combat</u></b>					
<b><u>Years</u></b>	<b><u>MiGs Killed</u></b>	<b><u>U.S. Losses</u></b>	<b><u>Overall Kill Ratio</u></b>	<b><u>USAF Ratio</u></b>	<b><u>USN Ratio</u></b>
<b>1965-68</b>	<b>110</b>	<b>48</b>	<b>2.29</b>	<b>2.25</b>	<b>2.42</b>
<b>1970-73</b>	<b>74</b>	<b>27</b>	<b>2.74</b>	<b>2.00</b>	<b>12.5</b>

The Navy promptly extended the TOP GUN idea to larger formations, eventually staging mock squadron strikes against defended inland targets in the Nevada desert.

The Air Force was not long in following suit. As the war in Southeast Asia was winding down, the U.S. Air Force added Tactical Engagement Simulation to its own training in its RED FLAG exercises, also in Nevada, and created Aggressor Squadrons that used Soviet tactics, and flew fighters with Soviet-like flight characteristics. In justifying these expensive add-ons, the USAF cited the work of Herbert Weiss, whose research into air-to-air combat in three wars showed high vulnerability for a novice pilot in his first decisive combat—less than 15% have a 50% chance of survival in their first deadly duel. However, Weiss noted increasing survivability as a function of winning: by a pilot's tenth successful mission, his chance of survival had improved by a factor of eight. The Air Force at RED FLAG seeks to allow its pilots to gain that crucial early seasoning through simulation, so that in their first actual combat they will be both more lethal, and more survivable.

TOP GUN had also alerted the Army to the advantage of simulating combat duels and engagements. Beginning in 1973, the Army launched systematic evaluations comparing the Army's customary training with tactical engagement simulation, employing emulators of direct fire weapons:

### **Tactical Engagement Simulation Pays Off in Land Combat**

"Results showed that [Tactical Engagement Simulation] increased the odds of winning an offensive mission by:

**30:1 for Light Infantry Platoons [237 trials of record]**

**15:1 for Combined Arms Teams [58 trials of record]**

**5:1 for Regiments or Brigades [428 trials of record]**

Supported by favorable reports from these trials, by the end of the 1970s the Army had adopted the Multiple Integrated Laser Engagement System (MILES), and had decided to set up its National Training Center at Fort Irwin, California, for battalion-size force-on-force simulation. In 1987 an analyst with the Army Research Institute, Dr. Robert H. Sulzen, summarized as shown the remarkably consistent evidence that by pitting soldiers against a capable, thinking adversary, they learned individual survival skills, and they learned tactical teamwork.

Spurred by this success story, in the mid 1980's the Army joined with the Defense Advanced Research Project Agency in the SIMNET Project to demonstrate the technological possibility of conducting tactical engagement simulation not with actual vehicles on real terrain, but with a large-scale, geographically distributed network of simulators on a "virtual," or "apparently real," computer-generated battlefield. In 1990, to inform itself of the effectiveness of SIMNET-like simulators for training troops on combat relevant tasks, under specified conditions, to established standards, the Army conducted a test of training transfer for nine tank platoons and nine mechanized infantry platoons. The test figured in the decision whether to continue with development and procurement of the Close Combat Tactical Trainer (CCTT):

### **Training Transfer with SIMNET**

	<b>Improvement</b>	<b>Sustainment</b>
<b>Tank Platoons</b>	<b>69%</b>	<b>91%</b>
<b>Infantry Platoons</b>	<b>67%</b>	<b>96%</b>

In the test, situational training exercises in the field, using tactical engagement simulation, assessed the state of training in each unit, scoring performance on hundreds of tasks and subtasks as pretraining ratings. Then, the platoons trained for three days with SIMNET. Finally, they were

again evaluated in the field using tactical engagement simulation, deriving posttraining ratings. If ratings could improve from pretraining to posttraining, SIMNET was credited with training transfer. If the pretraining score was a "satisfactory," and the posttraining score was the same, SIMNET got credit only for sustaining proficiency. The test also probed for instances of a loss of score from pretraining to posttraining that might signal dysfunctional training on the simulator. The results, to quote the test report, "show a statistically significant improvement in platoon performance of subtask standards after SIMNET training."

The implications of affirmative tests and evaluations of this form of simulation are of profound importance for the future of the armed services. Advanced, networked simulation works. It can and should be improved, but demonstrations and tests show it to be a training technology for the future. We shall demonstrate that technology for you here today.

Mr. Chairman, allow me to summarize using this chart of our country's first battles in past wars.

Battle is the ultimate test of any training system. On the record, I think it is fair to say that the United States Army made little progress in training for war over the fifty years following the Battle of Cantigny in May 1918. Moreover, the grim record of this century is quite consistent with this Nation's historic difficulty with finding ways to underwrite the peacetime training of its military forces.

