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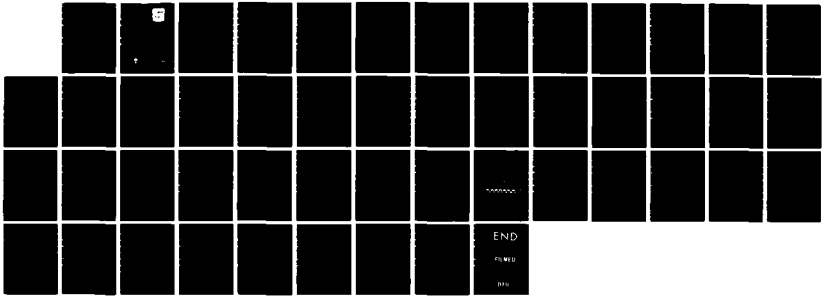

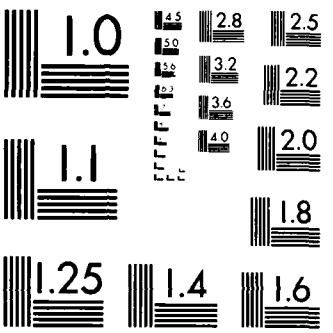

STUDENT ESSAY

ON THE MOVE: COMMAND AND CONTROL OF ARMOR UNITS IN COMBAT

BY

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15 APRIL 1985

US ARMY WAR COLLEGE, CARLISLE BARRACKS, PENNSYLVANIA

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The exercise of effective command and control (C2) by the commander of a mechanized unit engaged in active maneuver is most challenging. Since the introduction of tanks to the battlefield during World War I, armies have wrestled with the problems inherent in a war of movement. Plans made prior to the initiation of active maneuver are frequently invalidated by changes in mission, enemy initiatives, and equipment malfunctions. The search for better communications equipment, improved command and control vehicles, and techniques

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USAWC MILITARY STUDIES PROGRAM

ON THE MOVE:
COMMAND AND CONTROL OF ARMOR UNITS IN COMBAT

INDIVIDUAL ESSAY

by

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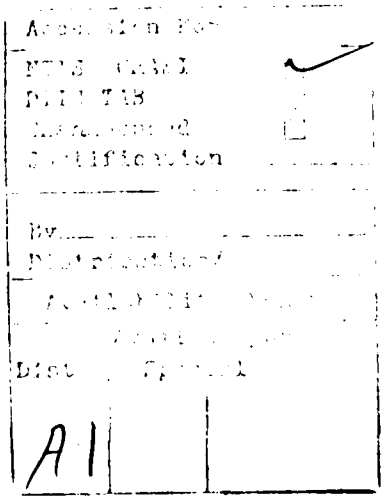

ABSTRACT

AUTHOR(S): John W. Mountcastle, AR

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The exercise of effective command and control (C^2) by the commander of a mechanized unit engaged in active maneuver is most challenging. Since the introduction of tanks to the battlefield during World War I, armies have wrestled with the problems inherent in a war of movement. Plans made prior to the initiation of active maneuver are frequently invalidated by changes in mission, enemy initiatives, and equipment malfunctions. The search for better communications equipment, improved command and control vehicles, and techniques that enable mechanized units to function effectively without detailed instructions has continued without pause since 1916. An assessment of progress in this area would indicate that, while there have been great changes in the scope of land combat and in the speed and power of armored vehicles, the challenges that await the field commander have not changed in their basic nature. The ability to command effectively while on the move is still dependent upon the equipment, training, and command climate in a mechanized unit.

THE PROBLEM: COMMAND AND CONTROL

> No plan of operations can extend with certainty beyond the first contact with the main body of the enemy.[1]

The snow that had fallen intermittently for the last three days had ceased, at least for a time. A quarter-moon's light barely illuminated the narrow valleys and craggy ridgelines that spread throughout Hohenfels Training Area in eastern Bavaria. Gusting February winds sliced at the exposed faces of troops as they played their roles in yet another maneuver exercise designed to test their unit's ability to execute its wartime mission.

The test for night training involved a full-scale battalion attack under blackout conditions. The hours before midnight had been filled with maintenance checks of the unit's M1 ABRAMS tanks and some limited reconnaissance by leaders. The wind and deep snow muffled the high-pitched whine of the tanks' turbine engines as they surged across the designated Line of Departure at 0200 hours. Radio Listening Silence, imposed four hours before, would be lifted only when contact was made with the enemy. No lights showed as four tank companies moved steadily along their assigned attack routes. The battalion commander, following the companies making the main attack, viewed the scene before him with the aid of night goggles which intensified the weak moonlight. The world took on an electric green tint as, leaning forward in the commander's hatch of his M1, the "Old Man" scanned the terrain ahead and to the flanks.

At 0213 hours, the darkness was shattered by the bright flashes of artillery simulators and a dozen flares as the lead units of the attack force struck the enemy's defenses. The battalion radio net came to life with

reports from those companies in contact. With most of these reports being acknowledged by the battalion's Tactical Operations Center, the commander was able to concentrate on the battle as it unfolded. As the battalion executive officer orchestrated the activity at the TOC, the commander issued a few short orders to his operations officer (S3) following the supporting attack (in a tank) and provided the leading companies with guidance as to speed and direction. Radio reports were short and specific, composed primarily of standard prowords that were used for brevity. As the battle developed, the battalion commander noted, with justifiable pride, how well his companies were responding to the enemy's presence.

With nearly twenty years of service behind him, the commander knew that all would not go according to plan. Still, he was not fully prepared for the sequence of events which would soon deprive him of tactical command and leave him adrift in the backwash of the attack, no longer in effective control of the fight going on with increasing intensity in the ridges, draws, and shadowy tree lines of Hohenfels. Once they started, the commander's problems came in rapid succession.

First, a radio report that the enemy was employing chemical agents demanded that all hatches be closed and protective masks be donned. With his mask on, the commander was deprived of his excellent night vision goggles and had to rely on the more restricted field of view offered by an extension of the gunner's sight. All steps necessary to continue the attack in a chemical environment having been taken, the commander held his watch to his face. As he peered through the sweat-dampened face plate of his mask, he realized with a start that almost ten minutes had passed since the gas alarm had been passed! Pressing his tank driver to make up for lost time, the commander forged on through the night in an effort to close on the lead elements making

the main attack. Calls were coming in from the forward elements again, their voices muffled now by the masks worn by the attacking tankers.

The most urgent message came from Company B, then making a supporting attack through difficult terrain. The unit reported no enemy resistance in its path. The promise of a breakthrough arose as the B Company commander sought further instructions and the commander of the reserve company requested permission to throw his weight behind B Company's attack.

Even as he weighed the possibilities offered by this turn of events, the battalion commander monitored a call from a lieutenant commanding a platoon in the company making the main attack. His news was all bad: the company commander was declared KIA by an exercise umpire, the XO had mired his tank in a snow-filled gully, and the right flank platoon was apparently lost. The young officer advised of a heavy enemy counterattack supported by antitank missiles, then abruptly went off the air. This new information demanded a quick decision and action. Just as the commander issued a net call to advise his company commanders and staff of his modifications for the attack force, he heard his own gunner yelling at the driver, a scared youngster who had arrived from Fort Knox just prior to the field problem. The gunner's voice on the intercom drowned out radio communication as he yelled: "Don't hit your brakes! Let her ride the slope! Don't lock the brakes. . . !" But it was too late. The commander had just a second to wish he had not been so noble about promoting his former driver before his tank took on all the characteristics of a 60-ton sled as it slid slowly, but steadily, down a forty foot slope through trees and brush to halt, finally, in a rocky stream bed.

After insuring that none of his crewmembers were injured the commander opened his hatch and reinitiated his call to the attacking units. No response. A frantic check of his radios revealed the worst possible situation. During the tank's sideslip down the hill, a tree branch had apparently

snapped both of his radio antennas off at the mountings. As he pulled himself from the hatch and stood atop his canted turret, the tired lieutenant colonel could not help but think, "Well, I'm in a damned fine mess! I might as well be dead for all the good I'm doing now." The driver, his fright now forgotten, announced in a disgustingly chipper tone that only one track was thrown. As a mood blacker than the night around him settled on the commander he noted that it was snowing again. And that it was very cold. Noises of the battle grew fainter as his battalion fought on without him. "Would the XO and S3 pick up the ball? Would the companies carry on?"

