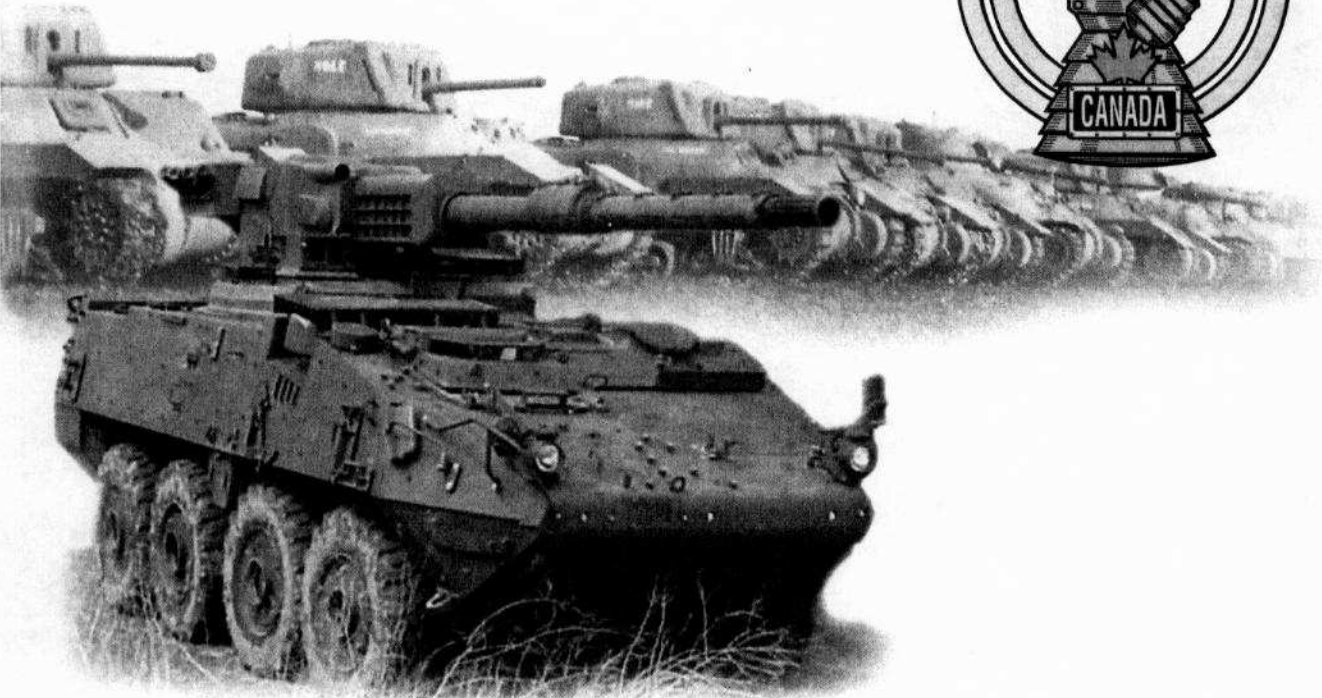


Armour *Bulletin*



Debating the Future Corps ACV



Armour School
Canadian Forces Base/Area Support Unit Gagetown
PO Box 17000 Stn Forces
Oromocto NB E2V 4J5

2900-2 (2IC TSS)

30 April 2002

Armour Bulletin Recipients

CALL FOR ARTICLES – ARMOUR BULLETIN 2002 NO. 2

1. You have in your hands what I consider to be a thought provoking and informative edition of the Armour Bulletin. In the process of compiling this journal, we have assembled a library of unpublished articles covering a host of topics. Many of these will be included in the next edition. However, we now need to gather some theme articles.
2. The theme for the upcoming Armour Bulletin is Army Transformation as it affects the RCAC. As you are likely aware, the Army will be implementing some fundamental changes with the introduction of the Interim Model (2007) and the Army of Tomorrow (2012), both of which will profoundly reshape the Corps and redefine how we conduct future operations. Details of this transformation, as it is now defined, are provided on the DIN at:

http://armyonline.army.mil.ca/CLS/636/ARMY_COUNCIL_27_MAR_PPT

I encourage you to read the information contained on this site, reflect on how it will impact the Corps, and to put your thoughts down on paper.

3. While articles on Army Transformation are preferred, submissions of a tactical, technical, or historical nature will also be considered. Guidelines for article format are provided on the inside cover of this issue of the Armour Bulletin. Where possible, submissions should be accompanied by digitized photos that are not imbedded in the text.
4. My intent is to have the next edition of the Armour Bulletin published in time for the Armour Corps Conference in October of this year. To this end, I request that all articles be submitted to the above address no later than 20 June 2002.

C.M. Hazleton
Lieutenant-Colonel
Commandant



Armour Bulletin

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LCol C.M. Hazleton

MANAGING EDITOR
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EDITOR
Capt S.J. Gooch

DESIGN AND LAYOUT
DGPA Creative Services

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Author's Guide

The Armour Bulletin, as a forum for debate and discussion, welcomes submissions and articles of a technical, tactical, or historical nature.

The following guidelines apply:

- a. it would be appreciated if all articles could be written on 8 1/2 x 11 paper, double spaced on one side, and be accompanied by a 3.5 inch disk copy;
- b. articles should not exceed 2000 words (much smaller articles are also welcome, ie, a page or two);
- c. black and white photographs and illustrations should accompany the article as a separate file rather than imbedded in the article. Photographs cut out of magazines are not acceptable as they are an infringement of copyright laws. Photographs and or illustrations add to the possibility of publishing;
- d. articles should contain footnotes, where applicable;
- e. historical articles must be used to illustrate lessons learned. The article must do more than inform the readers of facts and dates;
- f. only material of an unclassified nature should be submitted;
- g. the use of military abbreviations should be kept to a minimum for clarity;
- h. authors should include a very brief description of their current position and location, as well as an electronic photo of themselves.

The Editor reserves the right to reject and to edit articles and letters submitted for publication. Authors should not submit articles which have either already been submitted for consideration to another publication or have already been published.

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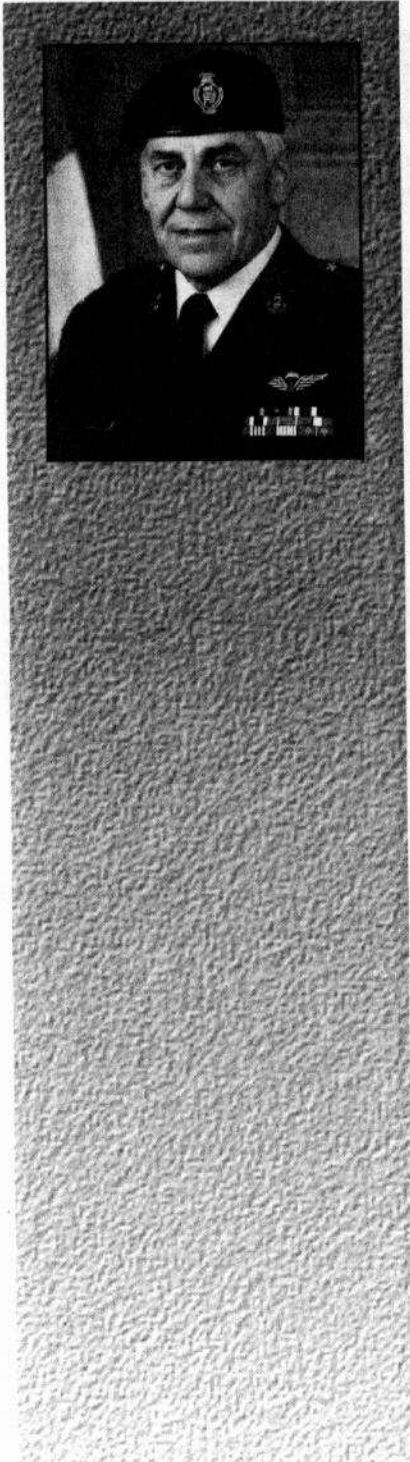
LAV 105 firing in front of Canadian built Ram tanks.

Next issue's theme:

Army Transformation as it Affects the RCAC
Vol. 34 No. 2



Colonel Commandant's Foreword



Whereas previous bulletins have focused primarily on one theme, this edition has broadened the horizon with articles that look into the future, providing ideas and opinions as to the direction in which the Corp should be heading.

Interestingly, the subjects cover the areas of concepts and organizations, doctrine, equipment, and training, subjects that are the four pillars or cornerstones of a process by which not only Armour, but the whole Army, should be developing. This combat development process, discussed in the last bulletin, keeps Army requirements orderly, balanced, and dynamic, as well as ensuring the senior leadership and their staffs stay focused and productive. It also provides a proven and substantive base upon which priorities for funding can be based. Using logic and proven methodology, needed now more than ever, substantiates requirements for policy planners and purse holders alike.

As with any process aimed at improving the Defence and security requirements of a nation, of necessity, the first analysis must be the threat. In the last bulletin existing threats, whether

terrorists or territorial, large or small, were seen as having the potential to escalate rapidly, requiring much more than the current capabilities of not only Armour, but the whole Army.

These threats and their potential for full-scale war have been recognized by even the most ardent peacenicks and passifists, public representatives. The public and media have certainly acknowledged the problem, brought into sharp focus by the terrorists attack of 11 September 2001 and the subsequent events. But what about the Defence Department? Has the war on terrorism brought the necessary changes to ensure our national commitment to fight and win will be appropriate for a nation of our size and strength? (Compare Canada's commitment in Korea 50 years ago when the population was half what it is now and the economic strength measurably less).


Or are today's challenges causing frustration and overwhelming the Defence Management System? In the haste to participate, are contingents being committed primarily to prevent declining international credibility? Should Canada not be fielding units



that were professionally developed using doctrine, equipment and training standards tested intensively during major training, exercises, and field trials? Should not the current operations be validating the results of a combat development process? To be doing anything less could jeopardize the nation's most valuable defence assets, the men and women who serve.

Idealistic? Evolutionary? Then what of the articles herein? They need to be read, studied, and compared with those in other professional journals like this bulletin, produced by the military profession. Read, discuss, debate, and challenge the ideas postulated. (Generals and their staffs do not have a monopoly on the smarts

market) Pass this bulletin around. Share it with others in the combat arms. Get involved in the process of developing the combat power of Armour within the Army context, preparing it to fight and win where ever, whenever it is needed.

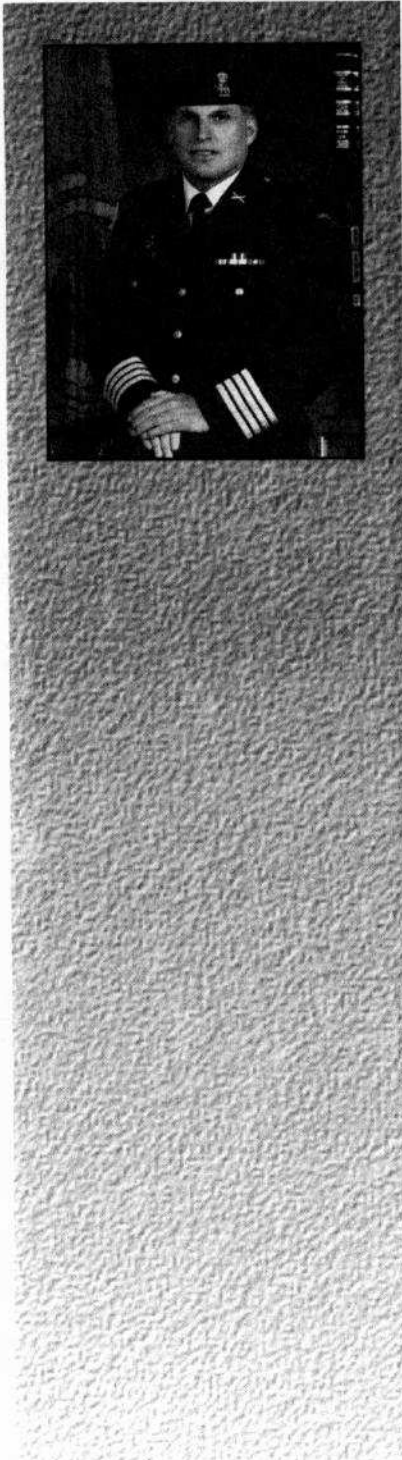
Use this bulletin to air your views. Get involved in the Armour Association to pursue your aims and objectives. Worthy would expect nothing less! 

