PFG

AHS

Co. G, 26RCT, Zollernstrasse, 17 Oct 44

Are there information requirements for command and control peculiar to military operations in cities? Do units assigned to such operations require special training? What kind of interventions with advanced technology would make the most difference compared with that available in autumn, 1944?

This presentation draws upon research into the battles for Germany's westernmost city, Aachen, which took place during September and October, 1944. The historical focus is the attack into the city itself 13-20 October 1944 by 2d and 3d Battalions, 26th Infantry, of the 26th Regimental Combat Team, 1st Infantry Division:

- **Population: once 165,000; 1944 ~20,000**
- **Garrisoned by 5,000 Wehrmacht and SS troops**
- **Force Ratio — Attacker:Defender::1:5**
- **U.S. Rate of advance: 300-400 m/day on battalion front of 1.5 to 3.0 km**
- **U.S. artillery support: ~74 batteries, average 9300 rounds per day**
- **German artillery support: ~69 batteries, average 4500 rounds per day**
- **1st Infantry Division casualties: 414 WIA, 75 KIA, 9 MIA**
- **POW: 3473 (total recorded by 1st Infantry Division)**

However, the overall purpose is to project requirements for future military operations in urban terrain and to identify technological interventions useful to success in such operations.

P.F. Gorman
Institute for Defense Analyses

JAN 28, 2000 CPOF Conf re MOUT

U.S. Army Doctrine for MOUT

FM 100-5 Operations 5 May 1986: **Commanders have always recognized the importance of urban centers as strategic objectives, but conducting operations in defended cities has always been difficult. As the battles in Stalingrad, Aachen, Hue, and Beirut have shown, such efforts require enormous resources, diminish the tempo of offensive operations, restrict maneuver and consume time. From an operational perspective, therefore, commanders should avoid committing forces to the attack of urban areas unless the mission absolutely requires doing so. ....Urban areas impede the operations of armored and mechanized forces, restricting their mobility, maneuverability, and the effectiveness of their long range weapons. Infantry forces including light forces are best suited to combat in built-up areas....**

FM 100-5 Operations 14 June 1993: **Urban operations present unique and complex challenges to Army forces. Urban operations can occur in any of the geographical environments. They can constrain technological advantages; they impact on battle tempo; they force units to fight in small, decentralized elements; they also create difficult moral dilemmas due to the proximity of large numbers of civilians. Commanders must enforce discipline in their operations to minimize unnecessary collateral damage and civilian casualties. FM 90-10 discusses fighting on urbanized terrain.**

2

Field Manual 90-10 (5 August 1979) is over twenty years old; this fact has invited severe criticism of the Army, for it seems evident that urban terrain is characteristic of more and more of the militarily significant surface of the earth, and that much experience has been acquired in the last two decades by U.S. Army forces engaged in Military Operations in Urban Terrain (MOUT) in Mogadishu, Panama, Haiti, and the Balkans, not to mention what has happened to the Russian Army in its recent travails. But while FM 100-5, the tap root of Army doctrine has been rewritten thrice in the same twenty years, its premises on military operations in built-up areas (MOBA) have not changed, and FM 90-10 continues to reflect mainline Army concepts.

The chart flags three of these. The first (highlighted in green) is, in the opinion of this commentator, as true today as it was a quarter century ago; what has changed is that opportunities for avoiding urban areas are diminishing, and missions for the force projection Army of today and tomorrow are more likely to mandate operations in cities than was the case yesterday. The second and third, highlighted in yellow, deserve serious reconsideration. While urban areas are battle environments categorically different from fighting in jungles or rural terrain, the military utility of armor and mechanized units **does not decline** in cities; indeed, the presence of survivable, agile vehicles may actually be more important tomorrow than ever before. There is little historical evidence that "light forces are best suited to combat in built-up areas;" my reading is to the contrary, that combined arms have been, and will remain necessary. As for urban settings constraining technological advantage, that may be merely another way of stating reservations about engaging mechanized forces in MOUT, but if the intent was to imply that advances in technology could offer only marginal improvements in force effectiveness, I strongly disagree, as will become evident.

Military Characteristics of Terrain

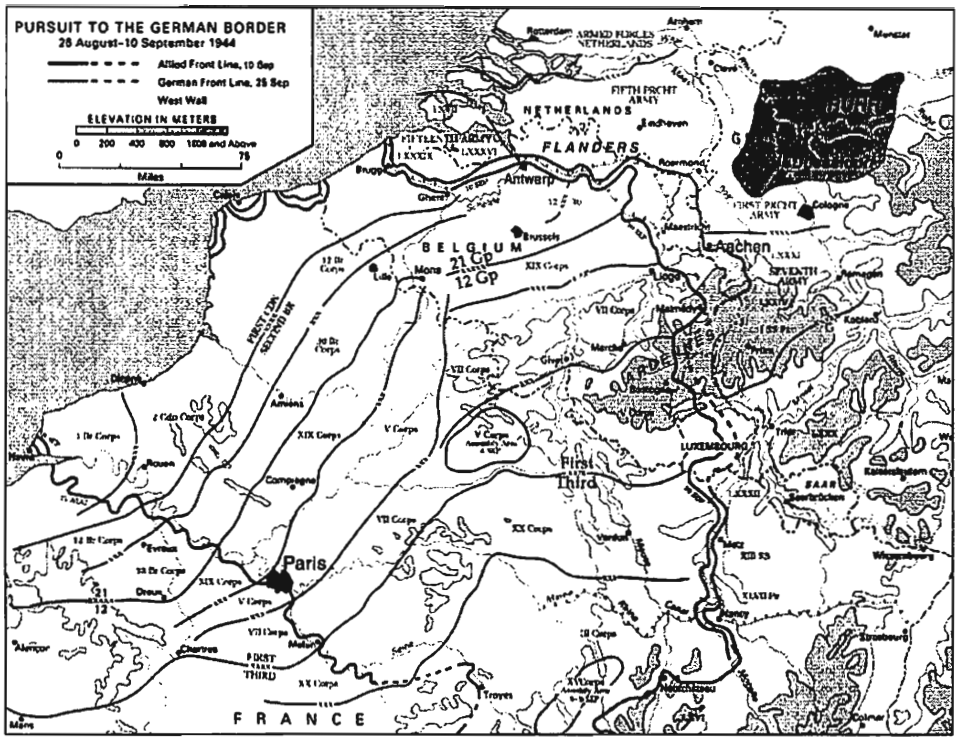
	Farmland	Jungle	Urban
Observation	1	3	2
Fields of Fire	1	2	3
Cover	3	2	1
Concealment	3	1	2
Environmental Hazards	3	1	2
RF Propagation	1	2	3
Verticality	3	2	1
Data Density	3	2	1

Scale: 1 **Maximum** to 3 **Minimum**

3

This chart explains why, in general, the Army has preferred to avoid military operations in urban terrain (MOUT). The numerics are relational.

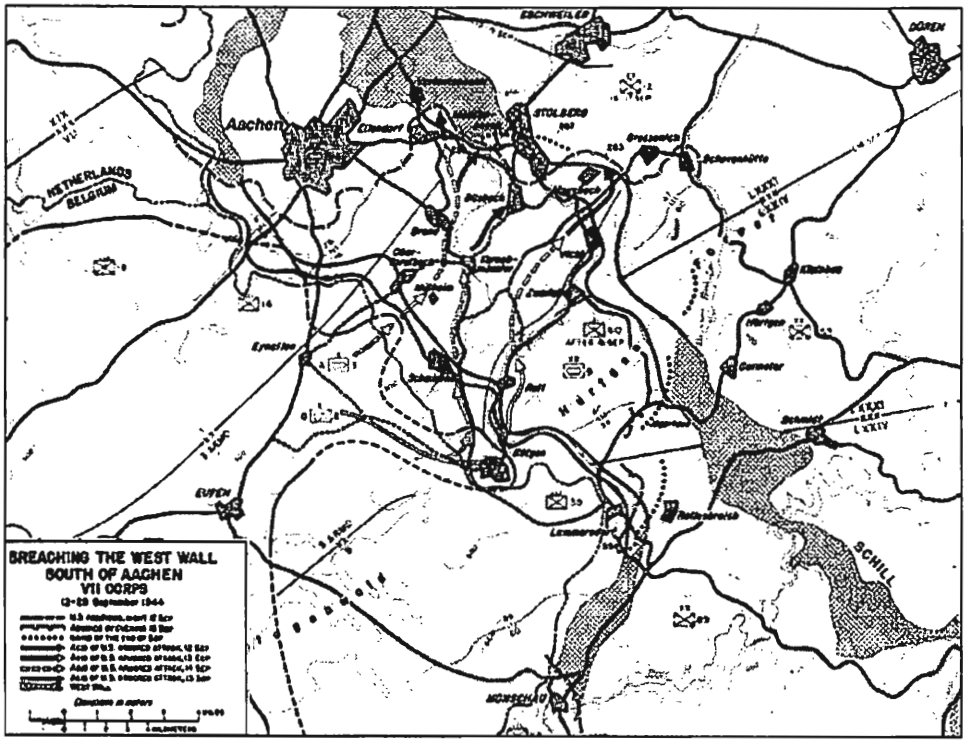
- Weapons are difficult to employ to best advantage because of constrained trajectories for indirect and direct fire, limited observation, and impoverished reconnaissance, surveillance and target acquisition (RSTA). Specialized munitions ranging from concussion grenades to masonry penetrating projectiles, or less-than-lethal munitions, are required, and resupply and medical evacuation are nightmarish .
- Tactical and logistic movements are hampered by rubble and easily-fashioned man-made obstacles.
- Ample cover and concealment favor the defender, particularly a defender who knows the terrain well.
- Environmental hazards (rodents, pestilence, falling objects, etc.) are high, and radio frequency propagation suffers from multi-path difficulties.
- Buildings and below-ground infrastructure introduce verticality into close battle, which stresses RSTA, strains the elevation capability of direct fire weapons, and impedes maneuver.
- Digital data on urban areas must encompass not only wide variations in altitude, but also the physical characteristics of man-made structures above, on, and below ground, as well as awareness of the position and status of the protagonists.
- Close battle in cities also entails awareness cultural proclivities and the location and status of non-combatants, the presence of whom often burdens a commander with humanitarian aid, and constrains his use of decisional options..