Daylight came before the commander was located by a searching helicopter and reunited with his commanders and staff. Upon rejoining them at the TOC, he was gratified to hear them explain that his sudden departure from the radio net had signalled his second-in-command of a problem. The XO and S3 had worked quickly to pull the threads of information together, issue new orders based on the changed situation, and then fought the battle to a successful conclusion. As he listened to the S3 describe the final phases of the attack, the commander pulled a small card from his wallet. Frayed and stained, it carried a phrase that he had read and copied while a student at Leavenworth:

> A mind that adheres rigidly and unalterably to original plans will never succeed in war, for success goes only to the flexible mind which can conform at the proper moment to a changing situation.[3]

The attack completed, the battalion went about the necessary business of rearming and refueling as the weary commander and his staff began to plan for the next mission. The officers went about their separate duties without taking time to dwell on the lessons learned during the night attack, but each was, in his own way, shaped by the shared experience.

Later, after the battalion had returned to its garrison, the officers would discuss in their professional development classes the myriad challenges

that await the commander when he orders his unit into action. The stress of combat, composed as it is by uncertainty, fatigue, surprise, fear, and anger works to test the best of men. The peculiar challenge of battle has been recognized, of course, for some time. Clausewitz urged steadiness when in extremis by writing:

> A strong mind is not one which is simply capable of strong exertion. It is one which, in the midst of the strongest exertions, can maintain its equilibrium, so that in spite of internal tumult, power of decision and insight remain as steadfast as the needle of the compass, which, regardless of the tossing of the ship, retains its accuracy.[4]

Commanders of combat units have faced challenges in the control of their forces for a thousand years. But the rapid developments of machine warfare during the Twentieth Century have not only heightened the tempo of operations, but have greatly expanded the maneuver commander's span of responsibility and control. The commander of a mechanized unit engaged in active maneuver must maintain control of his formations despite the difficulties imposed by a fluid tactical situation, his own dependence upon FM radio or visual signals, and the mobility demanded of him while maneuvering. The commander, especially at the battalion/squadron level, is further constrained by the very cramped interior of his fighting vehicle, the requirement to operate frequently in a chemical protective posture, and the lack of mobility in any way superior to that of his subordinates.

Current doctrinal statements acknowledge the importance of effective command and control (C^2) which must also encompass reliable communications (or, as it is frequently described, C^3). The US Army's capstone manual for operations, FM 100-5, states:

> At the very time when battle demands better and more effective command and control, modern electronic countermeasures may make that task more difficult than ever before. Commanders will find if difficult to determine what is happening. Small units will often have to fight without sure knowledge about their force as a whole.

> Electronic warfare, vulnerability of command and control facilities, and mobile combat will demand initiative in subordinate commanders. The commander who continues to exercise effective command and control will enjoy a decisive edge over his opponent.[5]

The greatest challenges to effective C^2 comes about when the commander orders his unit to get "on the move." The tightly structured command and control links that work so effectively in static situations are left behind as the relationship of space and time takes on increased importance. The response of 20th century soldiers to the C^2 problems inherent in mounted combat that have existed since World War I provides the focus of this study.

THE SEARCH FOR MOBILITY: WORLD WAR I

The Great War was only months old when the prewar staff planning that had generated the Schlieffen Plan and the French Plan XVII were bankrupted by actual events along the entire stretch of the Western Front. Although leaders in the Eastern campaigns would retain some degree of strategic freedom, field commanders in the West found themselves mired in a stalemate that offered little promise of a quick solution. Stubborn attempts to utilize horse cavalry in exploiting the limited breakthroughs gained by attacking infantry formations failed in every case as enemy defenders quickly closed gaps forced in their lines. Machine guns and artillery assumed the preponderant roles in operations as firepower overcame maneuver in the years 1914-1917.

The land-ships or "tanks" developed by the British were designed to provide an attacker with protection from small arms and indirect fire. Slow, cumbersome, and full of unresolved problems, the tanks were nevertheless pressed into service along the Somme in September 1916. Their initial success surprised even proponents of the clanking metal boxes. Crushing barbed wire entanglements, the tanks forced their way into the German trenchlines and fired on terrified defenders at brutally close ranges. In November 1917, the

accomplishments of armies, most historical treatments of the North African fighting seem to agree on several points. First, that the German general, Erwin Rommel, was able to infuse his always outnumbered forces with a clear sense of mission and that his concept of employing a highly mobile command group enabled him to directly and forcefully influence events on the battlefield. Second, that British and Commonwealth forces paid the price for not developing clear concepts of maneuver warfare within the greater part of their officer corps prior to World War II. Third, the tactical defeats suffered by some American units in 1943 were, if not preordained, at least not surprising given the generalized lack of experience among US field commanders.

Erwin Rommel commanded his forces from a mobile command post that was rapidly shifted from one critical point to another during his campaigns. Accompanied by messengers, and in frequent contact with his subordinate leaders, Rommel used whatever means he felt necessary to insure responsive, redundant C^2. At various times he took to the air in a light aircraft to survey the progress of some phase of an operation. Though seldom mounting a tank, (he preferred to use a fast, open car for his personal vehicle) Rommel usually kept a small kampfgruppe close by should he need the tanks' protection. While often pictured as an autocratic commander who insisted upon strict compliance with his directives, the history of the Panzerarmee Afrika is replete with cases in which commanders executed their missions in the best traditions of auftragstaktik. They were able to do this because they understood the concepts of maneuver warfare and had an appreciation for their leader's goals and procedures.[29]

Corelli Barnett, in his widely acclaimed book, The Desert Generals, describes the difficulties encountered by British forces in the desert. To the great credit of those who commanded in various echelons of the Eighth Army, lessons learned in combat were applied to building a superior fighting

In the early stages of the conflict, many Soviet battalion and regimental commanders were lost in action when, lacking effective means for C^2, they occupied front-line posts with their troops in order to exercise command. Conversely, at Division and Front levels, commanders were frequently out of touch with events because they were too far to the rear. By 1943, improvements in communications equipment, the provision of command vehicles, and greatly improved staff procedures enabled both high and low level Soviet commanders to occupy their proper place on the battlefield, with the means to effect C^2.

Soviet units underwent an almost unrelieved series of defeats in the initial stages of the war in the East, but were able to apply lessons learned in the bitter campaigns of 1941 and 1942. With a capacity for arms production that astounded the Allies and Germans alike, the USSR flooded the battlefield with mechanized equipment from 1943 onward. The employment of Russian mechanized forces demonstrated that the Soviets had gained a thorough appreciation of Blitzkrieg techniques and the C^2 practices necessary to employ armored forces effectively. One Soviet history, entitled Troop Control in the Great Patriotic War, states:

> Wartime experience has proven that firm and stable troop control, particularly during radical and rapid changes in combat situations and high tempos for combat operations, can only be achieved by creating an entire system of control points, a system which usually includes command, observation, and rear area posts.[27]

Compared to the tremendous expenditure of German troops and equipment in the East, the Axis presence in North Africa was miniscule. And yet, for the student of modern methods of command and control, the campaigns waged along the southern shores of the Mediterranean offer many examples of C^2 in combat, both good and bad. While there is great danger in making generalized statements about national characteristics or even attempting to characterize the

> thought is not to be rendered static by their adoption; they are 'speed plays,' for emergency use, or for other occasions where no time exists for a detailed study of the problem or for a rearrangement of our forces. A variation of these basic formations to meet the situation is a battlefield prerogative of every subordinate. A modified application of them will furnish the foundation for cooperative and effective execution which, at present, is often lacking.[25]

If, in 1942, American military leaders approached their initiation into active combat against the Germans in a serious mien, their concern was fully justified in light of the tactical successes enjoyed by German armored and mechanized units during the invasion of Russia and in the episodic North African campaigns of 1941-42. Although the Germans had suffered serious strategic reversals before Moscow in late 1941 and were destined to undergo a major defeat at Stalingrad in January 1943, maneuver commanders on the Eastern Front had once again demonstrated their ability to command and control their forces in a war of movement.