A handwritten signature in cursive script, appearing to read 'Clive Milner'.

Major General (ret)
Clive Milner, OMM, MSC, CD
Colonel Commandant



Director of Armour's Foreword



As your new Director and a former Managing Editor of the Armour Bulletin (AB), I am extremely pleased to have been given the opportunity to address the Corps through this medium.

It should be no surprise to you that the Armoured Corps is continuing to experience important challenges as we move into 2002. Notably, the Army commander's effort to balance affordability, sustainability and modernization priorities for the field force will certainly impact on our structures, and by extension, the Corps' manning, employability and training. The repercussions of any future changes are not fully assessed at this time, although early indicators from the Army Transformation Working Group have stressed that the "status quo" is no longer affordable, hence unacceptable. Let me therefore assure you that my comments are not meant to alarm, but rather to inform, as I believe that the inevitable changes, once ordered, will have been scrutinized by the Corps' leadership with the intent to minimize any discomfort.

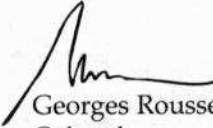
While writing this message, I am re-assured that our contribution to the Commander's operational capabilities will not be ignored, as we once again take centre stage in providing the reconnaissance elements which will spearhead the Canadian land contribution to the war effort in Afghanistan.

It is therefore "à propos" that this edition of the AB contain thought provoking articles on the future of our profession. I invite you all to **freely** express your views through the

"letter to the editor" in order that the doctrinal gurus may amend/refute or re-enforce their positions through constructive debate.

While on the subject of debate, I would be remiss not to invite all members of the Black Hat community to fully participate/engage in our Association. The Royal Canadian Armoured Corps Association provides a complementary voice beyond the chain of command and will continue to be a forum that bolsters camaraderie and critical debate. Please inquire upon your Commanding Officers or the Adjutant of the Corps about the next Annual General Meeting to be held in Borden. If you want to be heard, be seen!

In closing, and on behalf of the Corps, I would like to thank Colonel Bill Fulton for his selfless dedication, and dynamic and lasting contribution to the Black Hat community as Director of Armour. For the history buffs and/or those who enjoy statistics, Bill has completed 46 months in the seat, which ranks him second in Directorship longevity behind Colonel AG. Chubb, 1951-55. Finally, as I approach the end of my first year as Director, I am reminded every day that it is a tremendous honour and privilege to have been selected to serve you. I am looking forward to meeting more of you during my tenure and wish you and our great Corps, success and prosperity. ■■■


 Georges Rousseau
 Colonel
 Director of Armour



Editor in Chief's Foreword




This latest issue of the Armour Bulletin has strayed somewhat from past editions in that the articles have not focused on one theme. This is not to say the original topic of "Debating the Future Corps ACV" was not appropriate. However, given the world situation since 11 September 2001 and the ongoing proposals of change to Army Structure, I thought it appropriate that we increase our arcs of fire to include other topics of interest. You will note that the Bulletin has been grouped into "theme" chapters and, as such, I am confident there is much to chew on and digest.

I have included as the keynote address an article by BGen Nordick, entitled "Thought Piece on the Structure of the Armoured Corps in Canada." As you are all aware, BGen Nordick is not a "Black Hat" and as such, many of you are probably wondering why I chose his paper. Simply put, his paper is thought provoking and proposes changes to our Corps in order to meet the current and future challenges facing both the Armoured Corps and Army. I am confident his paper will generate the type of discussion and debate needed within our Corps to ensure we do not become complacent and miss current and future opportunities to ensure a strong and viable Corps within Canada's Army (as well, within this edition there are wide variety of articles which discuss many issues facing the Corps today).

As both our Colonel-Commandant and Director of Armour have indicated, the Armour Bulletin remains

a key venue in which all members of the Royal Canadian Armoured Corps can express their opinions and views on a myriad of topics. I hope you will continue to support the Bulletin with future articles, regardless of topic. Additionally, as of 2001 the Armour Bulletin will only be published on an annual basis, this is due in part to financial considerations within the Armour School.

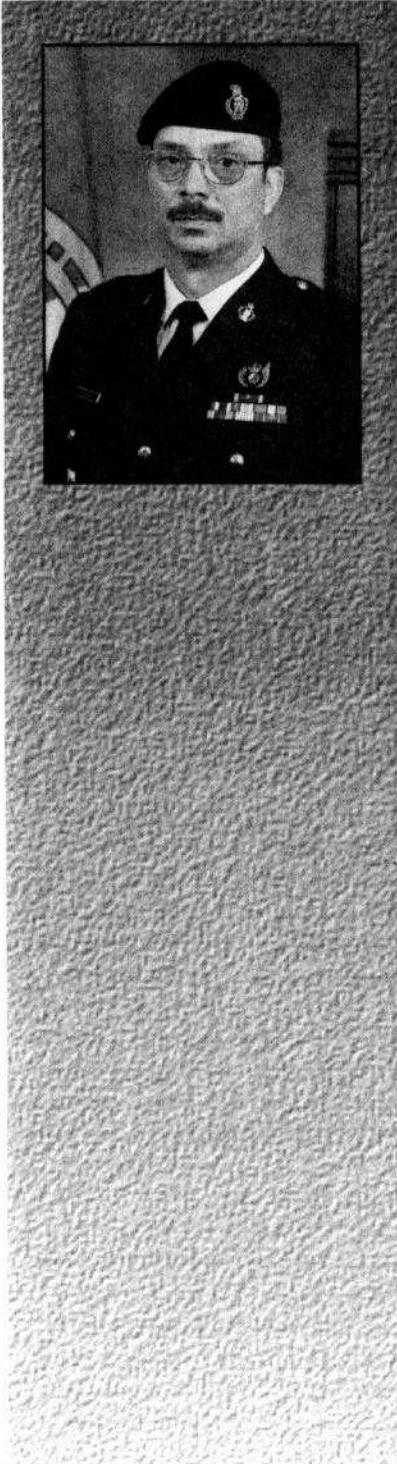
There being no shortages of issues to discuss within the Corps and Army, the next subject of the Bulletin 2002 will focus on the proposed Army Transformation Model as it affects the Armoured Corps. As many of you are aware the CLS has introduced a new model based on an asymmetrical structure approach at the formation level. This latest model in some respects marks a departure from previous guidance with regard to manning and the rule of three, but is clearly a more robust model than previous iterations. At first glance, this model answers many of the concerns previously expressed to the Land Staff from the RCAC. It is with this model in mind that I ask for your constructive feedback.

I look forward to reading your comments and receiving feedback on the Armour Bulletin. 

Lieutenant-Colonel
C.M. Hazleton, CD
Editor in Chief, Commandant
Royal Canadian Armoured
Corps School



Corps RSM




Let me start by saying how honoured I am to have been appointed as the RSM of the Armour Corps. In addition, it is with great pride that I have been given the opportunity to address the members of the Corps through the Armour Bulletin.

My first order of business on behalf of all members of the Corps is to thank CWO (ret'd) Jim Brown for his dedication to duty during his time in office. Also to wish him and his wife Carroll all the best in their future endeavours

One of the highlights of the year is attending the annual RCAC Association Conference and the Armour Board. This year these events were held at CFB Valcartier and very well hosted by 12 RBC. Of particular interest to me is the time spent during the conference with the RSMs. The opportunity to exchange ideas with members of the Corps at this level is invaluable. The increased number of attendees each year only demonstrates the importance of the conference and I would encourage the continued support of the Regiments.

I have also had the pleasure of traveling with the Colonel Commandant during the past eighteen months and have seen many soldiers throughout the Corps engaged in a variety of training. The common theme I see across the Corps, other than wearing

the Black Beret, is the sense of pride in which all perform their duties. I continuously meet soldiers who are very proud of serving their country and who are comfortable with speaking about it. This I see as a symbol of how strong our training procedures are today. As we embark on yet another road of change with the new Training Development Period system, I encourage you to maintain the status quo to your approach; in true Armour fashion, head on with aggression. The road ahead, like the one behind us, will not be easy and we must place our trust in our leadership at all levels to guide us down this road. This new training system will greet us with many challenges as we traverse through it and I am certain we will also find it very rewarding as well. After all, we only stand to get better and that is one of the reasons why we are part of one of the best-trained armies in the world.

In summary, I look forward to meeting more of you in my travels or here at the Armour School when you visit as students or augmentation staff. GOOD SHOOTING, keep up the great work! 

CWO D.R. Harvey, MMM, CD
Corps RSM



Keynote Address: Thought Piece on the Structuring of the Armour Corps in Canada



Brigadier-General Nordick graduated from RRMC in 1977. Since that time he has held a number of command appointments, including CO of 3PPCLI and commander of 4CMBG. He has also served on 2 tours in Cyprus, in the FRY, and in Bahrain during the Gulf War. He is now the Commandant of LFCSC in Kingston.

By Brigadier-General Nordick

“It is also a reality that sending an Armoured Regiment overseas on a Peace Support Operation with more than one of its integral squadrons severely restricts combined arms training in that Brigade for a period of almost one year..”

Recently I wrote a paper offering specific options for the organization of the nine-infantry battalions in the army. Although already in wide circulation, it will be published in the spring edition of the Army Doctrine and Training Bulletin. I am pleased to report that I continue to receive detailed and excellent feedback on this paper. However, one accusation launched was that I looked at the infantry corps in isolation. That I can assure you is not so, as those who have worked with me over the past two years can attest too. I have equally strong views on the organization of the entire combined arms team. Unfortunately, time has not permitted me to give those views my full attention. However, the Commanding Officer of the Armour School asked that I prepare a short thought piece to assist the Armoured Corps in opening a similar free ranging debate.

I want to start by stating at the outset that I am a firm believer there is an essential and distinct role for tanks in the army both today and

into the foreseeable future. From personal observation I also believe the C2 Leopard and the LAV3 complement one another very well and represent a significant increase in Combat capability for the army. I do recognize that the C2 has shortcomings with regards to its ability to take on heavy Main Battle Tanks, however, this is a situation that we will have to live with until a replacement is purchased in the future army time period. What this vehicle will eventually look like is the point of intense debate and research literally around the world. However, I am convinced of the need for a heavy direct fire capability in any future army and hence I would suggest that the tank (in some form) is here to stay.