Military operations in urban terrain almost always have occurred as a facet of operational maneuver. Combat to control the approaches to the city, or to isolate it, has often been more intense than that inside the urban complex itself. Aachen was clearly such a case.

Between early June and early September 1944, the Allies had projected over 2 million troops and three million tons of supplies onto the continent. SHAEF's strategic plan was to advance on a broad front to seize Germany's industrial center, the Ruhr industrial area along the Rhein, and then its political center, Berlin. Of four avenues of approach considered by SHAEF planners, the axis Mons—Liege—Aachen seemed the most promising [Flanders was too wet, the Ardennes too rugged; the Metz-Kaiserslautern gap was feasible, but indirect]. The United States First Army was in the van of the offensive toward the Aachen gap, striking out of the beachhead 750 miles to arrive at the western frontier of the Third Reich on 11 September flushed with victory, but hampered by overlong supply lines extending back to depots in Normandy. Ammunition and fuel were in short supply, and vehicles were in need of maintenance. Some sources say that the soldiers were tired, but most of the veterans I have interviewed mentioned not fatigue, but exhilaration: driving through towns where they had been celebrated as liberators, coupled with a sense that the defeat of Germany was at hand.

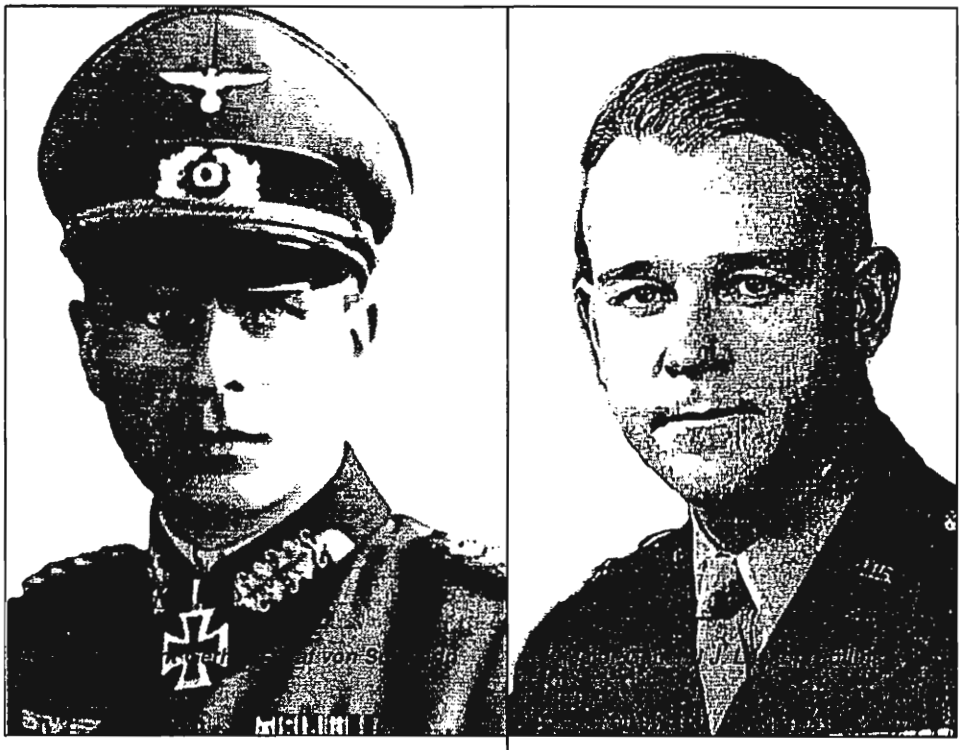
In France the Germans had suffered at least 400,000 casualties, of which more than 200,000 were prisoners of war. On 2 September, at Mons, Belgium, First Army had maneuvered its VII Corps across the main line of retreat of German forces retreating eastward from the Channel coast defenses, precipitating a swirling battle of three days in which thousands of Germans were killed, and 25,000 were taken prisoner. On 11 September the First Army had advanced to positions on the German frontier that pre-invasion planners had not expected it to reach until May 1945. Exhausted, First Army was nonetheless 233 days ahead of pre-invasion schedules.



Higher American headquarters were understandably more preoccupied with logistics than with the enemy. General Eisenhower reported to Washington that: "Losses of ordnance equipment [guns, vehicles] have been extremely high. For instance, we must have as replacement items each month 36,000 small arms, 700 mortars, 500 tanks, 2,400 vehicles, 100 field pieces. Consumption of artillery and mortar ammunition in northwestern Europe averages 8,000,000 rounds a month. Our combat troops use up an average of 66,400 miles of one type of field wire each month. (The AEF during the entire First World War expended less than 10,000,000 rounds of artillery and mortar ammunition.)"

The commander of First Army, General Hodges, believed that a "pause" at the German frontier would be necessary, but that view was not shared by the commander of VII Corps, Major General "Lightening Joe" Collins, who eventually elicited a First Army order permitting him to conduct a "reconnaissance in force" into Germany. The original plan of VII Corps was for the 1st Infantry Division to probe, and if possible, occupy Aachen, while the 3d Armored Division and the 9th Infantry drove toward Düren in the Roer valley through what became known as the "Stolberg Corridor."

On 12 September elements of the 1st Infantry Division penetrated poorly-manned outer border defenses south of Aachen; on the 14th the 3d Armored Division penetrated the *Vorstellung* [Scharnhorst Line] and advanced to the *Limes-stellung* [Schill Line] east of Stolberg. The following day, 15 September, the 3d Armored broke into open country behind the Schill Line. This success led General Collins to calculate that VII Corps could penetrate at least as far as the west bank of the Roer River [a tributary of the Meuse, or Maas River flowing northward through Düren and Jülich seventeen miles east of Aachen]. He moved his headquarters to Kornelimünster, inside Germany, to supervise his decision to bypass Aachen, controlling the city from surrounding high ground. That decision occasioned a politico-military tragedy.



On 12 September Aachen had been placed under the command of General von Schwerin, commander of the *116th Panzer Division*, a shell of a unit with but 1600 men, three tanks, a handful of assault guns, and two Luftwaffe fortress battalions. Hitler had ordered that all civilians in Aachen be evacuated, leaving only military units for a last ditch defense. When von Schwerin entered the city, he was shocked to find that all government and Nazi party officials had fled, that the police stations were empty, and that the people were in panic, uninstructed and without transportation. Von Schwerin thereupon countermanded the evacuation order, and directed the people back into their homes. On the 13th, he entrusted to an official of the postal-telephone service a letter, written in English, that was to be handed to the commander of the American forces that he expected would occupy the city momentarily:

> I stopped the absurd evacuation of this town; therefore, I am responsible for the fate of its inhabitants and ask you, in the case of an occupation by your troops, to take care of the unfortunate population in a humane way. I am the last Commanding Officer in the sector of Aachen. [signed] Schwerin

Von Schwerin may have been unaware when he wrote the foregoing that the order to evacuate the citizens of Aachen had been signed by Hitler himself, but he was soon informed of the facts. Armed with his note to the Americans as incriminating evidence, his detractors caused his relief from command and his arrest [ultimately, he avoided trial,but for his affront he was sent to the Balkans]. Nazi officials, accompanied by Gestapo and SA, reentered Aachen.

Unfortunately for all concerned, at about the time von Schwerin decided to turn the city over to the Americans, General Collins decided to bypass the city. But then two developments changed that plan: German resistance stiffened, and U.S. logistic support faltered.

VII Corps inability to monitor the political situation inside Aachen was a costly intelligence failure. When a city figures in operational plans, friendly situation awareness must extend to the mindset of enemy leaders and the populace; if indicated, both must be given every opportunity to surrender, or to claim "open city" status. What can be done to avoid similar failures in the future?

URBAN RSTA

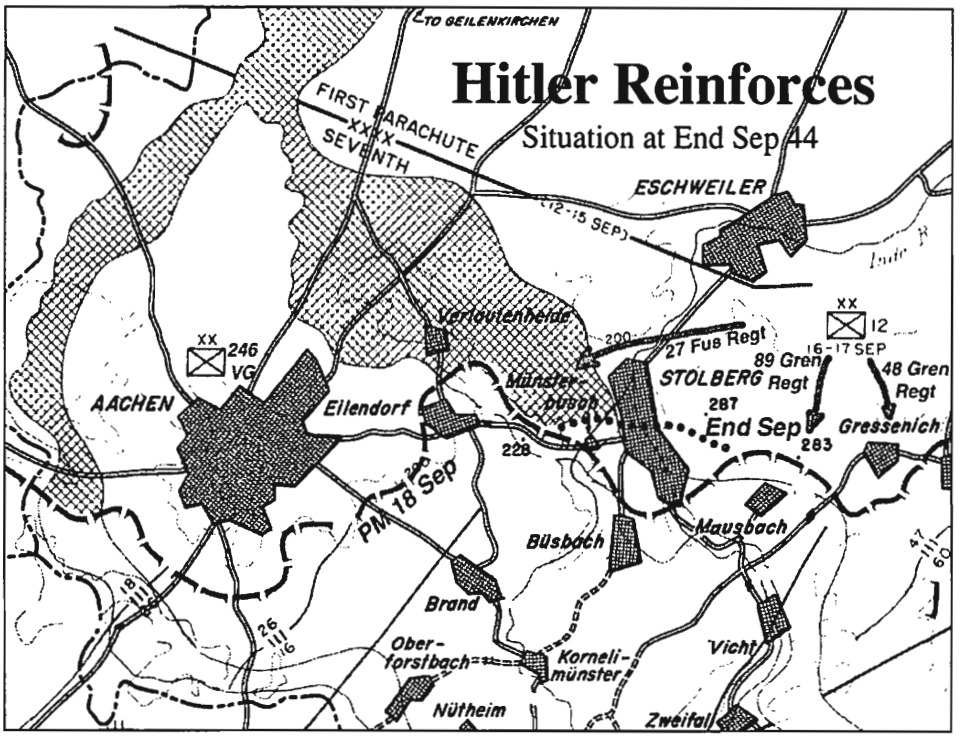
- First Army divided the investiture of Aachen between VII and XIX Corps.
  - Surrendered to the Germans the advantages of unity of command.
  - Invited their use of the northern corridor into Aachen that aligned with the boundary between the two attacking corps.
- Aachen was a case where "trickle down intelligence" did not work for forces deprived of organic surveillance capabilities
- The U.S. 1st Infantry Division, that had won the Battle of Mons by exploiting the Belgian phone system and the civil populace, failed to use comparable techniques in Aachen.
  - Allied surveillance was in any event focused on German forces, not on civil behavior and mood, and Germans were regarded as monolithically hostile.
  - The omnipresent world media may offer similar channels to assessing civil sentiment in future MOUT.