One student of what the Russians call The Great Patriotic War points out that, especially in the period 1941-43, German commanders enjoyed a "maneuver edge" over the Russians. German unit staffs were small and mobile. NCO's played a key role in staff activities, freeing officers for duty as troop leaders. The German use of the Kampfgruppe or "combat team" enabled field commanders to structure combined arms units to meet specific tasks. The Germans understood the concepts of Blitzkrieg as described here:

> The tempo of blitzkrieg calls for speedy and precise command, and its dynamic nature calls for anticipation. To achieve these the operational and higher level commanders have to be forward not only to see for themselves what is really happening but to get the feel of the battle.
>
> All one can add is that this command technique was not a gimmick of Rommel's but was laid down in Guderian's training manuals for the Panzertruppen. As Manteuffel put it, 'I was always located where I could see and hear what was going on in front; that is near the enemy and around myself—namely at the focal point.'[26]

attempt to create a "tank-pure" division, but instead utilized a combined arms concept of organization. The division's major element in the early organizational scheme was an armored brigade composed of both light and medium tank regiments. There were, all told, 25 tank companies in the initial structure. The US tank company was composed of three platoons of five tanks each, with a tank for the company commander and one for his XO, the "Communications and Reconnaissance Officer." American doctrine saw the company of 17 tanks as the basic tactical unit that would execute fast-paced maneuvers aimed at exploiting (a'la Blitzkrieg) enemy weaknesses. Studies written by members of the fledgling US divisions discussed the techniques to be employed in a war of movement. As noted by one such officer, armored units in a penetration would find their means of C^2 heavily taxed:

> It is at this moment [the penetration] when the principles of 'flexibility,' 'initiative of local commanders,' 'fire and movement,' and the use of 'plays' depending on flag or radio signals for quick execution may be most applicable. The small unit commander will probably find the 'unexpected' to be the rule from here on.[24]

The Americans understood the necessity for simple, easily conducted battle drills aimed at reducing, insofar as possible, the confusion that results from sudden actions on the battlefield. One approach taken, by the 1st Armored Division, was the development of reactionary drills or, to use sports parlance, "plays" in which armored or motorized units--from platoon to battalion level—would rapidly and with conditioned responses execute fire and maneuver with a minimum of verbal orders or radio conversation. A training memorandum published by the 1st Armored Division prior to its deployment to North Africa outlined the unit's high degree of interest in fast, effective battlefield actions:

> It is not expected that these plays will necessarily be the solution on the battlefield, but it is believed that a thorough knowledge of them will furnish a sound basis for inspiration when the occasion arises. Our tactical

of unit leaders to react quickly to changes in mission orders. The acceptance of the principle of auftragstaktik was essential to maintaining the pace of assaulting elements when their C^2 mechanism broke down because of equipment failure or because subordinate units had outrun the range of their radio links with higher headquarters. One German participant recalled the fast-paced action in early June 1940 this way:

> My anti-tank unit was halted for rest and moved into a forest beside the road. We had been there only a short while when a tank battalion of Mark IIIs went into action to our front. The battalion commander stopped his tank nearby. He had several radios on his tank and motorcycle messengers came and went constantly with messages. For half an hour he conducted the battle from his tank while he ate some sausage and bread. He seemed to me to be in control, like a soccer coach. I think he could feel the battle although there was so much dust stirred up by the tanks and smoke from a burning barn that it kept us from seeing much. Things went well for the tanks and then, with a wave to his messengers to follow him, he was gone.[22]

The degree to which senior German maneuver commanders became involved in the action was indicative of their personal commitment to proving the viability of their concepts of mobile warfare. Generaloberst Heinz Guderian commanded the XIX Corps, made up of 3d Panzer Division, 2d and 20th Motorized Divisions. As noted by one biographer, Guderian positioned himself so as to be able to influence the action.

> He travelled with the leading tanks of the 3rd Panzer Division in one of the latest models of armoured command vehicles, equipped with radio that enabled speech to his main headquarters in the rear and such other formations as he needed.[23]

Developments in Europe made a strong impression upon those charged with creating the new American Armored Force. Some expansion of the US 7th Mechanized Brigade had taken place during the US Army's maneuvers held in Louisiana in 1940. By the end of the year, two US armored divisions had been authorized and were being manned and equipped. Like the Germans, the Americans did not

The outbreak of open conflict in 1939 saw the Germans demonstrate their concept of maneuver warfare, which was aptly described as a Blitzkrieg by observers. As Hitler opened his spring offensive in the West during May 1940, German mechanized units exemplified the concept of auftragstaktik (mission-type orders) that guided their actions in fluid, fast-paced action. Essentially, the concept demanded that subordinate leaders possess an understanding of their leader's mission, his basic plan for mission accomplishment, and of the tactics necessary to succeed. In the absence of specific instructions, the well-trained unit leader was expected to make on-the-spot assessments and carry out his assigned tasks with energy and imagination. The German panzer units repeatedly demonstrated their ability to move inside their opponents' decision cycles, to maintain their momentum, and to react to the unexpected successfully. C^2 was thus enhanced throughout the German organizations. The tactical success enjoyed by German units in 1940 was largely a product of surprise, mass, maneuver, and daring execution of the mission.[20]

WORLD WAR II — LIGHTNING WAR

The startling victories enjoyed by the Germans during their "Blitzkrieg" of May-June 1940 were attributable, in large part, to the employment of ten Panzer divisions as the spearheads of all major German thrusts through Belgium and northern France. The German armored divisions developed during the late 1930's were not composed of masses of tanks. To the contrary;

> . . . on the eve of the 1940 French campaign, there were 35 tank battalions in the ten Panzer divisions with a total of 2,574 tanks. This was no more than the total French front line tank strength, but the bold and concentrated employment of the Panzer divisions, grouped in Panzer corps, proved decisive.[21]

Key to the success of the Panzer spearheads in the very fluid campaign in France was the widespread employment of radio in German units and the ability

In the early 1930's, Germans developed FM radios that were clearly the equal to anything provided to British or American tank troops. After Hitler threw off the Treaty restraints, German production of mechanized equipment rapidly expanded. Although not willing to abandon visual signals for C^2, the new German tank forces, with Guderian now playing a major role in their development, applied a great deal of energy to the improvement of not only communications modes, but to the evolution of battle tactics for armor. German officers felt the need for a suitable command vehicle for unit leaders, one that would enable the field commander to maintain C^2 while on the move. By 1938, German panzer battalion commanders were receiving specially modified tanks in which the main gun had been replaced by a dummy barrel (thereby providing sufficient space inside the turret for extra communications gear, maps, and personnel. This type of tank, the Panzerbefehlswagen, would see continued use throughout World War II, with a limited number of each new tank model modified for this purpose. (See Figure 2.) The armored infantry units (panzergrenadiers) were provided with command variants of the standard half-tracked infantry carrier.[19]

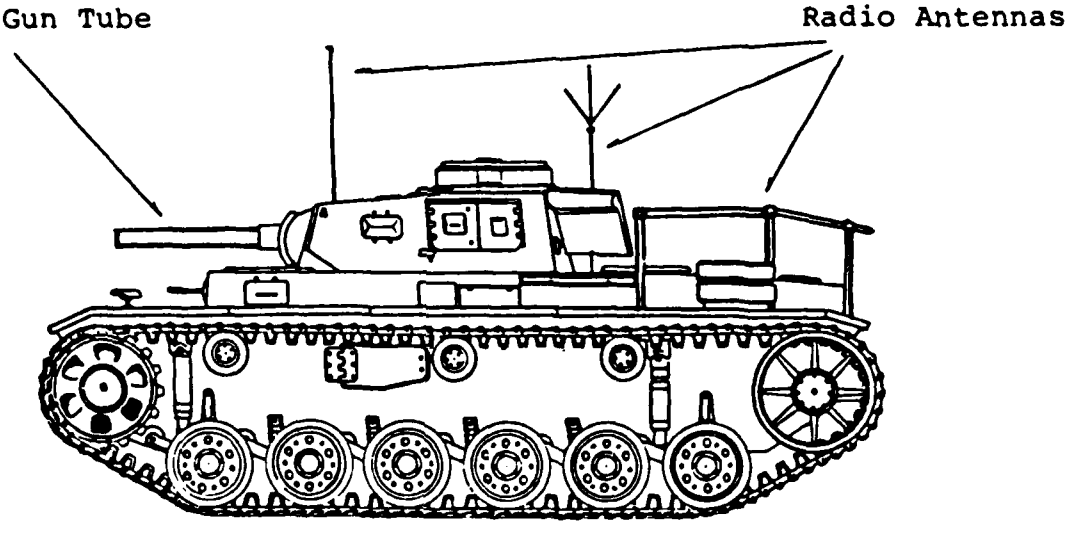

Fig 2: German Command Tank (Panzerbefehlswagen) - 1940

that, with the proper radio support, changes in mission and recent battlefield developments could be rapidly transmitted up and down the chain of command. He further suggested that each tank or light combat vehicle within combat platoons be provided with a radio receiver, so that the sergeants commanding those vehicles could also be kept informed. Ingles stated: "Radio provides the greatest possibilities for communication with the headquarters under which the tank unit is operating and for intercommunication between the tank units. Radio telephone is preferable to radio telegraph."[17]