I also need to lay some cards on the table to frame this discussion. First, there is only one role in the army at the moment for a complete tank Regiment and that is to support the Main Contingency Force (MCF). I do not see this reality changing into at least the army of tomorrow timeframe. Hence, this single primary task must dominate when deciding on the distribution and employment of our scarce tank resources. Except for this mission, and for Domestic Operations, Armoured Units are a force generation capability to provide armoured sub-units for a variety of overseas Battle Group deployments. They are also key to the provision of combined arms training across the entire army, up to and including Brigade Group level. It is also a reality that sending an Armoured



LAV AT 7

Regiment overseas on a Peace Support Operation (PSO), with more than one of its integral squadrons, severely restricts combined arms training in that Brigade for a period of almost one year and puts in jeopardy our ability to generate the MCF in the timeframe required.

There are also a number of related issues that the army must address. How best to provide LAV recon capabilities to the army, how to organize our heavy anti-tank capabilities, and finally how to position the army to prepare for the introduction of future army systems such as the Multiple Mission Effects Vehicle (MMEVs) used in the first future army experiments.

With these thoughts in mind I propose the following organization of the Armoured Corps based on three Regiments and the Armour School:

- Missions: Be capable of forming a composite Armoured Regiment of four 10-tank squadrons (total of 40 tanks) for the MCF within 90 days. Provide essential armoured elements for Combined Arms Training at Combat Team, Battle Group and Brigade Level on a

continuous basis. Generate sub-unit recon and tank resources for PSO and other operations. Be capable of deploying a Battle Group Headquarters to command an infantry heavy Battle Group in PSO or other assigned missions;

- Three Regimental HQs based on a Standard Battle Group HQ (LAV TAC and a dismounted capability). This will mean some restructuring of the HQ to meet a standardized requirement that is currently being developed by the Directorate of Army Doctrine;
- a total of 6 X 10 tank squadrons (Two Squadrons to the LDSH (responsible for support to 1CMBG and the CMTC), one squadron each to the RCD and 12 RBC to support local Combined Arms Training in 2/5 Brigades, and two squadrons to CTC (support to the school, CMTC, and 2/5 CMBG exercises in Gagetown). All spare tanks would be located in Edmonton and Gagetown to ensure tank support to both CMTC and major exercises. The smaller squadron size will not be a popular choice; however, it is a reflection of both tank availability and the fact that other systems

such as LAV will carry some traditional roles (destruction of enemy APCs and some fire support on the objective tasks). This organization also ensures the maximum number of Squadron HQs and echelons are available for the training of sub-unit commanders (built in possibilities of expansion if/when required). Coupled with the integral Anti-Tank (AT) resources discussed later, this organization gives the Brigade a credible heavy AT and direct fire capability;

- a total of 5 Brigade Recon Squadrons (mounted in Coyote with an integral AT capability, plus the ability to conduct NBC recon). The integral Assault Troops should be stealth recon mounted on ATV with an integral Unattended Ground Sensor (UGS) capability, a target designation capability and a 2000m dismounted AT capability. Two Squadrons should be located in both the RCD/12RBC to replace the missing tank squadrons. This will provide the five squadrons needed to ensure one squadron is available for deployed operations at all times. This structure also adds the possibility of adding a Recon



Regiment to the range of MCF land options. My experience commanding 1CMBG has led me to believe that only by properly employing the Coyote mast, coupled with gun/AT Coyote overwatch, and with an integral stealth recce capability, will we be able to make full and best use of this incredible resource;

- We should create three Recce Observation Squadrons (one in each Regiment). The composition should be a Squadron HQ (essentially the Combat Support Company HQ equivalent) commanding four Coyote surveillance troops (four or five car troops). This Squadron should be formed by RHQ recce troop and by withdrawing the Coyote Recce from the Brigade Infantry Battalions. Their primary role should be to provide Coyote surveillance assets to Battle Groups; however, they can also conduct Brigade tasks to supplement the Brigade Recce Squadron as directed (route marking, convoy escort, flank security, Rear Area Security, etc). Manning of these Squadrons is an issue that must be addressed. As I have discussed in my Infantry paper, there is still an essential requirement for close recce in the Infantry Battalion, hence this is a transfer of equipment and not necessarily the personnel to man the vehicles. This is an instance where I would recommend manning by a combination of both armour and infantry personnel; and
- I recommend the formation of three Brigade Heavy Anti-tank Squadrons equipped with 8-12 LAV TOW



M113 ADATS

drawn from the Infantry and four ADATS drawn from the AD Regiment. There are dual reasons for recommending the formation of these Squadrons. First to rationalize the employment of our heavy anti-tank resources and secondly to provide the springboard for the formation of MMEV Squadrons in the future army. Again there will be manning issues. There is still an essential requirement for medium range anti-armour weapons in the Infantry (2000m plus) and therefore there will almost certainly be manning shortfalls when these Squadrons are created. Given their current and future roles I strongly recommend that these Squadrons be manned by a combination of armour, infantry, and artillery crews. Although this is not a perfect replication of the MMEV it does allow us the time to develop doctrine and tactics for the use of this system prior to its introduction, something we have not been particularly good at to date.

This organization, I believe, provides a very balanced combat capability and an armoured corps structured to meet all of its competing requirements. I also believe it enhances our flexibility and combat capability by centralising certain capabilities in the short to medium term and provides an excellent springboard into the future. However, in addition to structural change, this organization does require some new equipment programmes including: adding an AT capability to Coyote in the Brigade Recce Squadrons; the addition of ATV, UGS and a dismounted AT capability to the Assault Troops; finding a replacement for the C2 tank in the future army, and purchasing the MMEV for the future army.

However, I acknowledge this organization is not without its challenges. It breaks the idea of symmetry, raises some manning and organization challenges that do not fit our traditional view of either the armoured corps or the combat arms. At the same time it does provide an army focus to the armoured corps to meet the challenges of the army of today and tomorrow. As well, the reorganization of mounted recce and the creation of heavy Anti-tank Squadrons gives the Armoured Corps a key role into the future and offers the army a significant ability to experiment with the MMEV concept as we strive for the future.



Anatomy of a Crisis



Major-General Maisonneuve graduated from RMC in 1976. Since that time he has held a variety of command and staff positions both in Canada and abroad. He has served on three operational tours in Cyprus as well as in the FRY and Kosovo. Having held the appointment of D Armd in 1995-96, he is currently the Assistant Deputy Chief of the Defence Staff.

By Major-General J.O.M. Maisonneuve

“Since a clear concept of employment was unavailable so soon after an event of such proportions, the JSSC planned on the basis of capabilities and returned to first principles.”

Events like those of 11 Sep 01 have a way of creating such shock and trauma to every individual that we often wonder who, if anyone, will be able to react to them and what can be done practically. For us in the Canadian Forces, these types of events are too familiar, but until now, we seldom thought they might take place in North America. Many of us have served in parts of the world that suffer such trauma, death and destruction, but right here in our backyard? I don't think so!

So what took place at the National Defence Headquarters (NDHQ) on the day of the attacks on the World Trade Centre and the Pentagon and in the days that followed? Did people react properly, or just sit on their hands waiting for someone else to take action? This short article hopes to provide some enlightenment from my personal observation.

Immediately after the attacks, the entire headquarters occupied its “battle stations.” For some, this meant being ready to react to requests for support within their personal responsibilities. For others, such as members of the Deputy Chief of the Defence Staff (DCDS) Group, it meant

getting personally involved in command and control issues, such as the control of Canadian airspace in support of the North American Aerospace Defence (NORAD) agreement with the U.S. Plans and coordination took place to safely ground all flights inbound for Canada, in cooperation with Transport Canada, and to place the CF at a higher state of readiness. In addition, support for more than 30000 stranded passengers was provided at airports large and small across Canada.

U.S. authorities have repeatedly praised Canada's efforts since 11 September, in particular for accepting the diverted flights into our airports, and for the increased information and intelligence sharing.

Day One of the crisis saw the DCDS himself spend almost all day in the National Defence Command Centre (NDCC), providing coordination of operations on behalf of the CDS and ensuring appropriate information flow upwards and downwards. The NDCC was a beehive of activity. Several Armour officers were intimately involved in the support of the operation and performed admirably, as always. After flights within Canadian airspace were grounded, actions began to organize support for stranded passengers, and to ascertain what type of assistance could be provided to U.S. authorities in New York. The Disaster Assistance Response Team (DART) was placed on alert, ready to deploy to the area if requested. Ships and aircraft were readied in case they were required.




Within a day, the Joint Staff Action Team (JSAT) and the Joint Staff Steering Committee (JSSC) were convened. The JSAT is chaired by the Chief of Staff J3 (COS J3), an officer of one-star rank, and includes representatives of every discipline within NDHQ. Its aim is to ensure coordination of all joint strategic actions for all international and domestic operations. The JSSC is chaired by the DCDS himself (three-star rank) and includes representatives of every discipline within NDHQ at the one- or two-star rank. The aim of the JSSC is to provide strategic guidance to the JSAT and to operations of the CF. The first meeting of the JSSC after 11 September included representatives at the highest level.

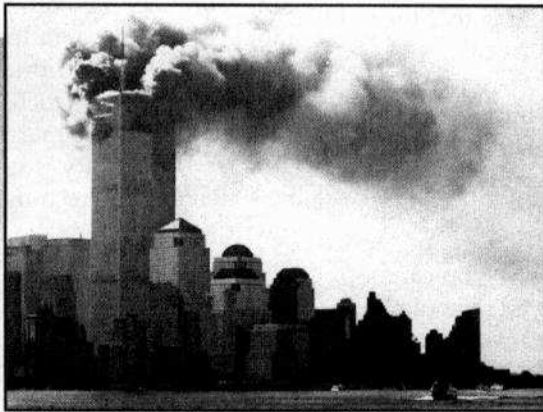
The JSSC set out to immediately develop options for CF capabilities available to react to the events of 11 September, both domestically and internationally, while the JSAT helped COS J3 maintain control of current operations. Since a clear concept of

employment was unavailable so soon after an event of such proportions, the JSSC planned on the basis of capabilities and returned to first principles, for example defence policy commitments, and the widest possible interpretation of available forces.

Consultations were taking place with U.S. officials throughout, and it became apparent that our contributions were not only being very helpful to them, but that they were very interested in a Canadian participation in an international coalition for the campaign against terrorism. In early October it was decided that a team of CF representatives would travel to the southern U.S. to provide the lead American HQ an idea of Canada's capabilities. The work of the JSSC was invaluable in this regard, and the team was able to put appropriate packages on the table. Eventually, the Canadian government announced a major contribution by Canada towards the coalition campaign against terrorism.

Efforts continue today, with a major planning and coordination Canadian HQ in place in the U.S., further verifications of how the Canadian contribution can be enhanced, and staffing of further long-term actions that may be appropriate in the fight against terror. Transparent to most members of the CF and the RCAC, staff activity is feverish at NDHQ to ensure the support of our sailors, soldiers and air personnel.

The 1900s were witness to two world wars and several other major and minor conflicts. Our grandfathers and great grandfathers fought for freedom, sometimes in far away lands as well as at home. This current campaign could be called our generation's World War. Paradoxically, it is being fought in the manner we anticipated at the end of the 1990s, with high-technology weapons, information manoeuvre and network-centric actions. But it is also being fought in caverns, caves and low-intensity hand-to-hand combat against an enemy who is devious, ruthless, and without rules. The price of our freedom lies in how we will react and ensure a safe and secure environment for our children. 



World Trade Centre



Future of Armour: In Three Steps



Colonel Marsh, OMM, CD, joined the Canadian Army in 1965. After commissioning in 1970 his first 15 years were spent leading armour troops both in Canada [12th RBC, Armour School] and Germany [2nd RTR]. Within the Corps he has served as OC Tactics Squadron, Chief Instructor and Director Armour. In the rank of colonel he has served in several positions, notably as Commandant Royal Military College and Land Force Command Inspector. He is currently the Special Assistant to Chief of Land Staff.