7

Aachen was awkwardly situated, an urban center where Belgium, Germany and the Netherlands conjoined, and where the populace was a mixture of those three nationalities. The Army Group had made no provisions in its allocation of zones of action for assigning the urban area to a single tactical commander, despite the fact that it was a rail and road hub, and its capture proved to be of prime politico-military importance.

The U.S. 1st Infantry Division of VII Corps, primarily responsible for the southern and eastern approaches to the city, had during its drive across Belgium enjoyed extraordinary success in locating and even identifying German units to its front and flanks even when deprived of surveillance support. One Major Demy, who headed a group of five Belgian liaison officers recruited by the division, had quietly used the still-functioning commercial telephone system to query friends, relatives, and their acquaintances to ask what the Germans were doing in the vicinity of respondents. When the Americans approached Belgium's traditional frontier (Hitler had annexed much of eastern Belgium), Remy and his four colleagues departed, and it did not occur to the 1st Division to seek German counterparts, even though subsequent events in Aachen demonstrated that the Aachen telephone system might have similarly been exploited.

While First Army did furnish the investing units aerial photographs and city maps of large scale, and while it positioned civil affairs units to move in behind the division to manage the populace, it made no coherent attempt to understand or to manipulate the citizenry of Aachen, or to treat the urban area as anything other than terrain posing problems for fire and maneuver, like those that had been surmounted amid the bocage in Normandy.



American intelligence had discounted the possibility that the Germans could shift forces from the eastern front [i.e., Soviet pressures were too high, and Allied air power had all but destroyed German railways]. On 17 September the 16th RCT defending high ground east of Eilendorf was subjected to the most intense artillery fire it had encountered since the beaches of Normandy, followed closely by determined assaults by two battalions of well-disciplined infantry. The attack was beaten off. From prisoners, the Americans learned that attackers were the 1st and 3d Battalions of the 27th Füsilier Regiment of the 12th Infantry Division, units that had arrived the night before from East Prussia, having entrained on 12 September and crossed Germany without loss. On 17 September the division's other two regiments, 89th Grenadier and 48 Grenadier, attacked the forward positions of the 3d Armored Division and the 9th Infantry Division.

Per Hitler's personal orders, the 12th Infantry Division had been withdrawn from the line the previous summer, filled with young conscripts, reorganized, reequipped, and trained for offense. VII Corps faced intense artillery fires and cohesive, well trained infantry. VII Corps inflicted heavy losses on the 12th Division in the last two weeks of September, but the division stalled the American advance, and bought time for Generalfeldmarschall von Rundstedt, recalled from retirement to command the fight for the West Wall, to rebuild the 116th Panzer Division, to assemble reserves, and to bolster artillery.

The enemy was newly obstreperous. But the greatest difficulties facing General Collins were logistics and weather: 3d Armored Division, authorized 232 medium tanks, reported on 18 September that it had only 75 ready for combat. General Collins recalled later that "we ran out of gas...we ran out of ammunition, and we ran out of weather. The loss of our close tactical air support was a real blow."

Enemy surprises, insufficiency of supply and fair flying weather will be even more important in future combat. How we insure against the bind in which VII Corps found itself?

Aachen: A Case for Constant Watch

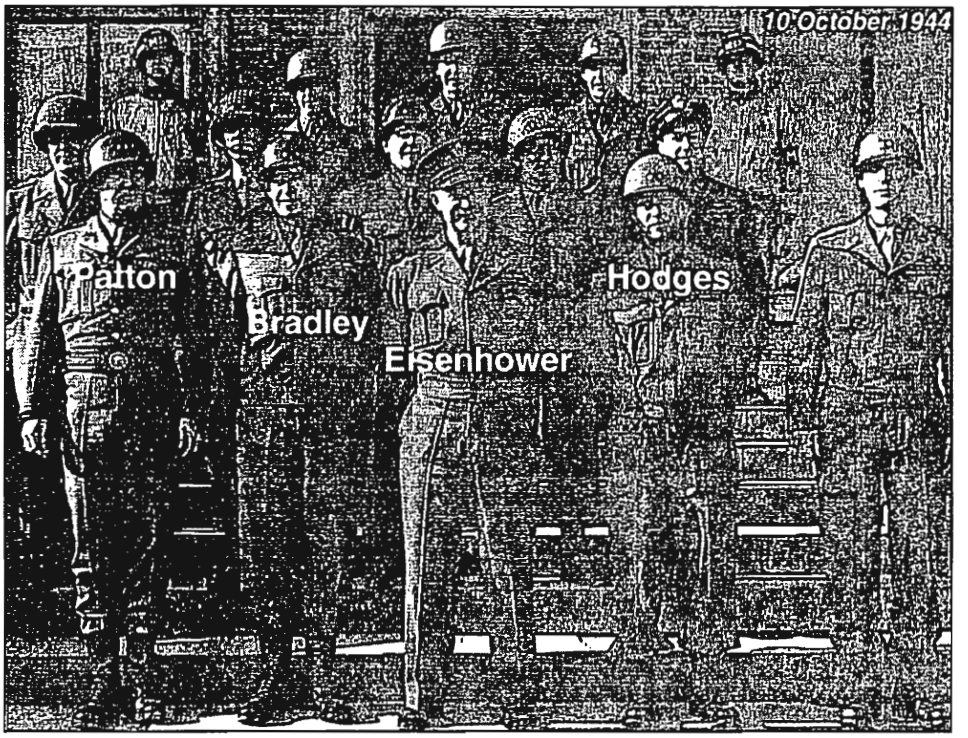
- Two failures of Allied intelligence were evident at Aachen:
  - (1) Lack of awareness of von Schwerin's attempt to make it an "open city"
  - (2) Surprise over the arrival of reinforcements from the Eastern Front
- Weather figured in both, establishing a requirement for all-weather surveillance
- Von Schwerin's initiative went undetected for failure to provide for continual surveillance of the inhabitants of the city
  - Sporadic or intermittent overhead surveillance would be unlikely to detect evidence of the order to evacuate the citizenry subsequently countermanded
  - Difficult to believe that all-source surveillance would not have reported the Nazi party's apparatus in the city being withdrawn, then reinstalled.
  - Indicators would have been subtle unless aggregated by change detection and multi-sensor fusion
- Tactical commanders "sensed" a change in German posture and aggressiveness long before the "intelligence system" agreed
  - Order of Battle (OB) is not the be-all and end-all of tactical intelligence
  - To upgrade tactical intelligence, upgrade tactical RSTA to 24X7 capabilities

9

Blame for the misapprehensions at Aachen must be attributed to all echelons of the Allied command. Preparations by the Allies for warfare amid the populations on the continent of Europe were limited to the organization of resistance movements to operate ahead of invading forces, and to formation and training of civil affairs units to police the populace behind their advance. Little of no attention was directed toward the thorny problems of military operations in urban terrain, or indeed in any terrain where people were plentiful.

Foresight on the exigencies of operating in Germany was particularly vacuous: despite the fact that the Allies were well aware that the German General Staff had anticipated two-front warfare for generations, they tended to underestimate the German propensity to rely on ways to deal with just that contingency based on unexpected action at unexpected time. Nor was the 12th Infantry Division the only shock: von Rundstedt was unexpectably able to field north of Aachen in mid-September the *183d Volks Grenadier Division* from Austria, like the *12th Infantry Division* from Prussia, newly refitted and rehabilitated.

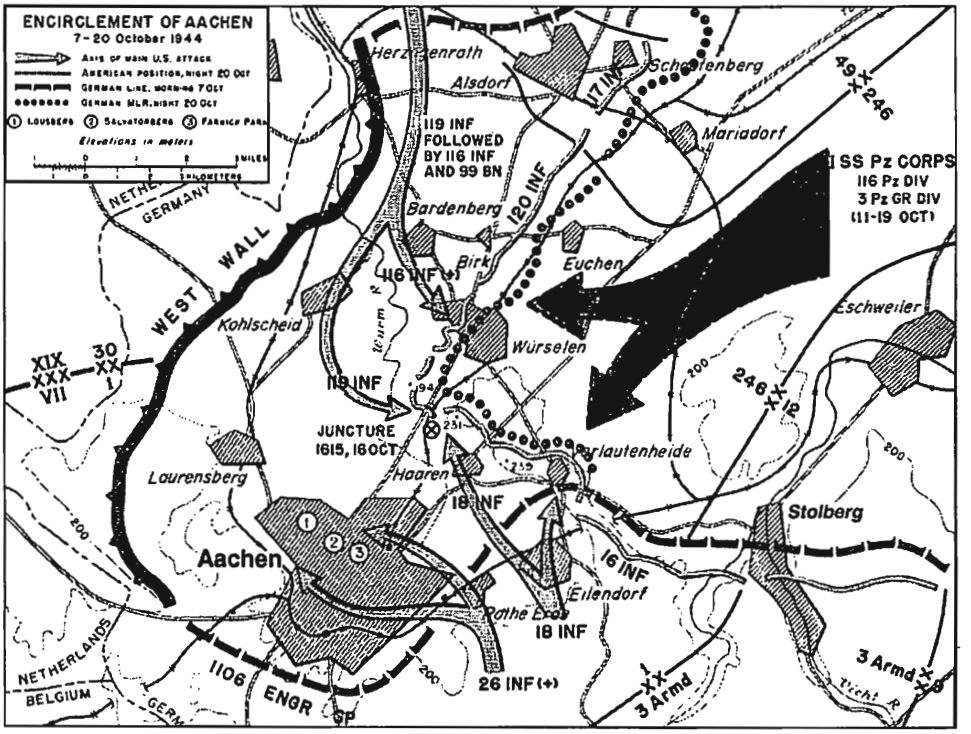
At the divisional level, it has been documented that the U.S. 1st Infantry Division reported in mid-September wide-spread, albeit short-lived "sheets in window" displays of willingness to surrender, tracked the relief of von Schwerin, and his replacement by first Lt. Col. Lyherr, and then, in October, by Col. Gerhard Wilck. And at that level, leaders of the 1st Division judged that there had been a reversal of viewpoint among their adversaries, from one of defeat and withdrawal, to increasing confidence and willingness to contest ground, and even counterattack — all views discounted by corps and higher echelons. The divisional judgment was based on fragmentary evidence that was not matched by indicators at higher, so that, in this instance, the misgivings at the two-star level were set aside at "higher," and VII Corps march to its rendezvous with MOUT in Aachen.