A proponent of airpower during the period, Italian General Giulio Douhet, stated that: "Victory smiles upon those who anticipate changes in the character of war, not upon those who wait to adapt themselves after the changes occur." His book, Command of the Air, urged governments to follow a policy of proactive development of military hardware and techniques. His thoughts impressed a number of German officers who, chafing under the restrictions of the Versailles Treaty, worked in secret to revitalize the German armed forces. Among those who led in the development of new vehicles was the Inspector General for Motor Transport, General Heinz Guderian. At Guderian's insistence, German troops trained on tanks in Russia and read the somewhat simplistic doctrinal publications available in Russia in the 1930's. ("The commander must be capable of exercising proper control in battle. The commander should, at all times, maintain a firm control over the progress of the battle.") Both Russia and Germany were grappling with the same sorts of conceptual problems relative to the increased demands for C^2 in an age that would be characterized by fast-moving mechanized operations conducted over rough terrain in dispersed formations. With their superior staff organizations devoted to problem-solving, it would be the Germans who forged successful tactical doctrine for mechanized combat.[18]

LTC P. C. S. Hobart, one of the battalion commanders in the experimental brigade, was determined to enhance the C^2 of his formations. In his history of the Royal Tank Corps, Basil Liddell Hart writes:

> In his concentration on wireless as the means of control, Hobart was aiming above all at increased mobility—and that meant using wireless in movement. [He found that] the custom of working constantly under the orders of infantry commanders, and in small packets, had developed the habit of advancing by small bounds, with the officers getting out of their tanks to confer prior to a fresh bound. The first need was to inspire all officers with the belief that wireless communication between tanks on the move was practicable, and the next, to convince them that they were capable of using it.[16]

Improved command and control for this type of mobile unit demanded that the commander be able to maintain radio contact with his subordinates. In that the effective transmission range of the old British MB/MC radios installed in Hobart's tanks was something less than three miles, armored unit commanders were required to be as mobile as their subordinates. To this end, Broad and his battalion commanders developed and used "command tanks." Built on the standard Mark I tank chassis, the C^2 tanks provided armor protection in an armored, box-like structure that replaced the normal revolving turret. By 1934, this unique vehicle had given way within the tank battalions to a tank with normal exterior appearance but with reduced ammunition storage space and increased radio equipment and folding mapboards within the turret.

A staff study completed in 1932 by a student at the US Army War College, Major H. C. Ingles, provides a clear picture of the steps recommended to improve the performance of the small mechanized force then training at Fort Knox, Kentucky. The 7th Cavalry Brigade (Mechanized), under the command of Colonel Adna R. Chaffee, a cavalryman, was striving to develop a workable body of doctrine for fast-moving armored forces. MAJ Ingles called for the installation of Frequency Modulated (FM) voice radio sets in all commanders' tanks and combat cars down to platoon leader level. His staff study argued persuasively

and Basil Liddell Hart in England, Charles DeGaulle in France, and the little-known Heinz Guderian in Germany, the pioneers of the modern armored forces were able to wangle some increased support from their respective military establishments.[13]

British experiments, carried out under the leadership of Colonel (later LTG) Sir Charles Broad, did much to advance the institutional acceptance of an armored force that could assume many of the functions of the obsolete horse cavalry while still assisting the infantry in the conduct of attacks. Although there was disharmony and confusion surrounding the results of Broad's work, the Royal Tank Corps began to be accepted by a larger segment of the Army hierarchy. Significant too were the clear indications that a mechanized force demanded greatly improved command and control once it began active maneuver.

Broad's "Report on Training of 1st Tank Brigade, 1931" indicated that intensified training in the use of wireless transmitters had been completed and that a number of tanks had been equipped with radios capable of transmitting voice. The radios, though obsolescent and subject to frequent malfunctions, were all that were available in 1931. The radios proved to be:

> . . . successful to a point. Practice showed that communication was effective at the halt and within a limited range. The radio is essential to efficient manoeuvre, and R. T. C. [Royal Tank Corps] personnel can be trained to use the devices.[14]

A finding of special significance in the British maneuvers was the need for simple, effective battle drills, reliable communications, and mobile command posts. The training report for 1931 further stated:

> . . . a series of new formations was devised and the signal difficulty overcome. . .by the adoption of a two-letter code. Orders for manoevre drills were given in this code, either by displaying a combination of flags, one above the other, or by wirelessing the two letters in Morse code.[15]

knowledge at hand, a failing that had hamstrung developments in many areas during the late conflict. One student of technological change has said:

> . . . The experience of war showed that the failure to emphasize better weapons rather than more weapons and the failure to attach sufficient importance to the formulation of doctrine issued directly from inadequate organization. . . . At the same time, the events of the war showed that decisions based upon opinion, memory, a limited range of personal experience, or emotional bias led only to failure.[12]

The British would eventually establish an experimental brigade to begin work on tactical doctrine for tanks, but not until 1927. The French, bankrupted by the Great War, made only limited efforts in the 1920's to improve upon the tank technology developed during the last two years of the conflict. The fledgling US tank corps lasted only until radical cuts in Army strength brought about its dissolution in 1920; with its collection of American-built Renaults and British Mark VIIIs going to the scrapheap or to support the Infantry School at Fort Benning. In Germany, the Weimar Republic was wracked by internal strife and limited by Treaty provisions to a 100,000-man army that was, in effect, a police force.

Financial constraints, combined with a widespread abhorrence of war and any perceived need for large standing armies kept military expenditures, especially for research and development, to a minimum during the 1920's. George S. Patton, who had established a reputation as an American tank commander in the War, saw little future for the tanks as long as they remained an adjunct of the infantry and returned to the cavalry.

It was not until the 1930's that developments in weapons technology, improvements in the size/weight/power ratios of automotive engines, and new techniques in armor plate production were able to provide support to those individuals who were struggling to conceptualize ways in which maneuver could be returned to the battlefield. Encouraged by the writings of J. F. C. Fuller