By Colonel Marsh, OMM, CD

“...the marginal utility of wheeled DFSV and the need to live within budget ...have been long ignored by the Armour Corps. Someone else is now taking action.”

The Armour Corps has a future if it can innovate. The roles of armour: fire-power, mobility, protection, communication, and flexibility are enduring military characteristics. The challenge is to visualize them in a new form in a different context in the coming decades.

STEP ONE: THE REALITY

The advent of rifling greatly improved the accuracy of guns, but it took almost a century and a million casualties before armies retired volley-fire doctrines. Understanding that the old order has passed is critical.

Open terrain, close-combat based on direct fire and manoeuvre has a limited future. Surveillance assets, both commercial and military, can detect most warm objects in open terrain. If you can be seen, you can be hit, and if hit, destroyed. The plethora of optical-electronic devices are displacing direct-fire. No longer must

the armour gunner or the Forward Observation Officer directly engage a target through Line-of-Sight observation and weapons. C4ISTAR technologies (Command, Control, Communications, Computers, Intelligence, Surveillance, Target Acquisition, Reconnaissance) and long-range, precision strike assets are capable of neutralizing high value, manoeuvre assets within 72 hours. This, the shaping phase of future combat, is likely to be executed by USA assets. Canada’s direct-fire, protected capabilities, if employed, are more likely to deploy for latter roles such as stabilizing operations. The **first reality** is that the Revolution in Military Affairs (RMA), fueled by the microchip, is forcing future conflict into two streams: one, swift, highly lethal, long-range and two, slow, low lethality, very close-range. Current operations in Afghanistan are illustrative. Cruise missiles [long-range] and Special Forces [very close-range] are the capabilities of choice. As the DFSV squadron is not well suited for either branch of future conflict its utility is marginal. A marginalized capability is unlikely to be sustained in a resource restricted environment.

An earlier decision by the Armour Corps to remove sensors from the reconnaissance vehicle, Coyote, and



render them as interim DFSV has made the Corps very vulnerable to first round reductions. Land based, mobile, protected reconnaissance assets [Part of the C4ISTAR suite] are in high demand. DFSV are not in high demand.

After long avoiding the issue – the Canadian Forces is too big for its budget – steps are now being taken to address the imbalances. *Strategy 2020* attempts to put the Canadian Forces on a sustainable, relevant, affordable, innovative path to the future. *Defence Plan 2001* brings substance to the strategy by directing the Chief of Land Staff(CLS) to, “...implement a transition plan to achieve a sustainable intermediate Army of Tomorrow structure for the year 2005, emphasizing medium-weight, mechanized forces with enhanced command support and ISTAR capability... This will lay the groundwork for a more fundamental Army transformation in the Future Army (beyond 2011)”. The Chief of Land Staff took the guidance one step further with specific direction in *Strategic Operations and Resource Direction 2002 (SORD 2002)*.

- **Strategic Objectives.** The army strategy has four objectives with associated five and ten-year targets. “Deliver a Combat-capable, Sustainable Force Structure” is the strategic objective that addresses capability and structure. It focuses upon command support including an enhanced ISTAR capability, brigade group interoperability with the US Army and experimentation. Army Transformation and LFRR are the key activities.



Cougar on Patrol

The army is transforming in two stages: stage one – achieve sustainable intermediate force structure, stage two – the fundamental transformation. Amplification of the stage one theme is found in Section 3 of the SORD 2002 – Managing The Army of Today.

- The Army will begin an incremental establishment reduction to improve sustainability.
- This plan... can be adjusted incrementally... and... will be reviewed following the Defence Services Programme update.
- The Army of Today end-state (2005) will provide a solid base for the transition to the Army of Tomorrow (2011) which may be more asymmetric and less balanced than is the Army of Today.

- The planning model... is a regular field force of three brigades with a total of ten manoeuvre units. Based on seven infantry and three armour units.
- Some heavier MCF-type armour and artillery capabilities will contain an increased reserve presence.
- At least one mechanized infantry company will be embedded in Regular Force armour regiments to facilitate operations.

Being compelled to live within budget is the **second reality**. Deficit living erodes morale, infrastructure, capability, and contributes to attrition. The number of personal bankruptcies and personal debt loads testify that many Canadians try to avoid financial reality. However, unlike the citizen,



militaries cannot “write-off” debt and start anew. Canada’s army is going to restructure.

The combination of the marginal utility of wheeled DFSV and the need to live within budget are, in my opinion, the major factors for DLFS (Director Army Structures) early call on the DFSV squadron positions. These realities have been long ignored by the Armour Corps. Someone else is now taking action. The resource path for the Armour Corps has been defined. Even a large infusion of cash to enhance national security and to augment CF capabilities in the war against terrorism is unlikely to alter the trend to reduce legacy DFSV capabilities. The challenge is to make the best of the hand dealt. Accept reality and build capability that CLS needs.

STEP TWO: INTERMEDIATE FORCE STRUCTURE

The Armour Corps knows its tasks. See the Canadian Forces Joint Task List (CFJTL) and the 11 Joint Capability Scenarios that describe the tasks and limitations. Armed with the CF JTL, Joint Capability Based Planning and the Strategic Operational Resource Direction 2002 (SORD 2002) the Corps should examine capabilities that support the CLS in achieving the 2005 and 2011+ force structures. What could the Corps do with the following? Given:

- Three battle group headquarters [Digitized HQ, “6A” configuration (2005)] with an ISTAR All Source Cell, SATCOM, LFC2IS with interoperability with the Canadian Forces Common Operating Picture

COP (21) and access to Coalition CINC 21.

- Three Headquarter Squadrons.
- Armour School.
- Three Leopard C2 Squadrons worth of equipment, PY and O&M.
- Three Coyote Reconnaissance Squadron worth of equipment, PY and O&M.
- Three LAV III mechanized infantry companies worth of equipment, PY and O&M.
- Access to ERSTA equipped tactical aviation.
- Armour assets available through Land Force Reserve Restructure.
- Total Force experience, notably 8CH.
- Army cyclical managed readiness.
- Access to US Army and USMC Assets.
- Modeling and simulation.
- Freedom to propose asymmetric solutions.
- Knowledge that the US Army Interim Brigade Combat Team (IBCT) is likely to heavily influence future CMBG force structures.

It is important to note that the SORD is strategic resource direction. It is not a force structure blueprint. Yes. It uses force structure terms, i.e. mechanized company, but sub-unit descriptors is our language of intent. [A complete listing of what comprises a LAVIII company is found in Electronic Battle Box.] The Command Comptroller has another description in detailed financial terms.

Given the above, what is the structure of armour units in the army’s intermediate force structure? While the Corps wrestles with this it is recommended that the Corps position some of its youngest and best in those activities where the army is investing:

- Army Digitization Office Kingston.
- All Source Cell in Command Support unit, 2CMBG.
- Urban Operations Working Group.
- ISTAR Technical Demonstrator, Valcartier.
- CINC 21 and COP 21 test bed (DRE Ottawa).
- Army Experimentation Centre.

Talent so trained is essential for the transition to a fundamental transformation 2006-2011.

STEP THREE: FUNDAMENTAL TRANSFORMATION

At the close of the 19th century New York City leadership was alerted to the threat of inundation by horse manure. Rising wealth was fueling exponential growth in the horse and carriage trade. Without a dramatic increase in the street cleaning budget horse manure was forecasted to cover city streets to a depth of several feet deep within a few decades! City planners did not perceive that the automobile would soon displace the defecating horse.

About the same time telecommunications analysts raised the concern that the projected demand for telephone operators would soon outstrip the



number of women in North America. The analysts failed to identify the emerging technology of the electro-mechanical switch and its ability to contact callers instantly.

At the other extreme of trend analysis a Vice-President of IBM, who in 1950 predicted a world market for computers at six! In some respects this prediction was accurate; only a handful of government agencies obtained a 1000 cubic foot UNIVAC¹. Although *Popular Science* of that era predicted that at 'some time in the future computers would weigh less than a ton', no one envisioned their relentless shrinkage in size coupled with geometric growth in capability. Fifty years later computers are a million times smaller and a million times more capable.²

Predicting futures based on transients like technology is risky. It is more profitable to examine the science behind the technology and human nature. Greed and gravity transcend history. They have been wonderfully constant. Although it is difficult for politicians to foretell short-term moods the long waves of people's behaviour

are evident in history. Likewise, the second law of thermodynamics is a restraining reality that governs virtually everything a tanker does and enjoys – shooting, manoeuvring, and drinking beer. So what are the dominant factors that shape Armour's future?

In the Canadian military context nothing is more predictable than the paucity of equipment. In peacetime there is insufficient money to buy military equipment; in war there is insufficient time to make large machines. In this decade (2001-2010) a high capital priority is army C4ISTAR³. This is more than a project; it is a strategic vector that promises to transform command, culture and capability. Simulations indicate that armour forces that really know where they are, know where their "Attachments and Detachments" are, and know precisely the enemy's location are at least 50% more effective. The only down-side is the emerging frustration that sabot rounds are not designed for 10 kilometer engagements and that other friendly weapons leave few, if any, targets for tankers. In the absence of a decade-long, armaments

and mobilization schema in a crisis Canada's contribution is likely to be C4ISTAR-based and light.

In the Canadian context there is insufficient money to buy an armoured fighting vehicle this decade and other, to-be-acquired capabilities will encroach upon the Queen of Battle's realm. Fighting a rear-guard action to protect traditional assets is short-sighted; it will only prove that we are not capable of change and not deserving of transformational investment. The army stills needs accurate firepower, protection, and mobility especially in situations where people of political significance are the centre-of-gravity. Unfortunately most peoples of the world congregate in urban sprawl and it is here where armour must function. Not a palatable thought but this is our likely battle-space. How is this best done? The Israeli Defence Force (IDF) are engaged in stability operations in complex terrain with armour. What would they recommend for armour operations post 2010? At this stage it is best to think what needs to be done without being distracted by technology. Once we know what we want

1. The "IBM UNIVAC" was actually manufactured by Remington Rand. Eventually 46 machines were sold. An accessory, the "high speed" printer, cost USD 185,000 in 1951. See www.computerhistory.org/
2. See ENIAC-on-a-Chip. To celebrate the 50th anniversary of ENIAC the 30 ton original was replicated on a 7mm by 5mm microchip by Moore School of Electrical Engineering, University of Pennsylvania.
3. C4ISTAR is the acronym for Command, Control, Communications, Computers, Intelligence, Surveillance, Target Acquisition, and Reconnaissance. Armoured crew commanders do C4ISTAR, but they forget, get lost, don't share well and are not interested in anything beyond sabot range. Army C4ISTAR is about to change business as usual.




to do technology can be harnessed. It is really difficult to look out ten years, but the trends appear to be:

- A dramatic change in heat transfer and boundary mechanics that should lower friction and increase energy density at least tenfold, possibly a hundred-fold.
- The advent of low-observable, possibly invisible skins.
- A shift from kinetic energy based weapons to non-kinetic means.

- Swarming doctrines based on autonomous micro-vehicles/genetic life-forms.
- Molecular reformulation at tactical ranges.
- A billion, billion-fold increase in C4ISTAR.

Should the above come to pass this decade then a fundamentally transformed army could be based on “light” [Hussar] and “heavy” [Cuirassé] special force soldiers operating with, and

linked to, surveillance and arsenal platforms. Traditional armour, infantry and artillery capabilities could blend into this new classification of soldier. A hundredfold increase in energy densities and the advent of invisible skins would allow “heavy” SOF to transit battlefields unobserved at 200km/h in individual exoskeletons⁴. A fundamental transformation is approaching. Don’t wait and shoot. 