The 10th of October was a momentous date for this gathering of American commanders: Lt. Gen. Courtney H. Hodges, commander of the First United States Army, had that morning directed that envoys be sent into Aachen to deliver an ultimatum to the German commander: Aachen was surrounded; the city was to be surrendered within 24 hours, or the Americans would pulverize it, then assault into the rubble.

First Army included 250,000 officers and men, 3 corps [XIX Corps (Corlett), VII Corps (Collins) and V Corps (Gerow)], 5 infantry divisions [30th, 1st, 9th, 4th and 28th], 3 armored divisions [2d, 3d, and 5th], and 3 mechanized cavalry groups [113th,4th and 102d], plus 9 separate tank battalions, 12 tank destroyer battalions, 31 antiaircraft battalions, 46 separate field artillery battalions, 3 chemical mortar battalions, and a number of other combat support and combat service support units. Hodges was a close friend of Lt. Gen. Patton, commander of Third Army, but was he was as restrained as Patton was flamboyant. Like Patton, however, Hodges had demonstrated that he was adroit with maneuvering massed armor and artillery. Hodges was a stickler for detail. A former corps G-3 reported that "When you did a situation report for the Third Army [Patton's], you showed the positions of the regiments [three command echelons downward]. When you did one for the First Army [Hodges], you had to show platoons [six echelons downward]." On the First Army's Operations staff there were sixteen liaison officers, each equipped with a jeep and radio so that, as Hodges' G-3 put it, the Army headquarters was "always right on top of the corps and divisions, else you cannot carry out the orders and wishes of the commander."

Commanders are, typically, idiosyncratic, and their demands on their command post will reflect their personal style. Required information system capacity is a function, *inter alia*, of number of entities managed, and information displays must be able to display whatever data the commander mandates.



The ultimatum of 10 October overstated the American grip on Aachen. The German garrison could still receive supplies and reinforcements from Würselen, and the actual closing of the ring around Aachen did not occur until 18 October. On the October 8, the 1st Infantry Division had executed an attack to the north with the 18th RCT to seize the high ground west of Verlautenheide, and despite heavy counterattacks, that thrust had put the 18th in position for observed fire on the routes into Aachen from the north. The success of the 18th RCT panicked the German commanders into piecemeal attacks delivered as reserve units became available. The American position was tenuous, but each attack was defeated in turn, and although General Huebner readied his slender reserves —the 1st Battalion of the 26th RCT, and a "string" on its 3d Battalion committed on the north side of Aachen— the 18th RCT never allowed the situation to deteriorate to the point where it needed more than air and artillery support.

The truth of the matter is that 26th RCT's attack in Aachen was a sideshow; the main ring events all took place to the north and east as von Rundstedt, striving to keep a corridor open to the defenders in the city, patched together one unit after another to sustain continuous blows against the 16th and 18th RCT defenses, and against the advancing 116th and 119th RCTs of the 30th Division. On 16 October, amid a flurry of armor-supported attacks and counterattacks on both sides, a patrol from the 119th RCT reached the positions of the 18th RCT, and Aachen was at last indeed surrounded.

General Huebner of the 1st Infantry Division needed to follow closely the actions on his north flank, not only because he might have to commit his reserve there, but because the outcome of that fighting would fundamentally affect his operation in Aachen. Noting that this action takes place on the seam between XIX and VII Corps, and 30th and 1st Infantry Divisions, future command and control systems must provide for this breadth and depth of situational awareness?

The 26th RCT O&O for Aachen

Operational and Organizational Concepts

① Combine the arms into a team: establish an infantry-protected base of direct fire and overwatch by attaching direct fire cannon (tanks, TDs) to each infantry platoon; attach one SP artillery gun to each infantry battalion to reinforce any team with large caliber direct fire.

② Firepower enables advance of infantry to clear buildings, which in turn permits the base of fire to move forward. Fires vicinity of cultural or historical sites are restricted.

③Teams control the open spaces (avenues, streets, city parks). with direct and indirect fire Each team "cleans" its sector as it advances: all civilians, all POW evacuated; sewers sealed; cellar passages blocked.

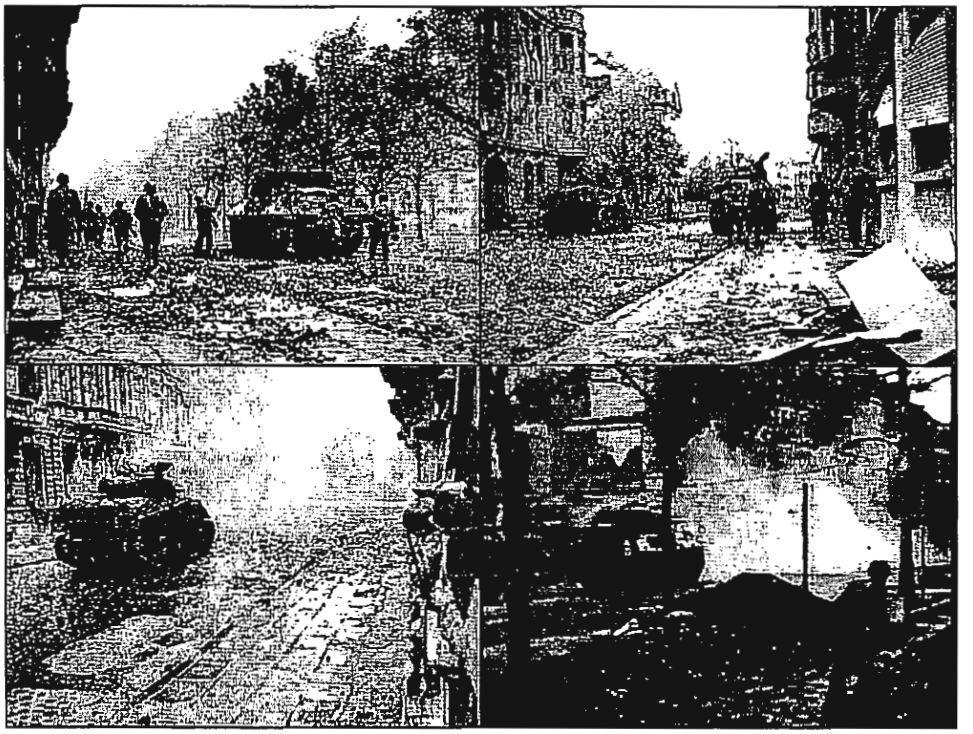
④Teams move forward by day; by night, defend while interdicting with indirect fire the next day's objectives.

⑤ Infantry fight light: resupply, evac with tracked vehicles.

⑥ Teams lay wire as they advance; companies lay laterals. 12

Some of you have had an opportunity to read reports on the operations of the 26th RCT in Aachen, and are aware that two line infantry battalions, reinforced with tanks and tank destroyers, attacked from east to west through the heart of the city. Outnumbered, with no special training for urban operations, undeterred by Army doctrine, the 26th Infantry succeeded in that combat environment as it had in the hedgerows of Normandy, in the pursuit across Franc, in the melee at Mons, and as they would in future combat in the Hürtgen Forest and on the north shoulder of the Bulge. To be sure, General Heubner, the division commander, and Colonel Seitz, the regimental commander, had had a month to think about the mission, and to work out plans for proceeding.

Their "O&O," to use the current Army term, is summarized on the chart. We will examine each of these in turn, but remember that our purpose is less to critique the 26th RCT than to project their experience into the methods and means for the 26th Infantry of the Army of tomorrow. (N.B., 1st Battalion, 26th Infantry, recently returned to its garrison in Schweinfurt, Germany, from duty in Kosovo. The unit had previously served in Bosnia and Macedonia as well.)



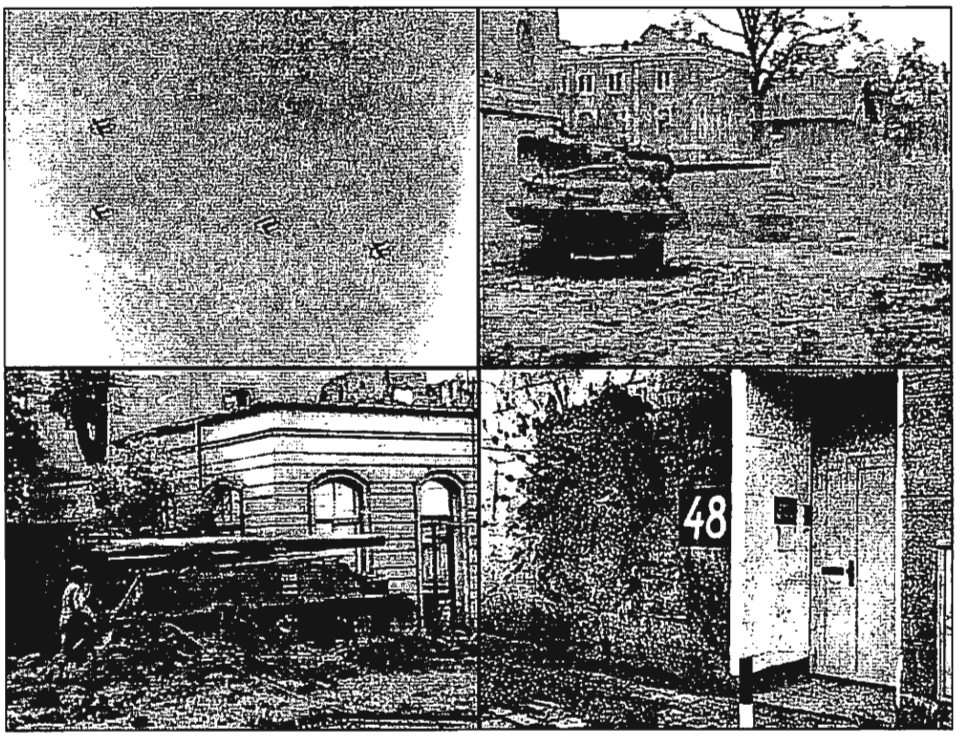
① **Combine the arms into a team based on a infantry platoon: establish an infantry-protected base of direct fire and overwatch by attaching direct fire cannon (tanks, TDs) to each infantry platoon; attach one SP artillery gun to each infantry battalion to reinforce any team for large caliber direct fire.**

② **Firepower enables advance of infantry to clear buildings, which in turn permits the base of fire to move forward. Fires vicinity of cultural or historical sites are restricted.**

② The photographs depict the armored vehicles advancing along streets, accompanied by infantry tasked to provide them close-in protection. Streets were also used to coordinate movements. Battalion would issue a sketch or plan of its sector with checkpoints marked at intersections for use in reporting location, and in coordinating the rate of advance so that no one element got ahead of the others.