### AMERICA'S FIRST BATTLES

War	American Revolution	War of 1812	Mexican War	Civil War	War of 1898	World War I	World War II	Korea	Viet Nam	Iraq
Battle	Long Island	Queenston Heights	Rio Grande	First Bull Run	San Juan & El Caney	Cantigny	Buna	Task Force Smith	Ia Drang Valley	73 Easting
Date	1776	1812	1846	1861	1898	1918	1942	1950	1965	1991
Outcome	Defeat	Defeat	★ Victory	Defeat	Costly Win	Costly Win	Costly Win	Defeat	Costly Win	★ Victory

I have based this depiction on a book of case studies by eminent historians entitled America's First Battles 1776-1965, one editor of which, Major General William Stofft, is now Commandant of the Army War College. These experts found that poor training in peacetime was the root cause of the difficulties; sound training the explanation for the few successes. Let me quote from the summary essay:

More glaring than poorly trained troops as a first-battle problem is the weakness of command-and-control. Virtually every case study emphasizes the lack of realistic large-scale operational exercises before the first battle, exercises which might have taught commanders and staffs the hard, practical side of their wartime business as even the most basic training introduces it to the soldier at the small-unit level. Virtually every case study indicates that the results of confusion, demoralization, and exhaustion at the command-and-staff level are at best bloody, at worst irremediable—a more crippling defect even than combat units falling apart, because units can often be relieved or replaced in time, headquarters almost never...

Of course, headquarters work hard, but the result too often seems to be that the troops, even when inadequately trained and armed, are readier for war than the men who lead them. The implied lesson is that senior commanders and their staffs might do well to free themselves from the routine busywork of peacetime military life and to plan and carry out frequent, more realistic training exercises for themselves, involving several command levels and arms, that will hone skills that otherwise must be bought with blood and possibly defeat...

One implication of modern simulation technologies is their usefulness in training commanders and staff personnel, as well as tankers and infantrymen. No longer need the latter function as training aids for the former. By networking (1) tactical engagement simulation with real equipment, (2) tactical engagement simulation on a virtual battlefield, and (3) tactical engagement simulation driven by computer constructs of war, it is possible to foresee large scale, realistic exercises being conducted at a small fraction of the environmental impact of an old-fashioned Louisiana Maneuver.

I hope you will excuse my omitting Grenada and Panama from my list of "First Battles," as they were each properly the only battle in a given conflict. Nonetheless, they were victories, and are properly considered harbingers of the success of DESERT STORM. I hope you will also forgive my presumption in listing "73 Easting" as the "First Battle" of DESERT STORM. My choice works well in the context of our discussions today.

Note that the two bright spots in this mediocre record were both battles in which the US Second Cavalry Regiment played a major role: at a place called Resaca de la la Palma on the Rio Grande in 1846, Captain Charles A. May of that regiment led a brilliant charge into the mouths of enemy cannon; at a place called 73 Easting in Iraq in 1991, Captain H.R. McMaster of the same regiment, my fellow witness, led his troop in cutting a three-mile wide swath through one of Saddam Hussein's crack, Soviet-equipped and Soviet-trained armored divisions.

Mr. Chairman, with your permission, I would now like to depart from prepared testimony, and to engage my young colleague in a more or less free-form dialogue.

Captain, tell the Committee about that Battle of 73 Easting. Remember I said that one difficulty Army trainers have had in figuring out what works and what doesn't work in combat is exactly that war stories are no basis for planning how to train for future wars. Yet war stories are often the only record of past battles. Was your battle any different?

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Demonstration of the simulation of "The Battle of 73 Easting" and of networked simulators.  
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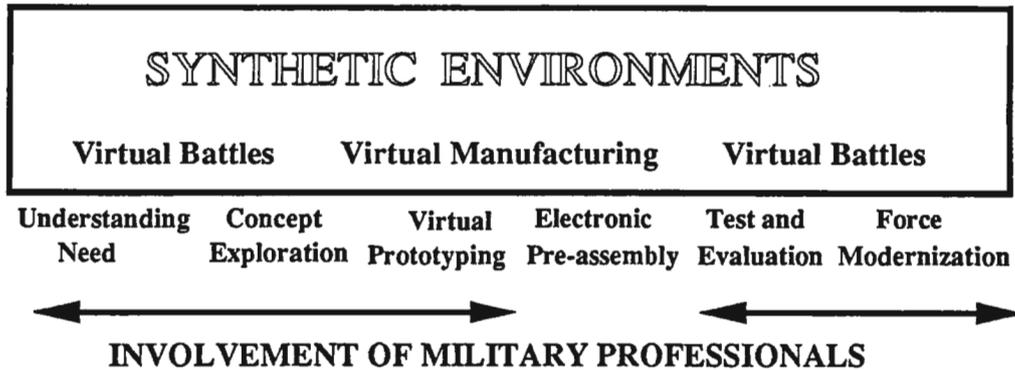
Mr. Chairman, what does this technology portend for the armed services in the future?

We cannot prepare for the future using the thought processes of the past. For the past fifty years, analyses of foreign threats have been the foundation for our force structure, and for defense scientific and engineering undertakings. Now there can be little certainty about threats, and therefore Congress must provide for what we know will be important, no matter how the international situation evolves. Last year Professor Stephen Rosen of Harvard brought out a book he titled Winning the Next War: Innovation and the Modern Military. He advocates a strategy of managing uncertainty, and he points out that, throughout this century, of all the ways the US armed services have found helpful for addressing the future, simulation has proved to be the most useful, particularly when the threat was ill-defined. He also urges that we look for ways of accelerating our manufacturing, and for enlarging our forces should a serious threat emerge. I believe the technologies you have seen provide us the means for acting on his advice.