Canadian Ram Tanks

4. Before one scoffs at this concept it is suggested that one scan the posted theses topics and review the research contracts at major USA universities and defence laboratories. The traditional time-lag between mathematical concept and product has shrunk for 50 years to 5 years.



The Future of the Tank



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By 2Lt John Nelson Rickard

"[T]he undeniable strength of anti-tank defence does not mean that the building of Tanks has become of no purpose on this account."

Heinz Guderian, 1937

INTRODUCTION

The tank has now been in service for some eighty-five years with the armies of the world and has proven itself to be a dominant weapon system in all phases of war. Originally created to assist the infantry across that last murderous three hundred yards in World War I, the tank quickly evolved into a weapon of strategic dimensions. Yet from the moment the tank first appeared, it has been engaged in a constant, seesaw struggle with the gun and now the missile. Consequently, the viability of the tank on future battlefields is one of the standard debates among military professionals and defense analysts. Because the tank has performed so well in the past, it is vital to objectively assess its ability to contribute in the future against the background of current and emerging technologies.

PAST CHALLENGES TO THE TANK

During World War I, the tank was the victim of its own mechanical failings and the primitive nature of its

construction. It was slow and could be knocked out by stout infantry and artillery. The greatest threat to the tank during the inter-war years was a lack of vision on the part of infantry and cavalry-minded officers who failed to see its inherent potential. Throughout World War II tank and anti-tank systems dueled for supremacy. Tanks evolved from small, essentially machine gun carriers, to the massive Tiger IIB of some sixty-eight tons, with 180mm of frontal armour and a powerful 88mm gun. But anti-tank guns (German 88') kept pace and short-range, hand-held weapons (i.e. American bazooka and German panzerfaust), tank destroyers (US M36 90mm) and rocket-firing dive-bombers posed further significant challenges.

By 1955 the French had deployed the first anti-tank missile. The advantage of the missile was clear. It could be steered to a target and could carry a larger warhead than a traditional anti-tank gun. Anti-Tank Guided Missiles (ATGMs) were first used en masse against tanks during the Yom Kippur War of October 1973. When Israeli armoured forces, lacking infantry and artillery support, charged off to the Suez Canal to reinforce the beleaguered garrisons of the Bar-Lev Line forts, they were ambushed by Egyptian infantry Tank Hunter Teams armed with RPG-7s and Sagger missiles firing from the huge Israeli defensive sand berm along the canal.¹ The Israelis lost over 150 tanks in the first

1. After the stunning victories over Egypt and Syria in 1956 and 1967, the Israelis went through what has been called the 'tank madness' where they put their faith almost exclusively in the power of the tank as a match-winner. It became the 'God of the Battlefield' and they allowed their infantry and artillery capabilities to wither. Charles Wakebridge, "Tank Myth or Missile Mirage?," *Military Review*, 56, 8, (August 1976), 4.



twenty-four hours and the Egyptians claim that 70% of the Israeli tanks left behind Egyptian lines were hit by RPGs or Sagers.²

While the Yom Kippur War demonstrated the vulnerability of the tank in open desert, the more recent war in Chechnya revealed the vulnerability of modern tanks in urban warfare. During the first month's fighting in Chechnya in 1994 Russian forces lost 260 Armoured Fighting Vehicles (AFVs) including sixty-two T-72s and T-80s to Chechen Hunter-Killer Teams using RPG-7s and 18s. Virtually all the tanks were destroyed by at least six lethal hits in areas not protected by Explosive Reactive Armour (ERA).³ By the end of the campaign, Russian tanks had taken a back seat, sealing off city blocks, repelling counterattacks and providing cover instead of leading the advance.⁴

THE MODERN THREAT TO TANKS

The threat to the tank today is omnidirectional. Other tanks are the principal threat, but disciplined infantry with RPGs and ATGMs are not

far behind and missiles continue to improve. Even now, the Americans are preparing a successor to the successful Tube-Launched Optically Sighted Wire Guided (TOW) missile.⁵ Anti-tank mines pose a serious threat despite attempts by the Germans, for instance, to stiffen the sponsons and angle the hull plates of the Leopard 2. For a decade now, anti-tank mines have had the capability to pop up, differentiate between friend and foe, and fire a shaped charge at a tank. Missiles and mines are deadly, but the perfection of indirect top attack systems is a problem that cannot be ignored and is exceedingly hard to counter.

Artillery has always proven a nemesis to tanks but Multiple Launch Rocket System (MLRS) is capable of delivering a devastating volley (the footprint of a single rocket is 200-400m long) across an entire grid square at a range of 32km. Each of the twelve rockets contain over 600 baseball-sized submunitions (shaped-charged) capable of defeating the top of tanks. STRIX is a 120mm terminally guided mortar that can destroy tanks beyond 7km. It uses a passive infrared imaging target

seeker and microprocessors to search a target area. Its smart fire-and-forget guidance system attacks from above with a shaped-charge warhead.⁶ Seek and Destroy Armor (SADARM), is an American warhead fired from a 155mm howitzer (with a range of 20km) which deploys sub-munitions by parachute. When sensors in the sub-munitions detect a tank, the munition is detonated over the top of the tank. Clearly, tank designers can no longer safely devote the largest portion of armoured weight to the frontal arc.

WHERE THE TANK STANDS TODAY

To hold its ground and remain the principal maneuver weapon of decision, the modern tank has undergone rapid improvement. Considering the growing importance of information technologies, the push for digitization and situational awareness, tanks had to incorporate electronics in a hurry. By 1990 electronics had become the critical design element in tanks. The electronics in the French LeClerc, for example, were estimated to be 65% of the \$4.5 million unit cost.⁷ As for

2. The Egyptians based their assessment on Israeli tanks inspected behind Egyptian lines after the war, including most of the victims of the first three days. American and Israeli weapons specialists claimed that only 25% of all tanks destroyed on both sides had been hit by missiles or RPGs. Col. Trevor N. Dupuy, "73 War: The Arab-Israeli Conflict, A Military Analysis," *Strategy and Tactics*, 90, (January-February, 1982), 45. The alleged performance of the ATGMs lead one historian to write shortly after that the tactical defensive had reasserted itself and that missiles clearly degraded the survivability of armor. Jeffrey Record, "The October War: Burying the Blitzkrieg," *Military Review*, 56, 4, (April 1976), 21.
3. Lester A. Grau, "Russian-Manufactured Armored Vehicle Vulnerability in Urban Combat: The Chechnya Experience," *Red Thrust Star*, (January 1997), 17; Lt Adam Geibel, "The Final Score: Russian Armor Losses in Chechnya Reflect Lethality of an Urban Fight," *Armor*, (May-June 1999), 47. Chechen Hunter-Killer Teams operated in cells of three to four men with an AT gunner, machine gunner and a sniper. They deployed at ground level, in basements and in second or third stories of buildings. Russian tanks could not depress or elevate sufficiently to deal with this threat. The lesson, however, is that tanks should not be used in street fighting. The Russians failed to encircle the city, which they could have done with armor. Thus they had to fight a blunt battle with tanks against an enemy who could reinforce.
4. LCol. Timothy L. Thomas (USA Ret), "The Battle for Grozny: Deadly Classroom for Urban Combat," *Parameters: US Army War College Quarterly*, XXIX, 2, (Summer 1999), 97. Many would argue that this is precisely what they are suppose to do in the first place.
5. The Americans call it the Anti-Armour Weapons System, Heavy (AAWS/H). It could reasonably be argued that the threat to tanks has always been omnidirectional.
6. Nicholas Fiorenza, "King of the Battlefield: New Artillery Systems Enter Service with European Armies," *Armed Forces Journal International*, (December 2000), 27.
7. James W. Rawles, "Electronic Tanks Ready for Battle," *Defense Electronics*, 22, 10, (October 1990), 44.



Table 1: The Modern Missile Threat to Tanks

	Warhead	Range	Speed	Penetration
AGM-114 Hellfire		8km		
Baktar Shikan	120mm	3000m	220m/s	800mm
Eryx	160mm	600	4.2s to max	900mm
HOT		4000		250mm
Javelin	127mm	2000		
LAW 80	94mm	500m		700mm
Maliutka M2T	3.5kg	3000m		850mm
Milan 3	115mm	2000m	12.5s to max	1000mm
Panzerfaust 3	3.9kg	500m	243m/s	700mm
RPG 7	2.25kg	500m	120m/s	330mm
RPG 18	1.4kg	200m	115m/s	
SADARM		20km		
Spigot	120mm	2500	190m/s	600mm
AT-3 Sagger		3000m	120m/s	450mm+
Toophan 1 & 2		3850	13s to max range	550-760mm
TOW			200m/s	
Trigat		2000		

Source: *Jane's Infantry Weapons 1994-95*

firepower, the standard western gun size is currently 120mm but the T-90, Al Khalid and Chinese Type 98 all have 125mm main armament and designs are in the works for up to 145mm guns. Ranges have improved with the increase in gun size. The British Challenger is credited with the longest-distance kill to date, over 4000m in the Gulf War. Ranges will only increase with the introduction and perfection of Tank Extended Range Munitions (TERM).

While ATGMs currently have the upper hand in the tank versus anti-tank battle, the modern tank has made great strides in survivability. Gains have been made in the basic armour suite. It is believed the M1 Abrams,

with its depleted uranium armour, withstood a direct hit from a 122mm-gunned T-72 in the Gulf. The Merkava Mk3 was the first tank to use modular armour replacing traditional cast or welded steel. As one author suggested in 1989, modular armour "makes the vehicle completely 'renewable' and no longer bound to a given armor suite which cannot be changed when new technologies or needs emerge."⁸

To counter the significant threat posed by top attack, the roofs of tank turrets are beginning to thicken. Sweden's Leopard 2S (equivalent to the German Leopard 2A6), has substantial add-on armour on the turret roof. ERA, which uses a counter explosion to defeat a missile, is now common, although

there are understandable concerns about collateral damage to friendly infantry and the tank itself, especially to its communications equipment. ATGMs answered with double penetrating warheads. One warhead activates the ERA while the second penetrates the main armour package. Still, ERA represented the first serious effort at developing a 'hard kill' Counter Measure (CM).

Improvements also continue to be made in fire-surpression systems. When they are integrated with the latest compartmental design advancements, tanks crews are provided with significant protection from fire. The Merkava, for instance, has been penetrated over the years during its

8. David Eshel, "Merkava Mk3: Isreal's New Spearhead," *Military Technology*, XIII, 7, (1989), 68.



Leclerc

front line duty in the Middle East, but the unique placement of the fuel tanks, elimination of hydraulics by an all-electric turret and unique ammunition protection means that no crewmen have ever been burnt.⁹

The most important advancement in tank survivability, however, has come in the area of Active Protective Systems (APS) which destroy or divert incoming missiles at a safe distance from the tank. The Russians were the first to develop APS between 1977-1982. The "Drozd" system utilized primitive millimeter-wave radar to detect an incoming missile. It then engaged the missile with short-range fragmentation rockets mounted on either side of the turret. Protection was

good only for the forward 60 degrees but Drozd was said to be 80% effective against RPGs in Afghanistan.¹⁰ The computer-based Arena Defense Aid Suite (DAS) is auto activated in 0.05 seconds and a multi-directional radar mount on the roof constantly scans for conventional and top attack threats. When a threat is identified a CM is launched from one of twenty silos around the turret and exploded in the path of the missile. Drozd and Arena are effective against TOW, MILAN, LAW 80 and other ATGMs.¹¹ They represent the first attempt to defend the tank *at a distance*.