② The rifle platoon to which each vehicle is assigned is advancing through the buildings to the right or left, heralding their arrival at a room or cellar with concussion grenades. Each armored vehicle kept the building ahead of its rifle platoon under fire, and suppressed enemy machine guns, snipers, and anti-tank guns.

② **Armored vehicles turned out to be of pivotal importance. Their location and status weighed heavily on the decisions of the divisional and regimental commanders.**



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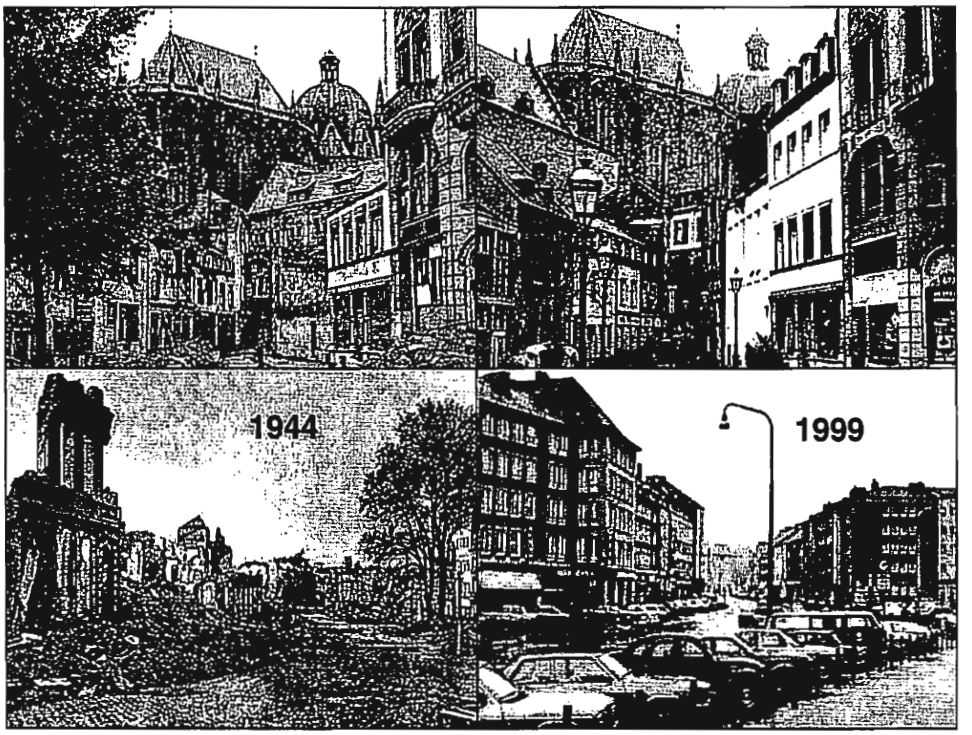
② In the upper left is a flight of four P-38 "Lightening" fighter-bombers from Major General Elwood R. "Pete" Queseda's IX Tactical Air Force, that had "an indissoluble operational partnership" with First Army. The P-38 mounted automatic cannon in its nose, and could deliver both bombs and napalm.

② In the upper right are tank destroyers mounting a 3 inch gun, accurate and hard-hitting.

② In the lower left is a rare picture of one of two the large-caliber self-propelled guns employed by the 26th RCT, referred to in most historical writings as a 155mm. There is some evidence, however, that this piece might be an 8 inch (203mm) gun. At the right is a contemporary picture of the entrance to the massive air raid shelter that served as the German command post in October 1944 (48 Rütscher Strasse, on the western side of the Lousberg). A large caliber projectile, presumably from the gun at left, knocked on the wall next to the door, and may have helped persuade Colonel Wilck, the German commander, to surrender.

② **Self-propelled direct fire weapons proved to be decisively intimidating. How can such a factor figure in future conflict?**



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② The two photographs on the left were taken in October 1944, after the surrender of Aachen. Those on the right were taken in 1999, with approximately the same view.

② The top pair of photographs are of the Dom, the great Munster cathedral on Munsterplatz, which sustained relatively little damage [the 19th century stained glass windows were shattered, and an artillery round had pierced the groining over the main altar].

② Virtually all of the city's historical and ecclesiastic buildings were damaged, some a severely as the buildings at lower left

② The lower left photograph was widely circulated in 1944 and 1945 to bring home to the German people the costs of war. The lower right shows the same area as it has been rebuilt (Alexiengraben).

② **Recent conflicts have demonstrated how difficult it is to avoid politically damaging "collateral damage." What can be done to limit unintended effects?**

③ **Teams control with direct and indirect fire the open spaces (avenues, streets, city parks).**

④ Soldiers of the 26th RCT were advised "don't use the street unless you have to." The "have to" included protecting the attached armor which had to move on the street, and positioning weapons to deny the street to the enemy, by delivering fire on known or suspected enemy positions. The heavy water-cooled caliber .30 machinegun was well suited for continuous coverage of open areas, but was more awkward to move and more difficult to conceal than the light machine gun in the upper right. Both the heavy and the light guns fired the same belted ammunition evident at lower left.

④ **What approaches should we take to prepare for future MOUT?**

④ **Each team "cleans" its sector as it advances: all structures searched; all civilians, all POW evacuated; sewers sealed; cellar passages blocked.**

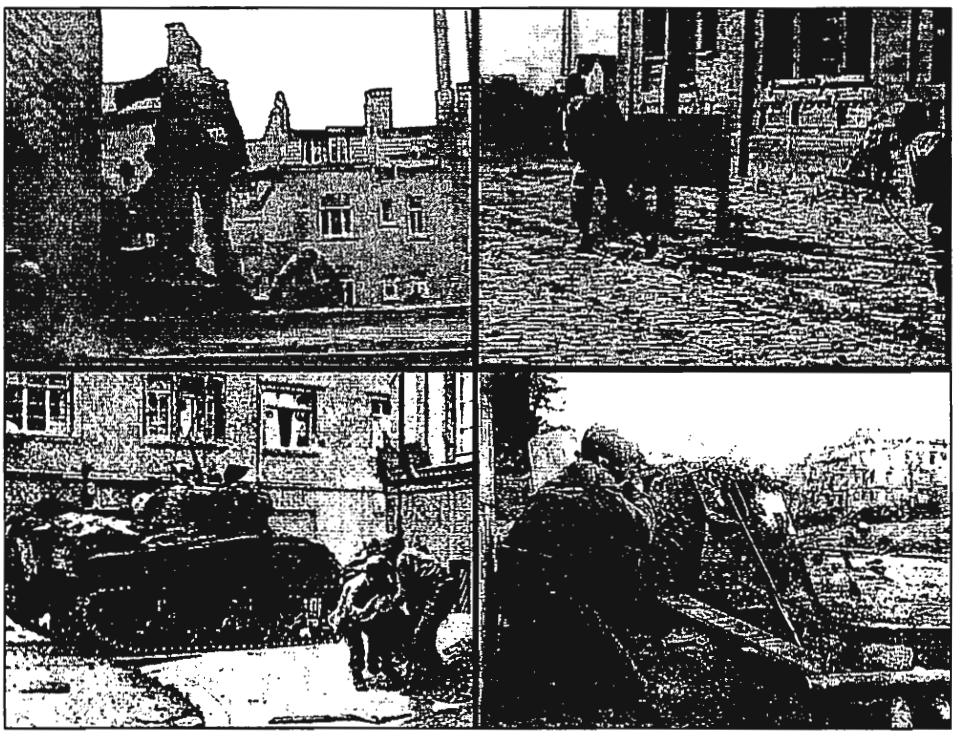
⑤ The 1st Infantry Division had anticipated requirements to provide for non-combatant residents of Aachen. Many citizens remained in defiance of Hitler's orders for forced evacuation, most living in indescribably bad conditions in air raid shelters bereft of light, heat, water, and sanitary facilities. The division had taken over a German Army barracks [Lützowkaserne] southeast of the city, and set up there "Lager Brand" to screen, feed, and house non-combatant refugees. By the end of October 4,500 Germans were housed in "Lager Brand", and cold weather brought the population to 6,000.

⑤ **Teams move forward by day; by night, defend while interdicting with indirect fire the next day's objectives.**

⑤ The days were getting shorter in October [Aachen's latitude is approximately the same as Nova Scotia's]. The 26th RCT ceased its attacks at dusk, and used the hours of darkness for resupply, evacuation of the wounded, movement forward of supplies and replacements, and preparation of the morrow's battlefield.

⑤ This schedule was welcome to the attackers, but no doubt gave the Germans respite, and permitted them to adjust their defenses.

⑤ **Discerning what areas were under effective friendly control often proved as important in command decisions as appreciating the extent of enemy control.**



⑥ **Infantry fight light: resupply, evac with tracked vehicles.**

⑦ **Teams lay wire as they advance; companies lay laterals.**

⑦ The 26th RCT stripped its infantrymen of all but one day's fighting essentials on the premise that they could readily resupply [upper right]. That decision was sound, leaving them unencumbered for clambering through Aachen's buildings and over roof tops[upper left], and running through its rubbled streets.

⑦ The logistic premise turned out to be off the mark. The 26th failed to anticipate the vulnerability of its wheeled vehicles to tire damage from the glass, nails, and other debris strewn on the surface of the streets of Aachen. As a result, the attacking battalions had to improvise [successfully] a system that used tracked vehicles almost exclusively for resupply and evacuation of the wounded [lower left].

⑦ Resupply was complicated because of the unusual amount of small arms ammunition and hand grenades consumed by the infantry, and the requirement to replenish the attached armored vehicles in the zone of close battle.

⑦ One major consumable was telephone wire(lower right). The advancing platoon teams laid wire forward as they advanced. Company behind them linked the platoons together laterally. Battalion linked with the companies and with the friendly units on the flanks.