The present era is witnessing a profound military-technological revolution, driven by the vaulting advances in information technologies —what the Russians have termed "informatics." During the 1920s and 1930s, maturing internal combustion engines, radios, and aircraft combined to alter fundamentally tactical and operational possibilities, and in the 1950s, nuclear weapons and intercontinental delivery systems realigned strategic relationships. Beginning in the 1980s, military applications for computers, sensors, and communication networks began to influence profoundly all three aspects of warfare.

For the national security of the United States, the most powerful application of advanced information technology is the creation of synthetic environments. Synthetic environments can reduce to human scale the vast, chaotic, stressful, complex interactions inherent in warfare: at last, we can comprehend *what could happen*, through experiment *find ways and means for influencing the future*, and thus more confidently *decide how to allocate our resources*.

You have just seen examples of that technology in action, synthesizing environments that once were real, or environments that represent the present. Those environments need not be confined to virtual battlefields. The same technology can create virtual manufacturing processes, or virtual production lines. They not only can facilitate training for, and rehearsal of, military operations, but also can transform the defense acquisition process: dramatically reducing its time and costs, from understanding a new threat, through devising a counter, to engineering, testing, and fielding relevant materiel.



Unlike the technologies that figured in the "revolutions" earlier in this century, these fully engage human experience and human imagination, and enlarge both. Importantly, they enable more direct and thoughtful involvement of military professionals across the acquisition process, bringing to bear military skills, knowledge, and intuition. This could be important both early in the acquisition process for identifying opportunities for meaningful technological intervention, and late in any weapon system life-cycle to ascertain its adequacy in the inevitable measure-countermeasure competition it will face from abroad.

These considerations lead me to three recommendations for this Committee, Mr. Chairman. All three entail your supporting the Department of Defense in developing these technologies, and the armed services in exploiting them. They are these:

- ☆ **Preserve the Warrior Ethos**
- ☆ **Insure a technological edge**
- ☆ **Foster innovation**

In the first and last analysis, what matters on the battlefield is the human will, and the human spirit. Tactical engagement simulation offers a way of providing a surrogate for combat experience at any rank, from flag officer to riflemen or deckhand. It can help identify those with the aptitude for combat, teach them relevant skills, and build both their competence and their confidence. It can train and evaluate them in a battle-like contest against experts, set realistic standards for them to train toward, and year by year, raise those standards beyond the reach of any foreign force.

Mr. Chairman, Congress should support continued search for ways to field forces with a technological edge. At this moment you may be assured that there are, in many nations around the globe, technicians and tacticians hard at work seeking US vulnerability, and ways of taking advantage of it. It is unlikely that there will be another battle like "73 Easting," if only because the US side in a future battle will not alone enjoy the advantage of satellite navigation and imagery, and of thermal-imaging fire control. Using simulation to anticipate, and to provide against future contingencies seems eminently sensible, whether for portraying a possible enemy initiative, for developing US counter-counter-measures, or for devising some new US tactic.

Finally, Mr. Chairman, Congress must insure innovation. One of my good friends is my former wartime commander, General William E. DePuy, a close student of American military affairs since the days that he marched off as a Second Lieutenant to take part in the Louisiana Maneuvers. He has told me of his pleasure at the changes that have been wrought in the American armed forces, only in part by technology, mostly by enhanced professionalism. He believes that there is emerging a distinctive American style of war, a style that is essentially joint, drawing on the unique capabilities of each service, and on centralized planning and decentralized execution. This jointness, combined with surprise, discriminate use of overwhelming force, high operating tempo, and the technological edge just mentioned, has produced forces of unprecedented military effectiveness. It is in the reach, the celerity, the adaptiveness, and the synchronization of US forces that much of their present strength lies, and if we handle reductions in force structure properly, we can augment that strength even with fewer forces.

General DePuy highly approved of General Powell's publishing JCS Pub 1, Joint Warfare of the US Armed Forces. DePuy holds, however, that any doctrinal manual is moot unless it leads to consensus within the armed forces, and that the surest way to lend substance to joint doctrine is through tough, realistic joint training. He remembered that General Marshall, during World War II, set up in the Southwestern United States, for training purposes, a Theater of War that by 1943 had over 90,000 soldiers and airmen engaged in continuous exercises in joint tactics and techniques—including the 90th Division, in which DePuy was serving. Consistent with what he told the Army many times, General DePuy holds that the Chairman ought to set up in the same region mechanisms whereby forces of all four services can train the way they will fight: under a joint command, exploiting jointly collected and analyzed intelligence, and drawing upon each

other's strengths to enhance their tactics and techniques. Out of that, he is convinced, will come more innovative combinations of force, and a reinforcement and extension of that American style of war.

Mr. Chairman, the official of the Department of Defense in the best position to develop the requisite supporting technology will speak next. With your permission, I will turn the meeting over to Dr. Reis.