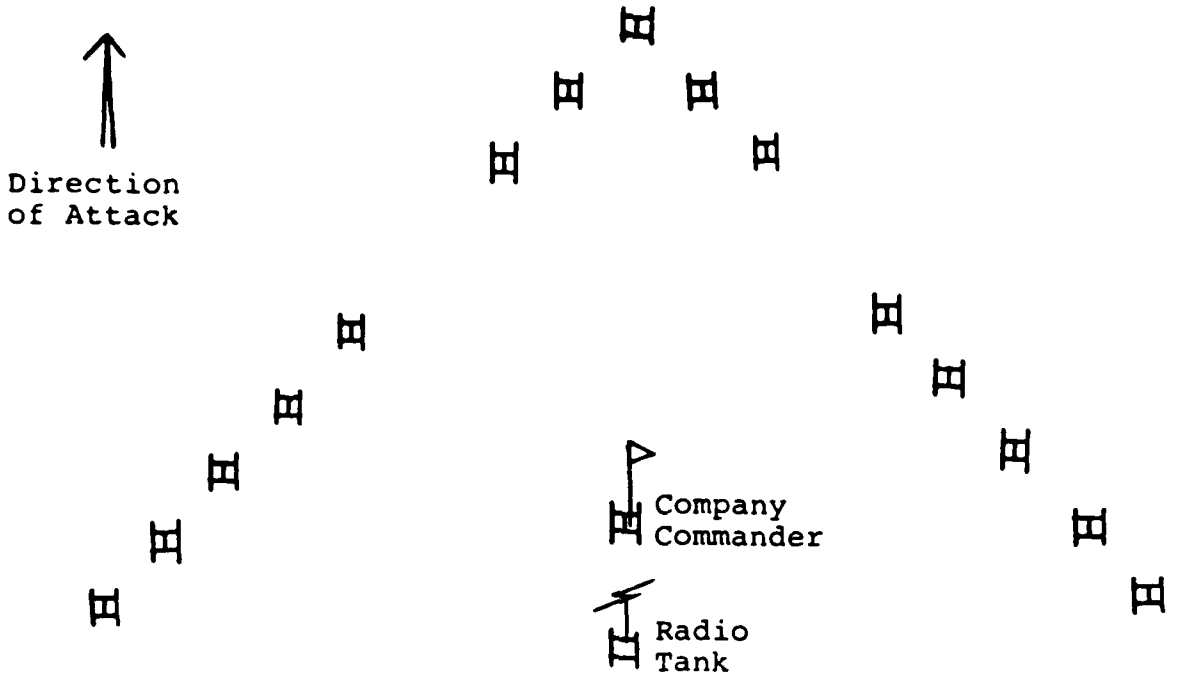

Fig. 1: US Tank Company (WW I) in Wedge (Attack) Formation

to digest the lessons of the "war to end all wars," the seeds of an even greater conflict were beginning to sprout in war-torn Europe and the far reaches of the Pacific.

THE INTERWAR YEARS: EXPANDING HORIZONS

The decade following the Armistice of 1918 saw a general retreat from "militarism" as the former combatants attempted a return to "normalcy." The plans for expansion of mechanized forces envisioned by the British, French, and Americans for 1919 were tabled and the military gave themselves over to the postmortems that follow every conflict. Those who would apply lessons from 1914-1918 to future developments in equipment, organization, tactics, and strategy were soon stymied by a lack of funding and government interest in their projects. An inhibiting factor in the search for new doctrine was the lack of effective organizations for assessing future requirements based on

The entry of the United States into the War in April 1917 was to presage by a full year the employment of any tanks under US command. Lacking tanks, the Americans were forced to buy and borrow tanks from the British and French. The British Mark V heavy tank and the light French Renault formed the backbone of the American Expeditionary Force's First Tank Brigade. Lieutenant Colonel George S. Patton assumed command of the 1st Brigade in the late summer of 1918. He led the unit through its baptism of fire in the St. Mihiel Salient and was directing a tank attack on foot in September 1918 when he was wounded. In that the speed of his attacking tanks never exceeded 5 MPH, Patton was able to direct their advance with his riding crop until he was felled by a German bullet.[9]

Unwilling to lose great numbers of senior officers in this manner, the US Army had begun testing the use of wireless sets patterned after the British equipment. By October 1918, wireless sets were being installed at the rate of one per tank company (17 tanks). A diagram published in the first American doctrinal manual on tank organization and tactics depicts the radio-equipped tank following closely behind that of the tank company commander in attack formations. (See Figure 1)[10]

Throughout World War I, tanks played a subordinate role to infantry formations. As noted in an American manual just after the War:

> The tanks are always subordinate to the infantry so far as actual combat is concerned. Viewed from the standpoint of tactics, the tank is purely an offensive weapon; that is, it must be employed while advancing on the enemy. Hence, when the situation demands a defensive attitude, the tank, if used, must be used in counterstrokes. A passive attitude will nullify its greatest asset—its mobility.[11]

Years would pass before tanks broke out of this constrained role. As long as the tanks were slow, attacked only limited objectives, and existed in small numbers, signal flags, flares, and the commander's arm and hand signals would suffice for C^2 on the battlefield. But even as the armies of the world began

British again used large formations of tanks to spearhead an offensive at Cambrai. German accounts stated that, ". . . their men felt powerless to withstand the tanks." Unfortunately for the British, the battle ended inconclusively, in part because the attackers lacked the necessary mobility to exploit the "break-in" of German lines created by the tanks.[6]

The ability to overcome defensive positions evidenced by the tanks was not lost, however, on the British, the French, and their newest allies, the Americans. All three armies increased their complements of tank units and made efforts to rapidly expand their mechanized forces. The Germans, who would display such virtuosity in armored operations during World War II, were slow to develop tanks and had to content themselves in the main with copying captured British models.[7]

The maintenance of control over attacking tanks proved to be a problem from the start. British and French commanders briefed their crews in detail on attack routes, objectives, and limits of advance. All of the planning conducted before combat was not wasted, but frequently was invalidated to one degree or another by changes in the tactical situation. Should a change in orders be demanded, the only means of communicating new instructions lay in the use of semaphone signals, colored flags, or colored flares. The smoke and dust of battle frequently obscured these attempts to communicate, with the resulting confusion that characterized tank attacks.

The British, in an attempt to maintain contact between attacking tank companies (12 tanks) and their battalion commander, outfitted older Mark I tanks with wireless sets and sent them into battle as rolling command centers. These tanks, sporting tall aerial masts procured from the Royal Navy, followed the company commander's tank. Despite these efforts, C^2 broke down with regularity, frequently causing tank unit leaders to lumber about the battlefield, rounding up and redirecting their tanks like mother hens.[8]

force. But during the period 1940-42 British C^2 failures were exacerbated by conflicts in doctrinal thinking that permeated the British military establishment. Cavalrymen were too frequently willing to conduct uncoordinated assaults over open ground, becoming easy targets for German antitank gunners. The slower British "cruiser" tanks, designed for an infantry support role, were unable to react quickly and effectively to changes in the tactical situation when initiated by the Germans. And it would take two years of harsh combat to overcome the problems of inadequate staff procedures at various levels within the British and Commonwealth forces, problems which contributed to confusion on the battlefield and less than effective command and control.[30]

The Americans, coming to the conflict as true novices, had to hone their combat skills in an on-the-job training program that allowed little room for error. Many accounts of combat in Tunisia during early 1943 point to the need for improved radio communications for armored units and the importance of clearly understood battle drills that are practiced by all vehicle crews and units. One company commander in the 1st Armored Division, a veteran of fighting in North Africa, stated that, in his unit, the use of drills was extensive.

> We always used battle plays when we left our tank harbor in any formation other than a column or line. Lieutenant Colonel Crosby [the battalion commander] . . . also used battle plays to control the battalion. . . . The battle positions of a platoon, company, or battalion can be changed instantly by giving a battle play order of a very few words.[31]

As the war continued, all of the combatants incorporated improvements based on combat lessons. Soviet forces, generally on the offensive after 1943, grappled with new procedures for C^2 when conducting infiltrations of German defenses and full scale armored assaults. And while, in the words of one German veteran, ". . . Russian tanks frequently presented their flanks to us for killing shots because their commanders seemed confused as to their

objective," in overall terms, the Soviets made very effective use of forward control parties during 1944-45. The Germans, placed on the defensive everywhere after 1943, continued to demonstrate the tactical acumen that made them such dangerous enemies. Small pockets of German resistance were sometimes able to create significant difficulties for Allied maneuver commanders attempting to maintain the momentum of an attack. As recounted by one US tank battalion commander, a veteran of fighting in Italy:

> We were attacking towards Rome. . . . General Geoffrey Keyes was present as my lead company was halted by a German anti-tank gun. He, of course, demanded that we press on. The lead tank from I Company was knocked out as it rounded a bend in the road. I, in the third tank, had my tank hit almost immediately and [was] disabled. My turret was hit and the radio antenna was knocked out. I was then without radio communications. Then I ran back to an H Company tank to get communications and continue the attack. The Germans still controlled the approaches to their position. We were able to get the stalled attack going again, but only because some of my platoon leaders used their heads and worked one of our assault battle plays.[32]

In the final stages of World War II in Europe, veteran forces found it increasingly difficult to maintain a high level of C^2 efficiency because of high personnel turnover due to casualties, illness, and transfers. All of these robbed units of those who had been indoctrinated in the standard operating procedures so important in combat. Communications equipment failed with regularity in US units. One battalion commander complained that during an all-day attack in November 1944 he never enjoyed adequate communications for more than ten minutes out of every hour. Some American units abused their communications by overuse, often providing listening German units with valuable information as to the US unit's location and mission.[33]

German's surrender in May 1945 marked the end of maneuver warfare on the Continent. The experience garnered by the victors was buttressed by information derived from interrogation of captured German officers. In the Pacific,

war still raged as Allied forces continued to tighten the ring around the Japanese home islands. The island fighting that characterized much of Pacific combat had presented its own challenges for the ground commander in his exercise of C^2. But these situations were regarded as unique and not truly representative of large-scale maneuver warfare. Ironically, perhaps, the United States would find its forces engaged in combat twice in the 20 years following the end of World War II, both times in the Pacific. Neither the Korean nor Vietnam conflicts saw extensive use of large mechanized formations. The recent combat experience of Americans notwithstanding, it is still the grand campaigns of central Europe, the North African desert, and the plains of Russia to which students of maneuver warfare look for information and historical analysis. Arab-Israeli conflicts in which armored forces played a major role and the potential wartime missions of the NATO divisions in Europe continue to capture the interest of those who would study the exercise of effective command and control in active combat.