⑦ The telephone network proved to be reliable, and flexible. The infantry had some portable radios, but these were not dependable amid the urban clutter. The vehicular radios were better, but there was easy way for an infantry leader on the ground to access these.

⑦ **What sort of "line of communications" should figure in future MOUT?**

Future Ground Combat Systems

(Multi-Mission Combat Systems)

Concepts Input to SAG

For report due 22 Sep 1999 from Senior Advisory Group to Dr. Fernandez and Lt.Gen. Kern per their instructions to:

- **Explore innovative technology solutions**
- **Enable Army to achieve vision of lightweight, lethal, survivable, multi-mission ground combat forces**
- **Help DARPA and Army determine course of action leading to development of truly innovative future combat systems**

SAG

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As a way of assisting you in thinking forward, here are the charts being used in briefings in the Pentagon concerning the future of MOUT.

In the spring of 1999 the Army (Lt. Gen. Kern) approached DARPA with a proposal to establish a joint program to develop what it termed a "multi-mission combat system" (MMCS). Tentatively, the Army would provide an 0-6 to act as Program Manager, and put up half of the funds for a 3 to 5 year program involving some $300 million.

In June 99 the DARPA, with Army concurrence, set up a Senior Advisory Group (SAG) that was to prepare a report per these instructions. The SAG adopted the term Future Ground Combat System (FGCS) to describe its objective.

The next several charts are from the FGCS SAG.

SAG Members

Dr. Joe Braddock	**LtG(R) Jay Garner**
Dr. Ted Gold	**Gen(R) Paul Gorman**
Gen(R) Al Gray	**Mr. Frank Kendall**
Mr. Larry Lynn (Chair)	**Gen(R) Glenn Otis**
Dr. Jim Teneglia	**BG(R) Huba Wass De Cega**

Government Advisors

Dr. Allen Adler (DARPA	**Dr. Mike Andrews (SALT)**
Dr. M. Freeman(DARPA)	**LtG Randy Rigby(TRADOC)**
LtC M.Van Fosson (DARPA)	**Mr. John Appel (SALT)**

Support

Mr. Jim Bowden	**Mr. Steade Howie**

SAG

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Were the SAG to have taped its early sessions, it would have captured a most memorable declaration by General Glenn Otis, Father of the M-1tank, who stated that ***in 1999 the tank stands in military affairs in the position occupied in 1939 by the horse. The task we face is no less daunting than that confronting the advocates of armor in the '20s and '30s. Force designers and technologists on both sides in World War II had decades to grope for means to restore tactical and operational maneuver for land forces. We have only two months to find a developmental path for enhancing tactical and operational maneuver while enabling world-wide strategic maneuver.***

In its rhetorical meanderings, the SAG touched repeatedly on the theme that the Army has far less need for **future combat vehicle**, than for a **system of systems** for Army and USMC operations on land designed around networking and robotics, a system that enhances force projection and tactical agility, and that extends the destructiveness of close battle throughout three-dimensional battle space.

At its meeting of 19 July, the Chair enjoined each SAG member to provide, by diagram with oral and written exposition, concepts that could serve to focus development of technology. These charts were submitted in response to that guidance.

CONOPS Enablers

- **Distributed, integrated force of teams with a mix of manned and unmanned systems, light (extensive reach-back, automation, low-weight vehicles, high fuel efficiency), lethal (precision munitions and effective suppressive ordnance), and survivable (teamwork and interactive protective systems).**

- **Organic C4ISR at every echelon linked directly to weapons, particularly those enabling engagement beyond line of sight. This must include provision for highly mobile C2, and for elimination of forward TOCs and FDCs.**

- **Highly-automated, self-actualizing C3 system that assures situational understanding and prompt execution of tactical decisions.**

- **Configured for airmobility: moving overseas using commercial transmodal equipment and civil air freighters, and able to be deployed and sustained within the theater by C-130 (or comparable airlifters).**

- **Punch and endurance beyond that of today's heavy-force, capable of forcing entry and of gaining and maintaining operational and tactical initiative.**

SAG 21

Any future ground combat system must provide for both lethality and force protection. Both are seriously deficient even in the most modern, "digitized" portion of the Army of today..

Current combat units have relatively primitive organic RSTA. This was strikingly evident in the Army's 1997 Task Force XXI AWE, in that leaders, having insufficient awareness of either friendly or enemy dispositions, did not use either fires or maneuver to best effect. A simulated JSTARS figured in the experiments, but, due to terrain masking and data latencies, it was unable to help Blue commanders fighting the close battle. Moreover, the tactical internet actually increased vulnerability in that it required each combat vehicle to broadcast its location repetitively, and the network itself proved to be vulnerable.

The Army must build a new generation of forces around materiel that will enable rapid deployment and sustainability in combat with air lines of communications only.

But central to force effectiveness will be provisions for significantly improved command, control, communications, computing, intelligence, surveillance, and reconnaissance (C4ISR), and reconnaissance, surveillance, and target acquisition (RSTA), especially for deployed forces in close combat.

Toward New Team CONOPS

	2000	post 2010
Force Structure	"heavy" or "light"	combined arms
Construct	duel; overmatch	win at extended range
OPTEMPO	diurnal spikes	relentless
Venue	mono-plane	3-dimensional
Close Battle RSTA	"higher"+ eyes	ISR layers all echelons
Indirect Fires	latency	linked sensor-shooter
Manpower	intensive	robot-assisted
AFV	crew + platform	network with robots
C3	TOC	distributed, automated
Mobility; strategic	DoD lift; RSOI	all lift; fight on arrival
Mobility: tactical	control zone secure LOC	control enemy CGs mass effects sustain from the air

SAG

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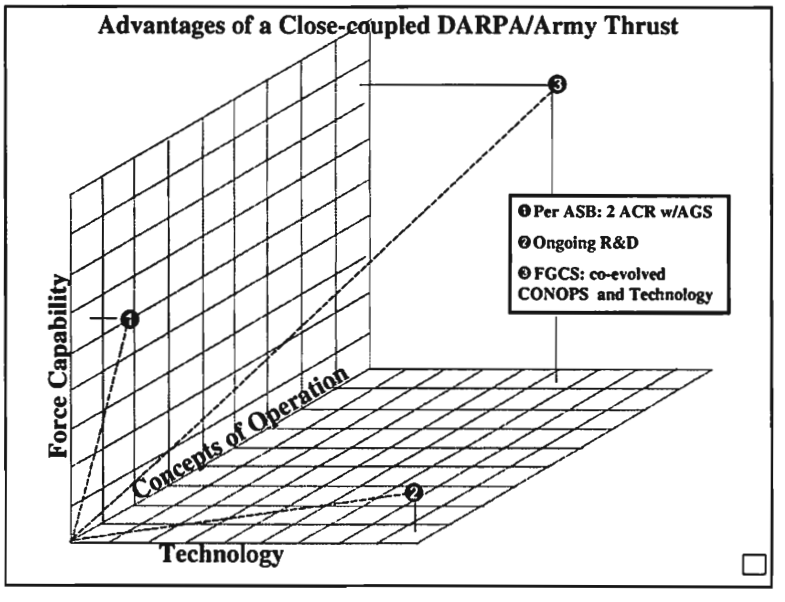
The concepts that follow a derived directly from analyses of close battle, and of technological interventions that would substantially increase the effectiveness of American land forces therein.

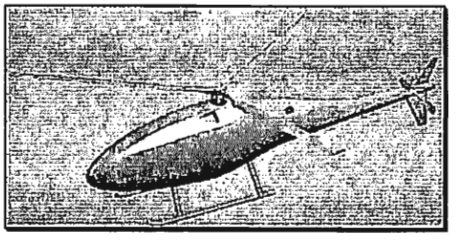
Adopting new concepts of operations (CONOPS) has always been difficult for the Army, particularly when an advanced concept requires novel materiel. But a powerful advantage can accrue through co-evolution of CONOPS and technology.



DARPA (TTO) Robotic Rotorcraft Programs

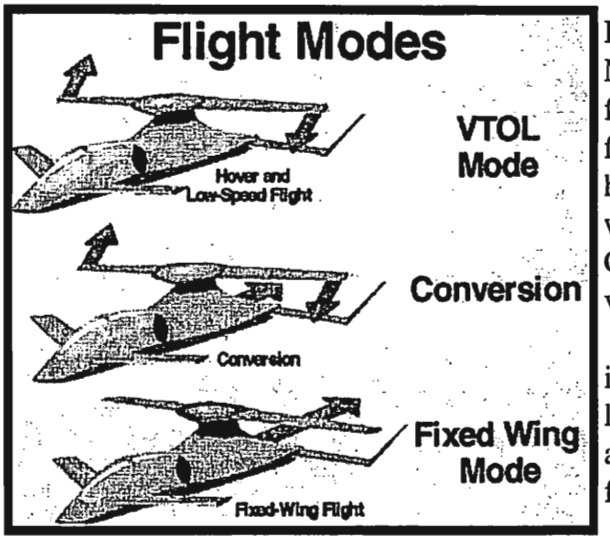
- **The Canard Rotor Wing (CRW) is under development as a maritime UAV (VTOL from ship); low radar signature**

- **The Hummingbird 160: unmanned VTOL; 40+ hrs endurance; max speed 140 kts; payload 300#; low radar signature**



SAG 23

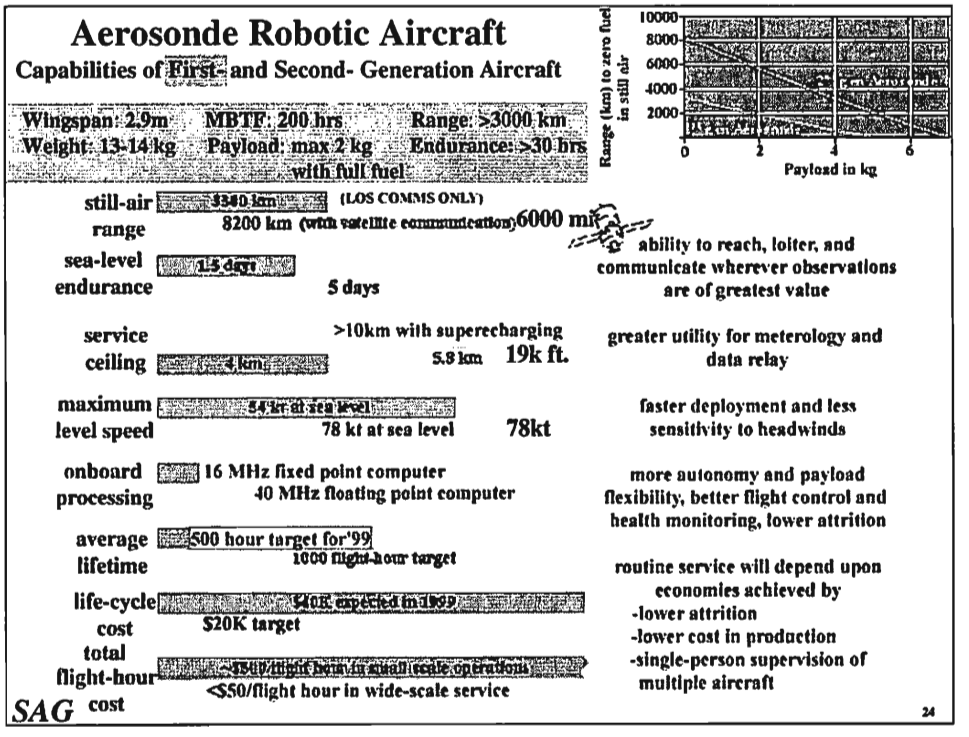
DARPA has under development two pertinent rotary wing robots, both capable of autonomous VTOL: the Canard Rotor Wing (CRW), and the Hummingbird 160.