The Russians also developed APS to *confuse and divert* ATGMs. Shtora-1, which first entered service on T-90s

in 1993, is an electro-optical jammer that jams the enemy's semiautomatic command to line of sight (SACLOS) ATGMs and laser range finders by creating a twenty-second aerosol screen 50-70m from the tank. It is activated when enemy lasers are detected. The Leclerc is protected with the GALIX CM system consisting of electronically controlled launching tubes set in the rear of the turret. 360 degree protection is available and the system is capable of creating a smoke screen 30-50m from the tank with visual and multi-band screening agents for up to 30 seconds to blind any optically or infrared controlled weapon system.¹² In 1998 Laser Warning Receivers (LWR) were just coming into use, but by 2000 many tanks had them. The new Chinese Type 98 tank has a LWR and more importantly, is reported to employ a high-powered laser to directly attack an enemy's optics and gunner.¹³

THE IMPRINT OF DOCTRINE

Although the tank's future is partly dependent on its ability to utilize new technologies to stay in the fight, it is also intimately tied to evolving doctrine and perceptions of the future battlefield. If one can believe Martin van Creveld, all fighting in the future will be against bandits and terrorists, strategy as an art form will collapse

9. R.M. Ogorkiewicz, "Israel Advances With Fourth-Generation MBT Armor and Heavily Protected Fighting Vehicles," *Jane's International Defense Review*, (May 2000), 55. The tank rounds are individually protected with special material, which slows down the transfer of heat and delays cook-off at temperatures of 600-1000 degrees Celcius for three-quarters of an hour.
10. Mark Hewish and Leland Ness, "Shoot First, Ask Questions Later: Smart Tanks Learn to Fend for Themselves," *Jane's International Defense Review*, (March 1996), 34.
11. Capt. Tom J. Meyer, "Active Protective Systems: Impregnable Armor or Simply Enhanced Survivability?," *Armor*, (May-June 1998), 8-9. The warhead is like a claymore mine and detonates approximately 2.5m from the missile. Within .2-.4s the system is ready to repel another missile threat. Protection is available through 300 degrees with a dead area at the rear of the turret.
12. *Ibid.*, 11.
13. James M. Warford, "The Chinese Type 98 Main Battle Tank," *Armor*, (May-June 2000), 12-13. In 1998 the Merkava Mk3 had a Laser Warning System (LWS-2).



and major military-technological research and development will disappear.¹⁴ LCol. Ralph Peters and the US Marines, however, see future warfare dominated by urban fighting. The theory is that the growing western edge in technology, specifically translated into battlefield awareness, will prove so dominant that our opponents will be driven from the open plains into the cities where our effectiveness drops.¹⁵ Yet we have *always* fought in cities and I agree with Canadian Army LCol (Ret) Jack English's thesis that conventional forces will be around for the foreseeable future.¹⁶

The United States Army also see a need for heavy conventional forces in the near future to deal with conventional threats, but the emphasis is shifting. Their Army After Next and Force XXI concepts seek information dominance in 'network-centric' warfare, Total Battlefield Awareness (TBA), and light forces rapidly deployable straight from the continental United States to effectively mount maneuver warfare.¹⁷ The army is now obsessed with early entry into future hot spots and the fact that a C-5 Galaxy transport aircraft can lift only one M1 Abrams does not fit its vision of the future. Perhaps if Micro Craft



M1A1 Abrams



Merkava

Corporation can perfect its half-airplane, half-blimp aircraft, capable of lifting eight Abrams, this might change, but the Army After Next concept clearly favours lighter vehicles for rapid deployment in 10-12 years.¹⁸

It seems evident that the Americans are determined to replace the tank as we know it, but the timeframe is in decades. In 1995 the senior army leadership decided not to pursue the evolution of the Abrams series

14. Martin van Creveld, *The Transformation of War* (New York: The Free Press, 1991), 210. His suggestion that the Iran-Iraq war was the last major war looked quite silly when the Gulf War broke out after.
15. LCol. Ralph Peters, "The Future of Armored Warfare," *Parameters: US Army War College Quarterly*, XXVII, 3, (Autumn 1997), 50, 53; See also LCol. Robert F. Hann II, "Urban Warfare and the Urban Warfighters of 2025," *Parameters: US Army War College Quarterly*, XXIX, 2, (Summer 1999), 74. He believes that "if demographers and political scientists are correct, the reality is that many, if not most, of the military operations of the next two decades will be conducted in and around large urban areas."
16. LCol. (Ret) John A. English, *Marching Through Chaos: The Descent of Armies in Theory and Practice* (Westport: Praeger, 1996), 194, 198. English added that predicting the demise of large interstate war is as difficult as predicting the stock market but "they still represent a potentially greater threat than small wars, international terrorism, or insurgencies." 197.
17. Some even suggest that the American Army today lacks the "size, mass and abundant resources to wage prolonged positional warfare." LCol. Richard D. Hooker, Jr., "Land Warfare: 21st Century Theory and Doctrine," *Military Review*, (March-April, 2000), 85.
18. Robert S. Cameron, "Pushing the Envelope of Battlefield Superiority: American Tank Development from the 1970s to the Present," *Armor*, (November-December 1998), 13. The Americans have long had an early intervention capability in the form of the Marines and the ready brigade of the 82nd Airborne Division. The Americans, however, want to bypass the buildup stage completely. There is no doubt that the ready brigade was highly vulnerable during the early stages of Desert Shield.



past its current System Enhancement Package (SEP).¹⁹ The focus now is on a 20-40 ton Future Combat System (FCS) with an ability to destroy multiple targets at more than 5000m, a speed of 100km/h, fully digitized communications, improved logistics and advanced APS. However, some commentators believe that at the current pace of technology, any FCS will not dominate a battlefield until at least 2030.²⁰ In fact, the requirement for manned armoured firepower, protection and mobility will not disappear over night. The tank's near future lies in upgrading current tank fleets. It has been estimated that the Abrams upgrade program alone accounts for around 80% of American heavy-armour industrial capability.²¹ The Americans have 7664 tanks in the Abrams fleet and the Abrams is expected to be an integral part of the Army until at least 2025.

TECHNOLOGY AND THE DILEMMA OF OVERMATCH

If one can accept the argument that tanks are here for the near future the question then becomes to what degree will they be able to contribute to the future battlefield. Those who foretell the imminent demise of the tank

miss a fundamental aspect of weapon development. No weapon system can long maintain a hard-won ascendancy because of the simple fact that all weapon systems utilize the same basic level of technology. The tank does not have exclusive access to some superior technology, and neither do anti-tank systems. Both will use robotics, miniaturization, advanced propulsion, biological sciences, adaptive digital networks, laser and directed energy technologies to increase lethality and survivability. The Americans have long boasted of their overmatch capability against foreign tanks, but achieving overmatch against a single anti-tank threat will continue to be problematic. Achieving overmatch against the full spectrum of anti-tank systems will be proportionately more difficult.

THE PROBLEM OF SURVIVABILITY

Armour-defeating attack is highly concentrated which means its effects are localized. On the first hit either mobility or firepower can be eliminated but the destruction of both is unlikely. Completely knocking out a tank requires a degree of overmatch against the armour and secondary effects to kill crewmembers.²² Indeed,

Ian Hogg, the international renowned weapons specialist, suggests that the real purpose of shooting at a tank is not to damage the tank "but to get at the crew and the machinery which is behind the armour plate."²³ This view has some merit considering the great emphasis placed on modern fire-suppression systems to protect crews. In the end tank crews must survive to fight again. However, in the Gulf War the coalition was clearly intent on destroying Iraqi equipment.

The proper question to ask is against what percentage of weapons systems on a future battlefield should the tank be immune? It cannot be immune simultaneously from mines, KE weapons, missiles, top attack, frontal attack, artillery and helicopters. Engineers can clear some mines, and good tactics can lessen the impact of incoming fires from other tanks. Moreover, it is apparent that the attack helicopter, although posing a substantial threat with its mobility and firepower, will itself be vulnerable to a range of weapons systems. Besides having to fight horizontally against other helicopters, armed Unmanned Aerial Vehicles (UAVs), fielded in quantity, could pose a serious problem.²⁴ Moreover, the helicopter will be vulnerable to

19. But the Abrams program is alive and well. Apparently, there will be more improvements in the next ten years than in the preceding twenty years since it was first fielded. Col. James H. Nunn, "Abrams Update: Vital and Improving," *Armor*, (November-December 2000), 48. It will receive a new turbine engine requiring 30% less fuel, 43% fewer parts and 100kg lighter. The Abrams design has been around since 1972 and by the time it is expected to be finally withdrawn from the army, almost sixty years will have elapsed.

20. Loren B. Thompson, "Heavy Armor," *Army*, (August 1999), 24. He adds that it is "surprising that a notional system [FCS] can undermine the case for making evolutionary changes to a weapon already recognized to be the best of its kind."

21. *Ibid.*, 25.

22. Richard Simpkin, *Tank Warfare* (London: Brassey's, 1986), 87. He defined lethality as a "function of the residual energy of attack after penetration of the armor and of the proportion of the armored volume affected by the attack."

23. Ian V. Hogg, *Tank Killing: Anti-Tank Warfare by Men and Machines* (New York: Sarpedon, 1996), 4.

24. Already, Pakistan has developed two UAVs. BRAVO has an 80km range and four hour endurance and a 15-20kg payload. SHASPAR has a 250km range with a 50kg payload and should be ready for deployment in another year.

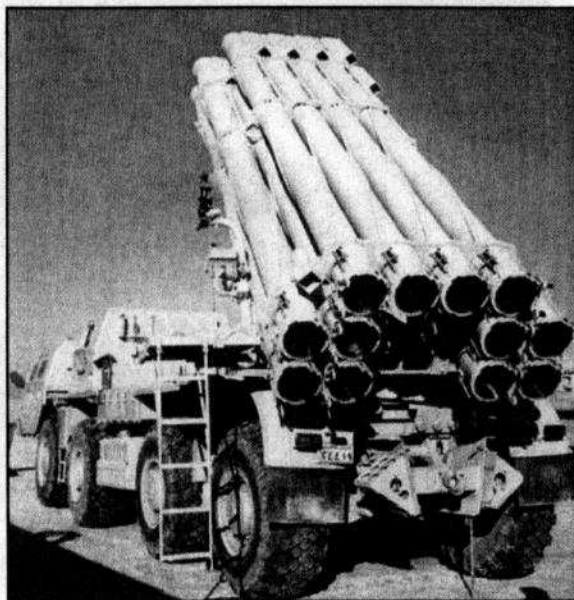


diagonal fire from tanks. In fact, some commentators have speculated that the tank could become the helicopter's principle foe.²⁵

Nevertheless, the tank cannot simply continue to upgrade its armour and accept the probability of first-hit destruction. Most observers agree that 60-70 tons is the limit to tank weight so there is a definite limit to the 'up-armour' philosophy. As one observer has noted, "Awaiting a qualitative breakthrough in armor or ERA is not an option for armored forces that are already outclassed by modern weaponry."²⁶ The current obsession with rapidly deployable forces will also directly affect the survivability and lethality of tanks.²⁷ The basis of survivability as it stands today, to withstand a first round hit, *must* be replaced with a new basis, the ability to stop incoming fires before impact.²⁸ Thus, as a minimum, the tank must strive to gain a high degree of immunity from missiles.