THE SEARCH FOR SUCCESS CONTINUES

In the forty years that have passed since the conclusion of World War II, we have seen tremendous technological advances in nearly every sphere of man's experience. As in many other areas, qualitative improvements have been made in armored vehicles, communications equipment, and in ancillary gear. And yet, the difficulties that faced commanders of armored formations in World War II still exist in form and substance today. Military men continue to search for better means of insuring command and control of their forces when they are committed to active maneuver. During the ten years following Japan's surrender, world peace was marred by dozens of limited wars. For weaponry, the combatants relied upon the huge surplus of World War II equipment that made up the arsenals of major powers, emerging nations, and dissident factions the

world over. However, unlike the great campaigns so recently concluded in Europe, these "small wars" were generally constrained by factors of geography, political aims, and weapons and forces employed. The Korean Conflict (1950-53) saw the use of armored formations by both Communist and United Nations forces. But, in the majority of these actions, the scope of mounted maneuver was limited, usually by terrain. In many instances, US tanks assumed the role of self-propelled artillery as they supported infantry attacks by fire rather than participating in the maneuver.[34]

America's involvement in Vietnam provided for the limited use of armored units. Although C^2 was challenged by the dense jungles, heavy forests, and rugged terrain in which US tank and armored cavalry forces operated, the difficulties of maintaining command and control were not as great as they might have been. Armored units generally operated at company or platoon level and almost always in support of infantry units. The experience of US mechanized force leaders in Vietnam was much more akin to the tactics employed by Marine and Army tankers during the close-quarters combat in the Pacific islands than it was to World War II campaigns in Europe. If there was innovation in C^2 during the long and frustrating conflict, it came in the form of the ubiquitous UH-1 helicopter, the "Charlie, Charlie" (Command and Control) aircraft. Hovering above the trees, it carried the battalion commander, his artillery Fire Support Officer, and various other retainers while providing direction to those below. Although C^2 helicopters played a significant role in Vietnam, no serious assessment of the potential Soviet air defense threat in Europe could escape the conclusion that the C^2 ship was too vulnerable for any such use in a European combat scenario. And so, the responsibility for C^2 still lay squarely upon the shoulders of the mechanized force commander.

Soldiers have continued to experiment with ways of enhancing command and control of maneuver units. In the late 1950's, a series of tests was conducted

in attempts to improve C^2 during periods of limited visibility. In one such exercise, carried out at Fort Stewart, Georgia, 60-inch searchlights were utilized to delineate the lateral boundaries of night attack zones for tanks. Tanks positioned on the flanks of the attacking formation fired solid streams of tracer ammunition along established boundaries in an attempt to guide the tanks conducting the movement. Upon nearing the objective, attacking tanks illuminated the defensive positions with their tank-mounted 18-inch searchlights. Test results indicated that while the various forms of illumination had provided some assistance in controlling the movement of the attackers, many problems typical in night attacks remained to be solved. Tanks had become lost, tended to bunch too closely together, and had utilized their radios to an unacceptable degree.[35]

Despite improvements in tanks, armored infantry carriers, and communications equipment, NATO commanders and their Soviet counterparts still placed great reliance on the use of battle drills as a means of inculcating maneuver units with a high degree of tactical sense. One US division commander, when asked if drills were effective, replied unequivocably: "Absolutely! They are greatly effective. I can't speak too highly of them!" But drills as such cannot totally replace the influence of the commander on the battlefield. One American general officer commented on the need for the commander's presence in this way:

> Go where the action is. George Patton had a good slogan, 'you can pull spaghetti anywhere, but you can't push it anywhere.' In almost any sample of 100 combat . . . [troops] usually about 10% are pretty courageous, 10% are pretty non-courageous, and the remaining 80% can be influenced either way. Successful command consists of pointing the most courageous in the right direction and influencing the 80% group to follow.[36]

The great success of Israeli armored formations during the Arab-Israeli War of 1967 was noted with something like awe by many western armies. The

ability of the Israeli forces to strike quickly and decisively over extended distances—often operating against the flanks and rear of enemy units—epitomized the ideal of freewheeling armored operations. The initiative displayed by subordinate unit leaders in fluid battlefield situations where formal C^2 had broken down indicated an Israeli appreciation for the concepts of auftragstaktik as defined by a German officer of the modern-day Bundeswehr:

> In future combat situations where high mobility and rapidly changing situations will prevail, the unforseen will be the rule. No operational plan, no matter how detailed it may be, can fully take into account all inponderables of combat. What is all the more important, then, is the freedom of action which every level of command is allowed. Thus a subordinate, after evaluating the situation on the spot and being well aware of the intentions of the superior leader, can take rapid action even if communications break down and it is impossible to obtain approval to depart from the original operational plan.[37]

A number of American commanders have grappled with this concept, especially as it may apply to combat against Soviet forces in Europe. The NATO mission of fighting effectively even though outnumbered in any European land war places great demands on the commander ("Personal command and control in battle is accomplished in situations that are obscure, when time is short, and under the stress of having suffered personnel and materiel losses.") This concept demands a great deal of subordinates as well. Recognizing this, and in an attempt to provide his subordinates with a sound conceptual basis for combat maneuver, Colonel Robert E. Wagner, then commanding the 2d Armored Cavalry Regiment, developed a simple, straightforward technique for warfighting that would be practiced throughout the Regiment in the 1980's. Built around the concept of the "V Technique," the system capitalized on the speed and mobility of cavalry, provided for flexibility and mutual support in the attack or delay, and established a highly usable set of "prowords" that effectively reduced the requirement for lengthy radio transmissions. The "V"

itself simply posited a general system for tactical movement in an inverted wedge, with platoons (or even companies) at the legs or extremities of the "V" and anchored upon a third element forming the apex of the formation. The system worked well because it made sense to soldiers. The "V Technique," which truly came to encompass a maneuver mindset, was adopted by a number of units serving in Europe and has found its way into official doctrine.[38]

A unit's state of combat readiness is reinforced and measured through training. The use of drills, the proper maintenance of equipment, and a clear understanding of the tactical environment in which one must operate all support a mechanized unit's potential for success on the battlefield. If C^2 is defined as ". . . the exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of his mission," one can readily grasp the difficult position faced by the commander in modern combat. The Israeli's found, during the Yom Kippur War of 1973, that the "lessons learned" during 1967 did not always apply when the enemy was aggressive and prepared to wage maneuver war himself. Israeli commanders soon found that the rapid movements over open ground that had previously paid large dividends now invited showers of "Sagger" wire-guided anti-tank missiles launched by Egyptian gunners. Combat leaders lost control of headlong tank charges when Egyptian artillery airbursts blew away radio antennas and when Egyptian electronic countermeasures were employed to effectively jam Israeli radio nets. The realities of modern combat having been impressed upon those who studied the 1973 war, there is now widespread agreement on the need for continued progress in developing better ways of assisting the armor commander to accomplish his mission successfully.[39]

One area in which little progress has been made is that of providing the battalion or brigade commander with a true command and control vehicle (C^2V)

from which he can exercise effective battlefield leadership. A British expert on armored operations provides this comment on the command vehicle problem:

> Any command vehicle which is not a lookalike invites and normally receives speedy attention. The turret of a tank just does not offer the facilities for sustained control of a complex force. The rear compartment of a command vehicle (CV) limits the commander's information to map and radio and prevents him from exercising and being seen to exercise forward command. The conventional solution is for the commander to go forward in a tank or other "rover" vehicle while his deputy or exec maintains continuity and coordination from the CV. This is just fine as long as the battle proceeds according to plan, so that the commander really is where it's all happening. But a sudden change of situation-like penetration to a flank, a switch of direction by the enemy, or new orders—leaves the command and control arrangements badly off balance.[40]

Recently, the US Army has been conducting tests at Fort Knox, Kentucky and elsewhere of prototype models of C^2V's for tank and mechanized battalion commanders. In each case, the C^2V models feature enhanced radio capacity (at the expense of ammunition stowage), an auxiliary power source, and improved arrangements for maintaining the maps and charts truly essential to battlefield command. (See Figure 3) The work being done is important in that it addresses one of the most serious problems facing the modern day commander; that is, how does one maintain contact with subordinates, operate on a high-threat battlefield, and have sufficient space in which to carry out the C^2 required.[41]

A survey conducted by the author explored the C^2 techniques employed by a number of former battalion commanders recently returned from Europe. Three salient points emerged from the survey. First, each of the officers recognized the need for a proper C^2 vehicle; second, none of them had structured his field headquarters in the same way; and last, all of them demanded that their company commanders be prepared to take appropriate action on the battlefield in the absence of specific orders. The essential message to be derived is that, while the latest Army doctrine calls for the commander to operate on his tank in a certain fashion, the equipment provided for him to do this is

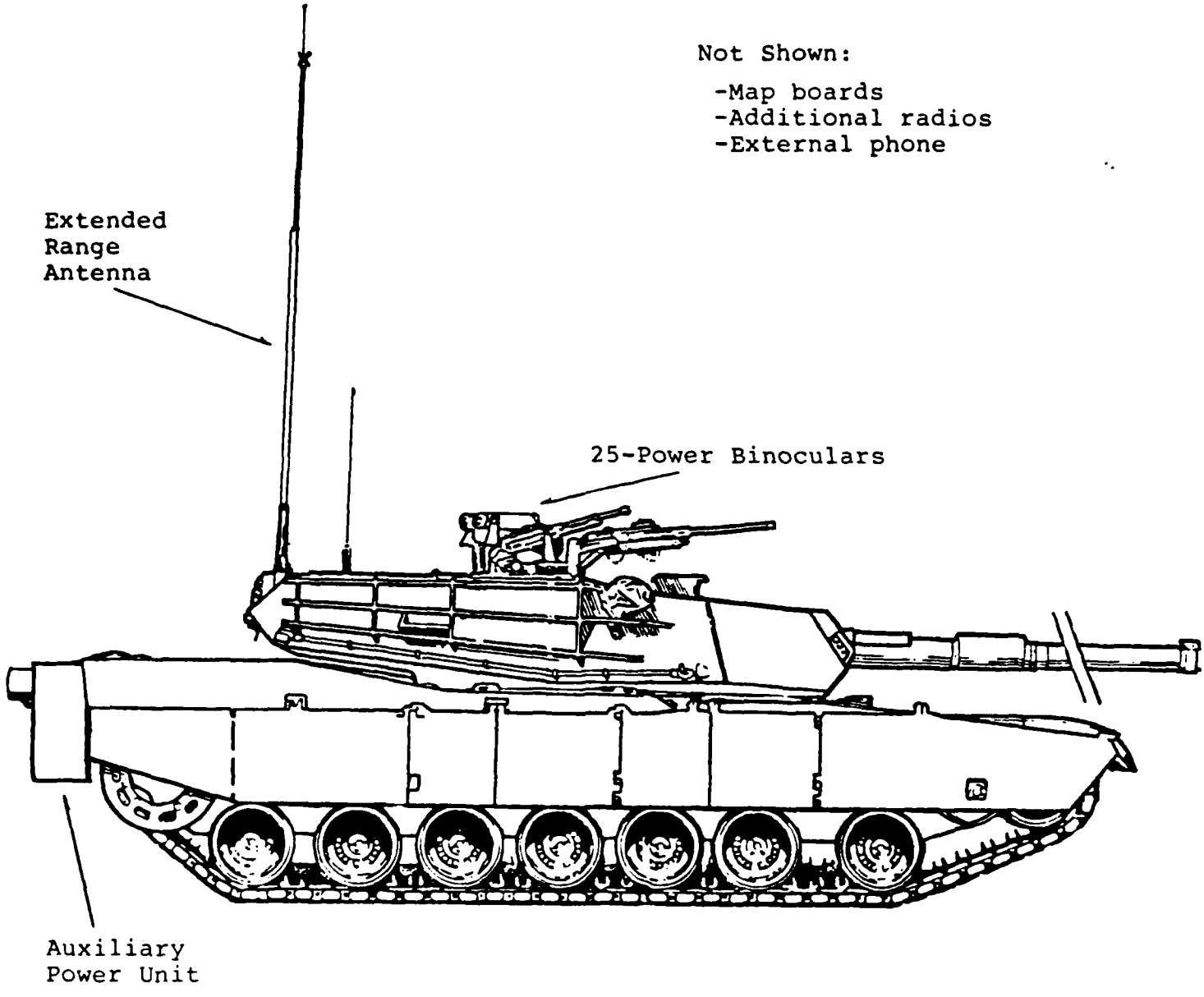

Fig. 3: M1 ABRAMS with Experimental C^2V Equipment Package - 1985

less than satisfactory. As a result, tactical commanders utilize field expedient methods as they attempt to surmount the challenges of C^2 in modern combat.[42]

COMMAND AND CONTROL: THE BOTTOM LINE

This review of command and control since World War I, with all of its challenges, and of the means utilized by those charged with exercising C^2 leads to several conclusions.

1. The commander must be supported by his military establishment with the equipment he needs to perform his C^2 mission.

2. Subordinate commanders must be provided with challenging, realistic training in a system of meaningful tactics aimed at an effective response to rapidly changing combat situations.

3. Commanders and subordinates must build combat-ready units that have, as their bedrock, the mutual faith between professionals at all levels that encourages independent thought and deed, especially in combat.

These conclusions have been reached by leaders of maneuver units since 1916. The difficulties have not truly changed so much as they have evolved over time. The commander of a tank or mechanized infantry battalion in the 1980's can understand the frustrations of his predecessors in this century. Finally, we must conclude that there is still much to be done if we are truly to meet the requirements of warfare in this decade. The US Army has not as yet accomplished its mission in this most critical area of command and control. But we must take steps to remedy this situation. As an institution, we owe our best efforts to those who command and those who fight--On the Move!

ENDNOTES

1. Helmut von Moltke, Tactical and Strategic Essays, quoted in MG Baron Hugo von Freytag-Loringhaven, The Power of Personality in War, p. 91.

2. The action described in this essay is based on a night attack conducted at Hohenfels Training Area, Germany on 23 February 1984. The unit was the 3d Bn, 63d Armor, commanded by the author.

3. Freytag-Loringhaven, The Power of Personality in War, p. 91.

4. Carl von Clausewitz, On War, Book I, Chapter 3, cited by Freytag-Loringhaven, p. 93.

5. US Army, Field Manual 100-5, Operations, 1982, p. 1-3. The view of an officer charged with carrying out orders is also instructive. MAJ Charles W. Dryer, in his article "Combat Leadership" Armor 68 (Jan-Feb 59), p. 41 said, "The most common causes for failure to comply with orders are ambiguity, vagueness, and/or incompleteness of orders."

6. See Chris Ellis and Peter Chamberlain, Fighting Vehicles, 1972, pp. 21-24 for information about (and illustrations of) tanks of World War I.

7. CPT Basil Liddell Hart, The Tanks--The History of the Royal Tank Regiment and its Predecessors. . . ., pp. 101-181 passim.

8. Ibid. See also Martin Blumenson, The Patton Papers, Part I, 1885-1940, 1972, pp. 583-587 passim.

9. Blumenson, The Patton Papers, pp. 612-618. The 1st Tank Bde (AEF) communicated by means of messengers, wire, and carrier pigeons prior to the installation of wireless sets late in the war. Also, look to CPT Joseph W. Viner, Tactics and Techniques of Tanks, 1920, p. 13. US forces received 150 French Renaults in August 1918 and 45 British Mark VIII heavies at about the same time. Plans to build nearly 1000 tanks in the USA were abandoned after the Armistice, with only 26 US copies of the Renault having been completed. By 1920, the US Army would fall heir to something over 1000 tanks of various types.