The first is a design initiated by the Boeing Phantom Works (the former McDonald-Douglas think tank) a hybrid fixed/rotary wing design. This aircraft can function either as a helicopter, or as a highly maneuverable, sub-sonic, fixed wing aircraft. Boeing states that: "The CRW concept can be applied to a wide variety of missions, including ground attack and utility. The aircraft concept inherently supports high speed flight and low observable requirements, due to the absence of propellers and rotors in the fixed wing flight mode."

The Hummingbird 160 is an unconventional robotic rotorcraft designed by Abe Karem, who states that his design has advanced avionics, rotor, body, and engine beyond the state of the current art, enabling the H 160 to achieve long endurance, versatile flight profiles, exceptional maintainability, and reliable GPS-based navigation. The aircraft is capable of lifting a payload of some 300 pounds.

Both of these aircraft could readily be incorporated into attack helicopter battalions, as their rotary-wing VTOL characteristics enable them to share LZs and maintenance.



There are already available — and more will surely follow — robotic aircraft with long range and endurance. Contemporary consideration of the problem of urban warfare tends to dismiss both range and endurance as remunerative realms for R&D, yet an eye-in-the-sky launched from outside the combat area [i.e., minimum drain on the combatant unit], with capability to dwell for a day or more, is entirely pertinent for meeting MOUT RSTA requirements.

The Aerosonde described above is an Australian innovation, stemming from their interest in gathering weather data from large continental-oceanic area.While current sensors for MOUT may exceed the carrying capacity of such robots, and communications systems for conveying the sensor data are presently limited, the technological vector points to placing over a city of military interest a constellation of robots equipped to provide any of several categories of RSTA data.

Military Operations in Urban Terrain

- **Current CONOPS for MOUT are strategically improbable and tactically infeasible: grenades and bayonets, room-to-room, floor-to-floor fighting can not suffice for the Army after 2010**
- **History (e.g., Aachen 1944) teaches the importance of potent, point-accurate weapons, and of controlling the open spaces (streets, parks), and access roads**
- **What is needed is a zone of situational awareness (SA) several kilometers in breadth around U.S troops so that U.S. commanders can make reasonable choices about fire and maneuver: assured blue SA and excellent red SA plus IUGS to enable control of (1) open areas; (2) underground infrastructure; (3) "cleared areas"**

SAG 25

Current Army practice re MOUT is vapid: contemporary MOUT exercises are closer to LAPD SWAT techniques than the experience of the 26th Regimental Combat Team in Aachen, October, 1944. Present presumptions [all wrong!] seem to be that:

— The use of armor is fatally flawed (remember Chesnya).

— Overmatch by specially trained, elite infantry is imperative

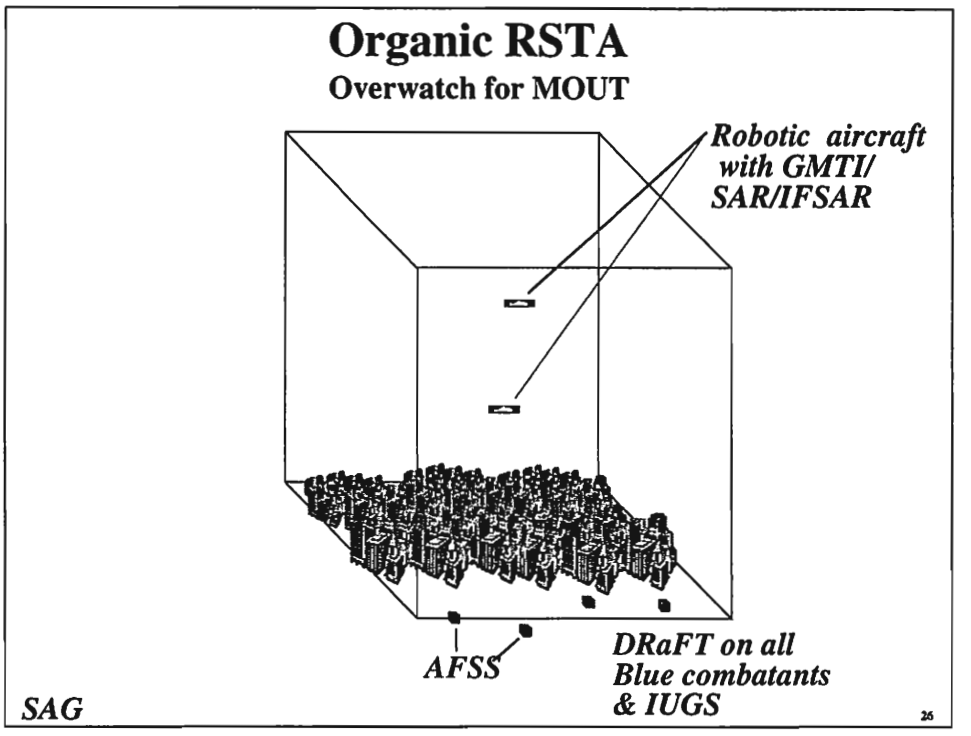
— Defender has all the advantages: heavy friendly casualties will ensue.

There is a pressing need for the Army to refocus its efforts to increase readiness for MOUT from dismounted units to teams of combined arms, and from training riflemen in building assault techniques to serious training of commanders in the use of fire and maneuver in urban terrain.

Even more importantly, senior leaders of the armed services must educate their civilian leaders and the American people on the consequences of committing American troops to MOUT: fire is essential to maneuver, and however discriminate those fires may be, collateral damage and casualties among non-combatants will unavoidable. Rules of Engagement that inhibit fires also constrain maneuver and increase the vulnerability of U.S. combatants.

The casualty rate in Aachen within the 26th Infantry (WIA 17/1000 per day, and KIA 3.1/1000 per day) resembled that of USMC units in Hue 1968 (WIA 17.5/1000, KIA 2.2/1000). In both cases determined defenders outnumbered U.S. attackers, but U.S. forces prevailed. Casualties at that level could recur in future MOUT, although it is possible that technology could mitigate that risk.

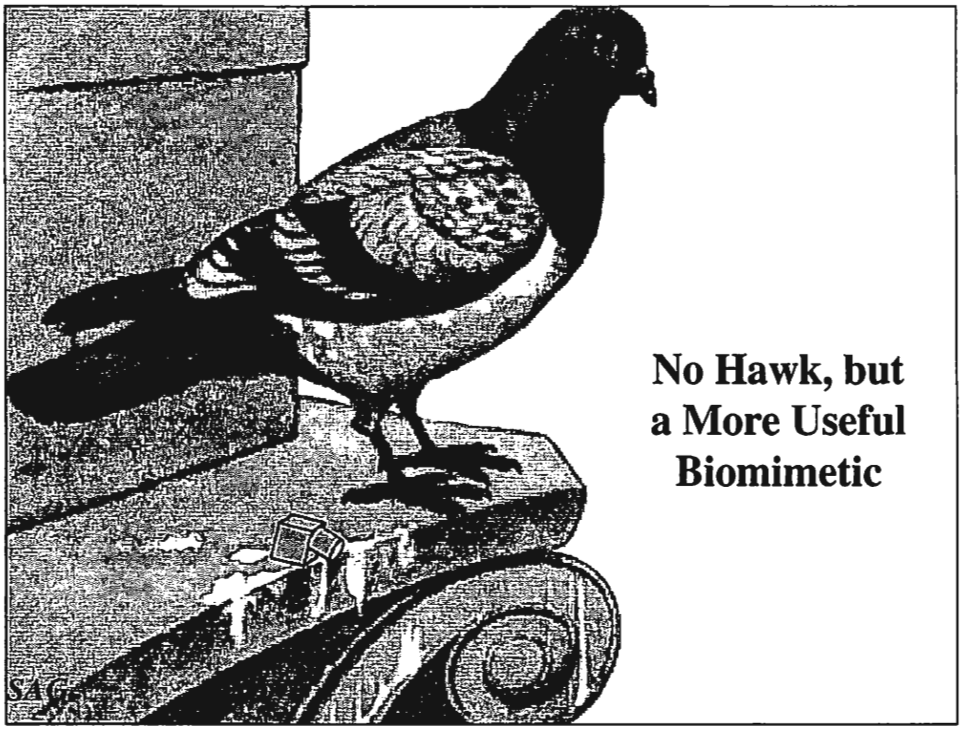
In short, a decision to commit U.S. forces to MOUT should entail a realization of the heightened risks, and readiness to accept the casualties among friends, foes, and neutrals that almost certainly will be involved.



Urban terrain does not obviate the usefulness of organic RSTA; to the contrary, if affords the commander some prospect of establishing a system of layered sensors capable of detecting and classifying movement in the streets and other open areas: in effect, establishing a degree of control over extensive areas, and compensating for the poor RF environment. Indeed, were CBI to be coupled with reliable data on elevation, construction types, and underground structures, the GMTI/other sensors could reliably indicate if, when, and where to fire or to maneuver to tighten control.