THE ABSOLUTE NECESSITIES

The lethality of the modern and future battlefield necessitates a sharp reduction in the tank's visibility. This can be accomplished by incorporating proven stealth technology but this will only be effective at long range. Increasing gun ranges and achieving a beyond-line-of-sight capability could significantly improve the tank's



Smerch MRLS

survivability at long range.²⁹ If the tank is seen, it must avoid being acquired. Again, stealth technology will help but the tank also needs a complimentary organic platform capable of 'running interference' for it at significance distances. This might reasonably be done with small UAVs capable of Electronic Counter Measures (ECM) mounted on the back deck. In essence then, the tank needs to keep creating further and further distance between it and its enemies. Offensive action, however, is essential to positive combat results so at some point, the tank *will be seen* as it closes on objectives and fights through.

If the tank is acquired, it **MUST NOT BE HIT**. Tanks must therefore continue to rapidly incorporate a more dependable system of 'hard kill' to destroy incoming missiles and KE weapons and 'Soft kill' to confuse or divert missiles. In 1999 Sweden unveiled its new multi-spectral aerosol system which uses water to screen tanks from electro-optical, thermal and 94 GHz radar. It is perfectly reasonable to believe that the tank *can* evolve sophisticated APS against missiles. Furthermore, there is no reason why, with miniaturization, tanks cannot be augmented with a battery of Surface-to-Air Missiles (SAMs) for

25. Joris Janssen Lok, "Gunships Go in Search of AAMS: Helicopters Must Protect Themselves Against the Latest Threats," *Jane's International Defense Review*, (August 2000), 56. It is also apparent that photos of the Chinese Type 96 Tank indicate that its laser defensive system can elevate higher than the main gun, meaning it has a potential against helicopters. Warford, "The Chinese Type 98," 13.

26. Capt. Tom J. Meyer, "Active Protective Systems: Impregnable Armor or Simply Enhanced Survivability," *Armor*, (May-June 1998), 7.

27. Maj. Gen. Edward B. Atkeson, "Main Battle Tanks: To Be or Not To Be," *Army*, (January 2000), 40.

28. Lt. Gen. Paul J. Kern, "The Future Battlefield," *Army*, (July 2000), 22.

29. Nunn, "Abrams Update," 48.




Mangusta Helicopter

added punch against helicopters and fast air. Finally, if the tank is hit, it must not be killed. The last line of defense will be the armour with all its evolving variants coupled with the best fire-suppression system available. Thus, the tank must extend the battle-space and force its adversaries to fight its way through these various stages of defense.³⁰

CONCLUSION

Guderian once said that when the greatest striking power of the offensive resided in a particular weapon [i.e. the tank] "the other weapons

must accommodate themselves to its needs."³¹ I continue to believe that the greatest striking power in armies resides in tanks. The tank will continue to lead the charge, but not alone. Tanks in the future will be fully integrated with other assets and the synergy generated through situational awareness *should* give the tank greater staying power and the ability to press forward. Theorists cannot simply wish the tank away because the time 'appears' right for the next logical progression. It will have to be *physically driven* from the battlefield like the horse was by the machine gun or the battleship was by the aircraft

carrier. The helicopter has not proven it can do this. In similar fashion, SAMs, though potent, never drove fighters and bombers from the sky. Foretelling the death of the tank in the near future is to think that the line to a future combat system is a straight one. In fact, it is not. It is dependent upon military conservatism, budgets, doctrine and the actual feasibility of technologies. 

30. I would like to thank LCol Mike Cessford for his influence on this aspect of the paper. LCol Mike Cessford to author, 21 June 2001.

31. Heinz Guderian, *Achtung Panzer!* (London: Arms & Armour Press, 1992), 205.



ACV – The Way Ahead!

By Captain D. Bromley

“...maintaining armour tactics in a wheeled vehicle was acceptable for nearly three decades in Canada, [so] there should be no great concern over which vehicle is used by the RCAC.”

The ACV has been an intensely debated issue among the Corps’ officers. Understandably, there was great relief when they announced that the Director of Armour officially stopped any further plans to replace the Leopard C-2 with an ACV. However, I question whether the Corps was too quick to reject the merits of replacing the tank with an ACV. The Leopard C2 is extremely out of date and consequently serves as nothing more than a tank trainer.

The ACV is the Corps’ means to create a niche for itself in this Army and in global security.

The argument opposing the ACV has been fueled more by sentiment than logic. The mere insinuation that a wheeled vehicle could replace a tracked vehicle seemed, to most, to be ludicrous. According to many, an ACV could not provide the mobility nor the firepower of a tank. Certainly the Canadian Leopard C2 can provide more crew protection than any current ACV, but our Leopard C2 cannot provide any more firepower or mobility. This begs the question as to why the RCAC is determined not to allow the Leopard I to die gracefully.

The CF carries out many global security tasks that are operations other than war (OOW). Yet, in all the overseas operations conducted by the



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The Leopard and Cougar: both nothing more than tank trainers.



CF since the Korean War, only one has involved the commitment of tanks. The remainder of these operations saw the RCAC in theatre with vehicles other than the tank. The RCAC currently maintains a tank fleet due to Canada's NATO commitment which requires the government to provide a tank-based armour force. If the CF ever committed a force in a war scenario, it is somewhat questionable whether the Canadian government would send the Leopard C2. Yes, the Leopard C2 does have an excellent gunnery system, however the caliber of the gun is insufficient and its protection is too weak. Amid the political discussions over whether or not to send the RCAC into the Gulf War, the United States offered to equip the RCAC with M1 Abrams tanks. In addition to this, the Germans offered the Canadian Government Leopard II tanks. Though there was no formal brief on what a Canadian Armour force would go to war with, it was clear that it was not going to be the Leopard I tank. This occurred more than ten years ago and clearly stated the tactical viability of the Leopard I main battle tank. Though the Leopard tank has undergone upgrades, there are few soldiers in the RCAC who believe that this tank could fight alongside M1, Challenger II, or Leopard II.

For the skeptics who believe that a wheeled vehicle could never achieve the mobility of a tank, one must look no further than the LAV III. During the LAV III trials it was deployed to the Gagetown training area to test its cross-country capabilities. The LAV III followed a tank from A Sqn VIII CH for a day under spring conditions when the ground was extremely soft. The tank crew was intent on leaving that wheeled beast in the training area sunk over its turret. However, they were sadly disappointed at the end of the day. The A Sqn crew returned to Worthington Tank Park with a new


found respect for wheeled vehicles. The LAV III successfully followed the tank for the entire day, in areas where no vehicle should have been, wheeled or tracked! I am not advocating that the LAV III has the same cross country capabilities as the Leopard, but they are very similar when crewed by experienced personnel.

Though the RCAC has never officially stated that the Canadian Leopard C2 is nothing more than a tank trainer, coming to this conclusion on their own is not difficult for the crews. Considering our NATO allies did not want us going into combat with the Leopard I and that the LAV III can apparently operate in similar terrain as the tank, it reaffirms that the Canadian Leopard requires replacement. In his book, *Iron Fist - Classic Armoured Warfare*, Bryan Perrett made the following comment: "As with every area of human activity, the evolution of armoured warfare over the past ninety years has been a process of continual learning and, within this, one of the most important elements has been what might be called in jargon the 'man-machine interface'." I believe that the RCAC could learn from Mr. Perrett's comment. The technology has again evolved providing armoured warfare with a new tool to conduct its business. This new tool is the ACV. The leader in technological acquisition, the U.S. Army, has already realized the potential of the ACV and constructed a force based around the LAV 105 ACV, which is tasked to deploy rapidly into troubled areas. Their role is to prepare the way for follow on heavy armour forces if required.

The purchase of an ACV would provide the RCAC with depth. The ideal operational vehicle for OOW and low intensity conflicts, it can also serve as a tank trainer for conventional

operational roles within a combat team. Given that most accept the idea that the Leopard C2 would not be used in a war and that maintaining armour tactics in a wheeled vehicle was acceptable for nearly three decades in Canada, there should be no great concern over which vehicle is used by the RCAC. As Mr. Perrett stated, the man-machine interface is most important. If the RCAC maintains a high standard of training for armour crews, there will be no armour tactics skill fade.

An ACV would provide the RCAC both a task to train for and pride for being the best at what it does. An ACV force has proven itself important enough that the U.S. has invested heavily into its development. The RCAC now has the opportunity to invest in an ACV and maintain its leading edge technology in armour as it did with Coyote. This would allow all of the RCAC to be employable for operations other than war in either an ACV or Coyote, depending upon the mission. In addition, Reserve units with the Cougar could be employed as part of an ACV fleet, making the RCAC a corps without boundaries.

An ACV provides the RCAC endless possibilities of employment and flexibility. The RCAC's decision not to replace the Leopard C2 with an ACV must be logically re-examined, free from sentimental attachments. It is no longer feasible to view the Leopard I main battle tank as being capable of fighting alongside our allies in a major conflict. The ACV is new technology that would provide the RCAC a role within our Army and alongside our Allies. Let us remember that it was once a ludicrous idea to replace the horse with a vehicle! 

Perseverance!



Tracks or Tires, That Is the Question: A Crewman's Perspective

By Corporal M.P.G. Cushing, CD

“With the move to a light rapid deployable force concept the main battle tank’s days are numbered.”

It is one of the most pressing questions on the mind of everyone in the Armoured Corps. The announcement of a replacement project for the Leopard C2 tank and the Cougar AVGP Fire Support Vehicle (FSV) has become a matter of some debate for all black hatters. The idea of replacing the tank with a wheeled vehicle, or Armoured Combat Vehicle (ACV), does not sit well with most tankers. So why give up track for wheels?

Looking back through military history, the development of the tank in the First World War truly marked the birth of the modern armoured corps that exists today. From those clumsy and unwieldy first tanks to the modern heavy and super heavy high tech juggernauts, such as the German Leopard 2A5, the tank, armoured tactics and doctrine have come a long way. Today’s advancements in armour protection, engine power packs, fire control systems, optics, and most importantly, weapon systems have given the tank greater freedom to move and fight on the battlefield. This would give the impression that the tank is here to stay.

Without question there will be a requirement for heavy armoured mechanized forces for some time to come. However, the greatest drawback

to these heavy units is the ability to get them to the battlefield on time – case in point, the Gulf War. The Gulf War was a wake-up call for the Allied Forces. It took months to build up a ground force large enough and heavy enough to take on the Iraqi army. Fortunately for the allies, Saddam Hussein failed to take advantage of the slow build up in ground forces. Otherwise it would have been a much harder and more costly fight. With this in mind the US is determined not to let it happen again. To that end, the US is assembling what they are calling the Interim Brigade Combat Team (IBCT). This will be a light, highly mobile, self-contained, combat ready force, able to deploy anywhere in the world within 96 hours. To do this, the US Army is going on a diet.

The US will be equipping these light brigades with a complete complement of LAV vehicles. On Nov 17, 2000, the US Army announced that it would be outfitting its new units with the General Motors LAV III. The vehicle that will be replacing the tank, although still under debate, will most likely be the LAV Mobile Gun System, based on the LAV III chassis. This vehicle mounts the General Dynamics Low Profile Turret System (LPT) with a 105mm auto loaded main gun, a 7.62mm coax machine gun, as well as an externally mounted anti-aircraft machine gun or 40mm AGL (automatic grenade launcher). All the crew members are located in the hull with the main gun being mounted overhead.