10. Viner, Tactics and Techniques of Tanks, p. 32.

11. Ibid., p. 66. CPT Viner, the author of this instructional manual, had firsthand knowledge of the subject, having served as one of Patton's company commanders in France.

12. I. B. Holley, Jr., Ideas and Weapons, p. 176.

13. See Walter Millis, Arms and Men, Chapters 4 and 5 for an overview of technical and tactical developments that characterized the interwar years.

14. Basil Liddell Hart, The Tanks . . ., p. 290.

15. Ibid., p. 325.

16. Ibid., p. 326.

17. MAJ H. C. Ingles, "Command and Signal Communications to and within Mechanized Units," p. 2. Ingles called for immediate improvements in the communications support for mechanized units, saying: "If tank units are to be coordinated with the operations of the unit to which attached there should be a channel of signal communication between the commander of that unit and the tanks. Proper control of the tank unit by its own commander will also require command channels, and the necessary signal communication to assure their efficient operation, with the various elements within the tank unit."

18. Giulio Douhet, Command of the Air, p. 15. Russian doctrinal development suffered from the widespread purges which decimated the Soviet officer corps in the late 1930's. The quote cited is taken from an article in a Russian military journal. Published in April 1937, the article was entitled, "Employment of Tanks in Battle."

19. Kenneth Macksey, The Tank Pioneers, pp. 325-326. Provides background on German developments in the 1930's. A number of sources provide information on German command and control vehicles. Two good ones are Chris Ellis and Hilary Doyle, Panzerkampfwagen, German Combat Tanks, 1933-1945, pp. 119, 126 and Field Marshal Ferdinand von Senger und Etterlin, German Tanks of World War II, pp. 40-42.

20. LTC Richard F. Timmons, "Lessons From the Past for NATO," Parameters 14 (Autumn 84), pp. 3-6.

21. Richard M. Ogorkiewicz, "The Structure and Functions of Armored Divisions," Part 2, Armor 67 (Mar-Apr 58), p. 38.

22. Interview with LTC (Ret) Heinz-Georg Leifke, Kitzingen, Germany, 12 May 1984.

23. Kenneth Macksey, Guderian: Creator of the Blitzkrieg, pp. 84-85.

24. Ogorkiewicz, "The Structure and Functions of Armored Divisions," Part 2, pp. 42-44. "Tank Combat Principles (Tentative)," pp. 30-31. CPT G. A. Hadsell, "Notes on 'Employment of the Armored Division, Oct. 21, 1940," MG Alvan C. Gillem Papers. These notes were prepared by CPT Hadsell, the company commander of Co. A, 66th Armored Regiment, a part of the 1st Armored Division, based on his reading of the Division's doctrinal thesis. Notes dated 3 Nov 1940.

25. Training Memorandum No. 127, HQ, 1st Armored Division, Sept. 9, 1942, p. 3. MG Orlando W. Ward Papers.

26. Interview with LTC David M. Glantz, Carlisle Barracks, PA, 15 Feb 1985. Also, see Richard E. Simpkin, Tank Warfare: An Analysis of Soviet and NATO Tank Philosophy, p. 43.

27. N. N. Popel, V. S. Savel'yev, and P. V. Shemanskiy, Troop Control in the Great Patriotic War, p. 27.

28. Ibid., pp. 28-30. Additional information provided in Interview with LTC Glantz. See too Ogorkiewicz, "The Structure and Functions of Armored Divisions," Part 1, Armor 67 (Jan-Feb 58), pp. 19-21.

29. Sherwood S. Cordier, "Key to Rommel's Victories," Armor 73 (Aug-Sep 64), pp. 48-49 and MG Alfred Gause, "Command Techniques Employed by Field Marshal Rommel in North Africa," Armor 67 (Jul-Aug 58), pp. 22-25.

30. Corelli Barnett, The Desert Generals, Parts II-V, pp. 69-248 passim.

31. Statements of CPT McWatters, Co. G, 13th Armored Regt., 30 Sep 1943, in MG Orlando W. Ward Papers. Another source of information from this period is the Oral History Interview transcripts of interviews with GEN Hamilton H. Howze. See especially Volume 2.

32. Comments on Russian tank tactics provided by MAJ Ulrich T. Wagner, Bamberg, Germany, 13 Oct 1981. Russian improvements in C^2 are described by Popel, et al., Troop Control. . . ., pp. 30-31, 42-49. Finally, information on C^2 difficulties when faced with German antitank guns provided in an interview conducted by US Army historians with LTC Bogardus S. Cairns, 24 April 1950. Now in Ward Papers.

33. See a "Study of T/O & E Deficiencies in Armored Divisions," Memo from CG, 2d Armored Division to CG, First Army, 14 Oct 1944. Now in MG Ernest N. Harmon Papers. Also, US communication problems found in Ninth Army After Action Reports for November 1944. Report by LTC Woodyard, Commander of 1st Bn, 333d Infantry. German intercept of US radio transmissions described by former German captain Kurt Goeppel, Bamberg, Germany, 13 Oct 1981. CPT Goeppel also provided information on tank killer teams which were positioned to ambush US and British tanks based on information derived from the intercepted radio orders of Allied field commanders.

34. C^2 for tank units in Korea is discussed by LTC Edward G. Edwards, "Armored Command Control," Armor 62 (Nov-Dec 53), pp, 16-17. Applying WW II lessons in the 1950's, armored infantry units in the 2d Armored Division utilized M3A half-tracks as C^2 vehicles. See "Mobile CP for Armored Infantry Companies," Combat Forces Journal I (Dec 50), p. 13.

35. COL Robert E. O'Brien, Jr., "Armor in Night Operations," Armor 67 Jan-Feb 58), pp. 34-38.

36. Among the proponents of battle drills were GEN Hamilton H. Howze, USAMHI Oral History Interview, Vol. 2, and CPT Robert E. Wagner, "Flexibility Through Control," Armor 73 (Aug-Sep 64), pp. 44-47. The quoted comment on battlefield leadership comes from a survey edited by GEN Bruce C. Clarke, Art and Requirements of Command, Vol. II: Generalship Study, p. 96.

37. "The German Army's Mission-Oriented Command and Control," Armor 90 (Jan-Feb 81), p. 41.

38. Field Circular [FC] 71-100, Armored and Mechanized Division and Brigade Operation, p. 34. COL Robert E. Wagner, "The 'V' Maneuver Technique," Armor 90 (Mar-Apr 81), pp. 14-15. As a BG, Wagner brought his concept to 3d Infantry Division, where he served as the ADC-Maneuver.

39. For the cited short definition of C^2, see FC 71-100, p. 3-1. A good overview of the Yom Kippur War is contained in the book by MG Chaim Herzog, The War of Atonement, pp. 186-190.

40. Richard E. Simpkin, Human Factors in Mechanized Warfare, p. 47.

41. "Command and Control Vehicle (C^2V) Program," DCD, US Army Armor Center, 1984. This study has constructed prototype C^2V's based on the M1 and M60A3 tanks and on the M3 CFV and M113.

42. Interviews with COL J. L. Bates and LTCs W. P. Giddings, J. L. Noles, and J. B. Quinn. Some commanded from tanks, some from M113's. Some took their artillery FSO with them in an M113, but none found room for the FSO on a tank. All of those who did attempt to command from a tank were eventually forced to use a different vehicle because of communication problems. Current doctrine, as expressed in FM 71-2J, The Tank and Mechanized Infantry Battalion Task Force, 1984, calls for the tank battalion commander to carry his FSO with him in the loader's station on the tank.

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An appreciation of the significant, pervasive leadership challenges presented by the rapid developments in technology since World War I is necessary for the successful commander. Maintaining effective command and control (C^2) has been, and continues to be, a major problem in maneuver units. The impact of greatly increased mobility on the battlefield has been documented in both formal and informal histories, is discussed in professional journals, and has been repeatedly addressed by practitioners in speeches, conferences, and essays. A distillation of accumulated experience generally finds its expression in official doctrinal literature. The bibliographic listing of sources that follows highlights a representative selection of those source materials.

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F. Survey

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