Using the methods of the 26th RCT in Aachen, the attacking unit would want a modern equivalent to the 90mm, 155 mm, and 8 inch guns attached to rifle squads that were the primal force behind the 1944 offensive.

IUGS could also play a key role in this sort of operation, largely by providing definitive classification of hostile vs. non-combatant movement. [N.B., IUGS in this context would preferably be placed high on structures where seismic and acoustic sensors would report position more accurately, and where imaging sensors would have a wider field of view.] The key technology intervention suggested for IUGS is a means to emplace them, assuming that the DRaFT/GMTI links would still enable them to communicate to decision makers.



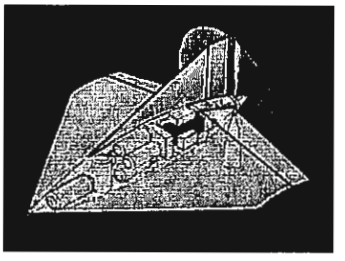
When most of us think of UAVs, we think of miniature fixed-wing aircraft. For surveillance of a city such platforms are distinctly disadvantaged: as they fly-through the battlespace, either their "soda-straw" view of the terrain is chopped into glimpses of streets orthogonal to the line of flight, or it is confined to one "urban canyon" aligned with the line of flight. The RR Hummingbird is a superior platform for MOUT.

Another helpful robot would be one that could **fly to a perch on a building, there to deposit a staring surveillance device**, such as one that could evolve from DARPA's micro-cameras now in test at Fort Benning. The latter are IUGS equipped with automatic target recognition (ATR) that in detecting and reporting infiltrating humans have demonstrated a high success rate, with few false alarms. While they are currently dependent on careful hand-emplacement and alignment, and will require significant further development before they can be adapted to use with an airborne robot, **they promise to support a concept of projecting continuous surveillance ahead of a force maneuvering in urban terrain**.

The more daunting technological challenge, not now being investigated, lies in developing a platform capable of depositing the sensor reliably and accurately. Tele-piloted micro aerial vehicles (μAV) seem less promising than a VTOL robot that could alight on a laser-designated spot, pinpointed from overhead.

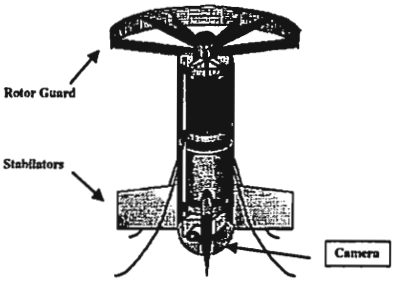
MAV Systems with Sensors

MicroSTAR



- **Lockheed Martin Sanders (Prime)**
  - 15 cm, 100 g, fixed wing MAV
  - Electric engine, ~6 W, battery powered
  - Range: 10 km, endurance: 30-120 min
  - Build 1: integrated sensor, processor, navigation and comm system
  - Build 2: Collision avoidance system &upgrade of Build 1
  - Build 3: IR sensor and upgrade of Build 2

Kolibri

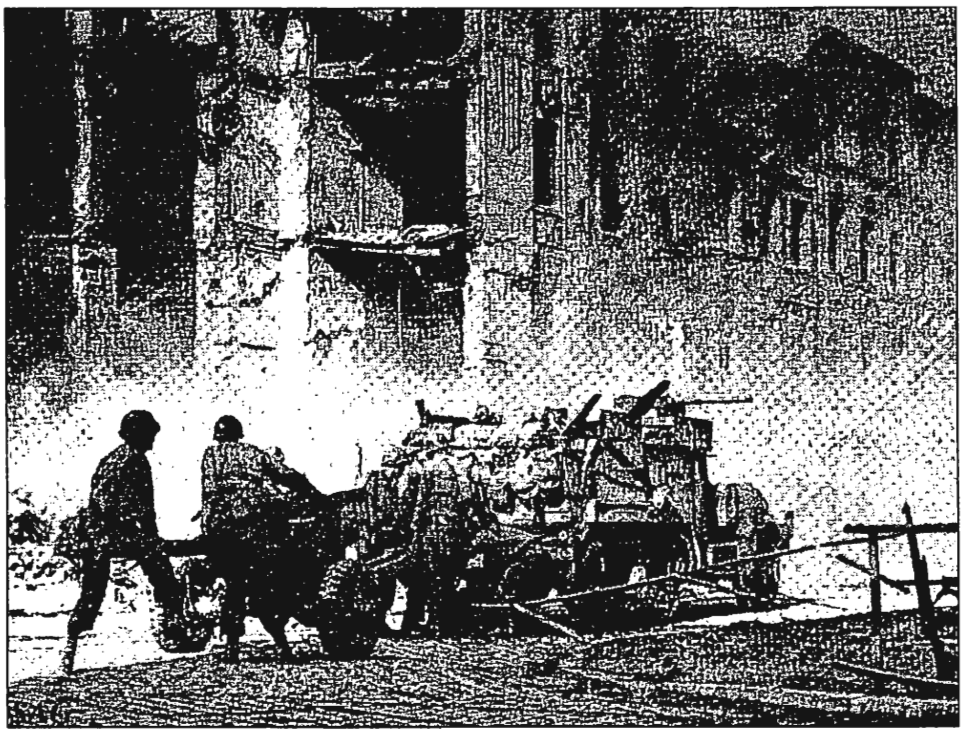


- **Lutronix Corporation (Prime)**
  - 10 cm, 122 g, hybrid rotary/fixed wing MAV
  - IC Engine, 0.16 cm^3, 18 W
  - Range: 40 km, endurance 110 min.
  - Day/night sensor with 200 millilux visible light camera
  - Comm System: 1 GHz UWB, 300 mW

SAG 28

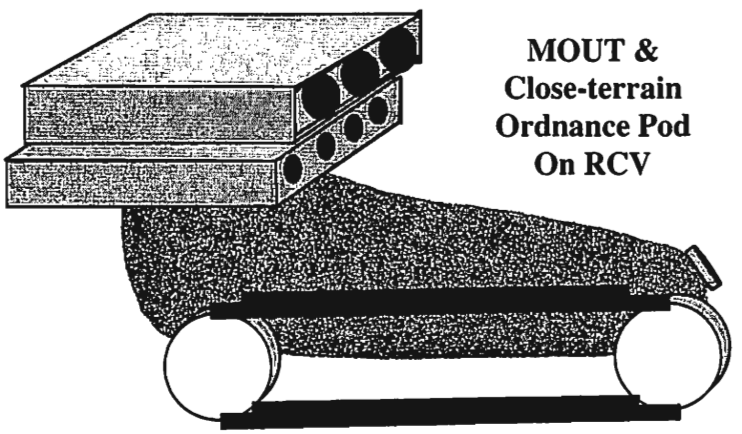
Here are two designs submitted to DARPA under TTO's μAV program: note that the one on the left is electric powered at ~6W, while the one on the right has an 18W internal combustion engine, presumably to enable it to achieve the desired 40 km range and one hour endurance. Note also that the sensors on both produce fly-through images that would require extensive interpretation before being provided to combatants.

For MOUT, the preferred design might resemble the one the right, modified to accept the electric engine shown on the left (simpler, lower acoustic signature), with a drastically reduced range/endurance objective. It should have a guidance system for GPS way point navigation until captured for landing on a laser spot. And it should be capable of carrying a staring surveillance sensor with ATR.



Robots for MOUT are often thought of in terms of the stair-climbers used by police and explosive ordnance disposal teams. While there is undoubtedly a role for such small crawlers to play in MOUT, experience with them to date suggests that they are difficult to control by tele-operation, and that they have difficulty with the rubble and other chaotic obstacles endemic to MOUT. The picture above from Aachen underscores the Army's experience there: only large tracked vehicles could negotiate the cluttered streets (wheeled vehicles often had their tires punctured by nails and glass amid the litter), and they were used not only to position guns (here a 57mm anti-tank gun is being unlimbered from a half-track), but also for resupply of the maneuver force, and for evacuating casualties.

One proposal worth examining would be a [manned] Robot Control Vehicle fitted with tracks, and mounting missile pods with large caliber, blast-optimized warheads that could fly to a laser designation. Large vehicular robots could execute the missions of fire support, resupply and medical evacuation for the advancing attackers, and could furnish anti-tank protection as required.



Recommendation:

Military Operations in Urban Terrain

- Enhance RSTA with layers of sensors capable of MTI surveillance of roof tops and open areas (streets, parks, yards), and acoustic sensing of enemy fires and movements. **Present to decision-maker fused output upon a 3D visualization of the urban terrain.**
- Exploit robotics to provide vehicular support for direct fire, resupply, and evacuation. Scavenge wired comms.
- Adopt an O&O that utilizes all three dimensions of an urban battle space, and provides for extensive situational understanding, precision fires, and selective maneuver.
- Train, deploy, and fight as combined arms.

SAG

The Army must be capable of room-by-room combat in cities, and its readiness for that form of MOUT is probably higher today than at other time in its history. But FGCS should enable a much more expansive CONOPS, one predicated on controlling large urban areas, and taking advantage of adroit fires and maneuver in that terrain no less than in any other.

- Develop RSTA supplements for MOUT, especially staring imagers with ATR and other IUGs, and arrays of acoustic sensors to extend SA around U.S. forces.
- Large robotic ground vehicles should be furnished for direct fire, maneuver, and combat service support amid rubble and other obstructions.
- The Concept of Operations should cope with verticality, seek to deny the enemy advantages of cover and concealment, and employ fires discriminately and tellingly.
- Since terrain data for urban warfare is potentially very dense, and because verticality presents unique problems for visualization, MOUT should be emphasized in DARPA's programs relating to C3.
- As for combined arms:

"The Russians certainly failed to fight a combined arms battle in Grozny [Chechnya], largely because the underestimated the Chechens. The three-dimensional nature of urban combat — its insatiable demands on casualty evacuation and resupply, the extreme decentralization forced on combat units because of intervening urban structures (which block line-of-sight radio communications), and the absence of situational awareness in extremely restricted terrain — requires a different psychological and tactical approach...To fight and win in large cities, the experience of the Russian army in Grozny show that combined arms are essential..."Antal, Lt. Col. (P) John F., "A Glimpse of Wars to Come: The Battle for Grozny," ARMY, Vol 49, No. 6, June 1999. P. 40.