Corporal M.P.G. Cushing, CD, has served as a Leopard C1, Cougar and Coyote gunner in the LdSH(RC) for the past 10 years and has completed four tours in the Balkans. He is currently serving as a Coyote Gunner in 2nd troop B Squadron LdSH(RC).



Centauro

LAV 105



MOWAG Piranha

Rooikat



Canada is looking very closely at what the United States is doing with these new brigades. After years of experience in peacekeeping and peace support operations, and having to deploy troops rapidly around the world, Canada is seeing the need to follow suit. The CF, although maintaining an AVGP/LAV fleet for almost 20 years, has finally accepted the fact that its AVGP/LAV fleet is ill equipped to meet the demands of its most recent deployments. The Canadian Forces (CF) has acknowledged that it requires a vehicle capable of providing the battle groups with heavy direct anti-armour fire support and, unlike the Leopard tank, be easily deployable to any location in the world. Up until now, the CF has been relying on the Cougar FSV and the Leopard tank, both of which have seen long years of service. However, neither meets these requirements. Having said that, what should the Canadian ACV look like?

First, the CF needs to look at what the ACV will be replacing. The first vehicle is the Cougar FSV. The CF has been using the Cougar since the early 80's. Initially purchased as an interim vehicle to act as a tank trainer, the Cougar has seen operational service in Eastern Europe and Africa. It has proven to be a reliable but limited vehicle with respect to its firepower

(76mm un-stabilized main gun), mobility (6-wheel drive) and protection (up to .50 cal ball). The second vehicle is the Leopard C2 main battle tank. The Leopard tank entered service with the CF in 1977, replacing the venerable but outdated Centurion main battle tank. The Leopard, with its fully stabilized 105mm main gun, day/night fire control system, full ballistic sensor suit, 7.62mm coax machine gun and 7.62mm anti aircraft machine gun, was state of the art when initially introduced. Twenty-five years later, even with recent upgrades, it is now showing its age. The role of these vehicles is to provide direct fire support in the maneuver battle both in the offence and defense. With the move to a light rapid deployable force concept the main battle tank's days are numbered. So what kind of wheeled vehicle do you replace a tank with?

There is no easy answer to that question. Since the initial development of the tank there have always been three factors to consider when it comes to tank design: firepower, armour protection and mobility. Trying to balance these factors is no easy feat. Too much Armour and not enough horsepower and all you really have is an anti-tank pillbox. Now, given the fact that an ACV must be transportable in aircraft such as the C5A Galaxy,

C17 Globemaster, CC130 Hercules, and the C141 Starlifter a fourth factor comes into play – size. This restricts the weight to less than 30 metric tons and restricts the size to that of the inside of a transport aircraft. The latter has a huge effect on the first three factors and makes it much more difficult to balance the design.

With the development of low force tank guns and auto loaders, which reduce crew fatigue, the main weapon system for the ACV becomes less of a problem. The 105mm low force tank gun, or the standard M68A1 tank gun fitted with a muzzle brake and heavier recoil mechanism to reduce gun recoil impulse, is the ideal weapon system for the ACV. Both of these guns fire NATO standard ammunition including HEAT (High Explosive Anti Tank), HESH (High Explosive Squash Head), smoke WP (White Phosphorous) and BE (Base Eject), APDS (Armour Piercing Discarding Sabot) and APFSDS (Armour Piercing Fin Stabilized Discarding Sabot) rounds.

Armour protection, unfortunately, has to be compromised due to the weight restrictions. Modern armoured soldiers in heavy and super heavy tanks such as the M1A1 Abrams have had little to worry about as far as enemy



anti-tank weapons. The heavy armour plating, depleted uranium armour, and composite ceramic armour have made it impervious to all but the heaviest of anti-tank guns and missile systems. With the new weight restrictions, all of this special armour becomes obsolete. This leaves the soldier with a very vulnerable vehicle. To minimize this weakness, mobility must be increased. A lightly armoured vehicle, which is very quick and highly maneuverable on and off road, is the answer. The ACV will be a wheeled vehicle, and as such, will be either eight or 10 wheel drive (the 6-wheel drive concept just does not measure up). Other factors that must be taken into consideration are: platform stability, a fire control system that can track at increased vehicle speeds, crew survivability and reliability of subsystems, such as an auto loading system. The crew commander has to be able to see 360 degrees and must be able to track targets independently. The next factor in the design is how will this vehicle be employed? Is it a tank? Is it a tank destroyer? Is it an assault gun? Is it all of the above? Or is it something new?

Most likely the ACV will be employed as a combination tank destroyer/assault gun. With this in mind the CF and the armoured corps need to decide whether or not they want the ACV to fit current tactics and doctrine or change the tactics and doctrine to fit the ACV. So, are there any armoured vehicles out there that fit the bill? The answer to that question is yes, and no. There are several wheeled armoured vehicles available which meet most of the requirements, but not all.


The Italian Centauro (8 X 8) tank destroyer is a likely contender as a hybrid tank/tank destroyer. It mounts

a fully stabilized 105mm main tank gun, a 7.62mm coax machine gun, as well as one or two 7.62mm anti-aircraft machine guns. It is equipped with day/night thermal sights and a commander's independent thermal viewer, giving it hunter killer capability. It has a crew of four - commander, gunner, loader operator, and driver. Centauro has a combat weight of 25000kg and meets the size requirements. The hull is configured with the engine mounted in the front and the turret to the rear. It has a very low silhouette, with a total height of only 2.735m. Its overall performance is good. The fact that it is configured like a main battle tank means that transition training would be relatively smooth. Its biggest draw back is its lack of commonality of parts with existing vehicles in the CF inventory.

The South African Rooikat 105mm armoured car is also a likely contender. The configuration is very similar to the Centauro with the same weapons and crew layout. Instead of having the engine in the front however the engine is mounted in the rear with the turret centrally located in the hull. It is also 8-wheel drive. Its weight comes in at 28000kg just under the 30-ton limit, its total height is 2.8m and the overall performance is slightly better than the Centauro's. The Rooikats primary role in the South African Defense Force is as a reconnaissance vehicle with its secondary role as that of a hunter/killer or tank destroyer. Again, the problem is the lack of commonality of parts.

The LAV III chassis or a modified LAV III chassis is the suitable choice due to commonality of parts and availability. The LAV III with the LPT is ideally suited to take on the assault gun or tank destroyer role due to its compact size, speed, maneuverability and firepower. What it lacks in armour

protection it makes up for in agility. The LPT is unique in that it presents an extremely small target when in the hull down position, about the size of a large filing cabinet or a large soldier. Having the entire crew located in the hull means that no crew member is exposed when in a hull down position. The addition of an auto loader means a reduction in the number of crew from four to three, as well as reducing crew fatigue by removing the physical act of loading the gun. The LAV III with the LPT is a good choice as an assault gun carrier or a tank destroyer. However, the designated role of the new ACV will play a major factor in determining whether or not it is a suitable choice to replace the tank. Consideration could also be given to the following: Gait Industries VEXTRA 105mm 8 X 8 armoured car, the Henschel Wehrtechnik TH 400 6 X 6 armoured car and the MOWAG Piranha II 10 X 10 105mm armoured car. There are also a large number of light tracked vehicles to choose from as well.

All of the above vehicles have strong attributes, unfortunately all lack the armour protection required to allow them to lead onto an objective. Only the heavier armour of a main battle tank is truly suited to this task. Therefore, as an augmentation to the MBT, while considering its speed, firepower, limited protection (even including add on armour), agility and its unique configuration, the LAV III with the LPT is the clear choice as an assault gun/tank destroyer. The debate continues... 

Perseverance!



AFV Track Systems: Present and Future

By Captain G. Dyck

“By reducing the operating cost of tracked vehicles,... rubber track will allow the army to continue to leverage its tracked fleets operationally.”

INTRODUCTION

Emphasis in the army of late has focused on wheeled combat vehicles as the new fleet of LAV-3 make its debut, and Coyotes gain operational praise on various deployments. The inevitable comparisons between legacy fleets and these vehicles have been made, and this article will not further contribute to the debate. The army will retain a substantial fleet of track based combat vehicles into the foreseeable future. Vehicle platforms based on the Leopard chassis, M113A3 and stretched Mobile Tactical Vehicle Light (MTVL) variants, as well as M109A4, will remain in service or are in process of life extension. The intent of this article is to raise awareness within the army of where we are going with track technology. This article will focus on changes the crews will see as new track systems are introduced and will compare the three types of track that are currently in service, entering service, and undergoing trial. A description of each track system, followed by a comparison of installation techniques, advantages and disadvantages, will be highlighted.



The predominant track fleet in the Canadian Army is the ubiquitous M113 family of vehicles. I will use this fleet to illustrate where we are going in the short term and likely to go in the middle to long term with track technology.

The M113 family of vehicles entered service with Canadian Army in 1965 with T-130 track. In 1976 the M113 fleet switched to Deihl 213B and, after track pin failures, to 213G. This track, as most readers are aware, is a double pin track system. This track uses a track pin with a polygon shaped profile, with an inductively hardened surface. The end connectors feature two reinforcing ribs on either side



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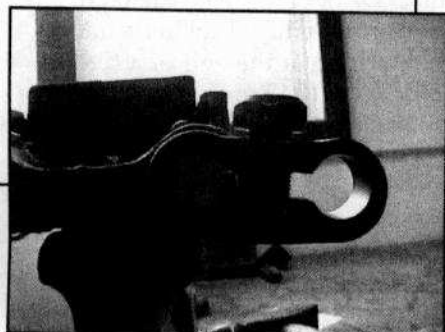
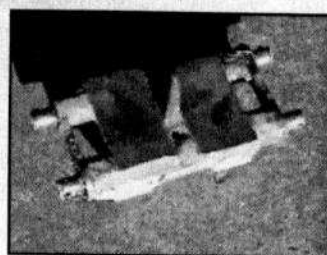
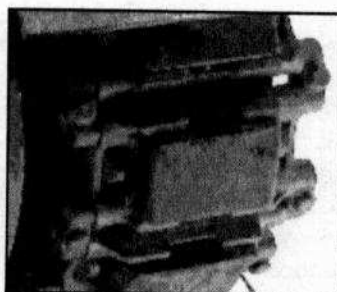
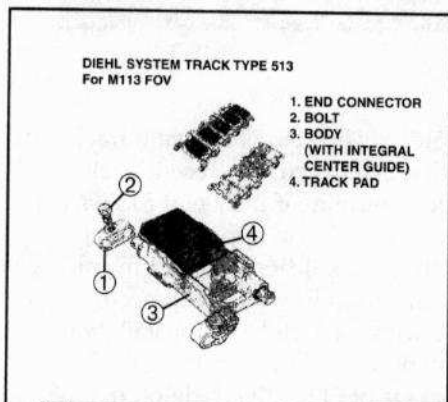
of the bolt hole with matching track pin polygon profile. The track shoe features rubber centre sections over which the road wheels operate with integral steel centre guides. The track assembly is driven via the end connectors by an eleven toothed drive sprocket. Steel grousers are provided for additional traction and are fitted in every 7th to 9th track shoe, replacing the rubber pad.

The Deihl 513 track was adopted by the M113 fleet manager for fielding on M113A3 and MTVL variants in 2000, following a competitive evaluation between the Deihl 513 track and the United Defence Limited Partnership (UDLP) T-150 track in 1997. Deihl 513 is in service with the German and Australian M113 fleets. This track was operationally deployed by the 5/7 Royal Australian Regiment, 2/3 Cavalry during peace support mission to East Timor with the M113A1.

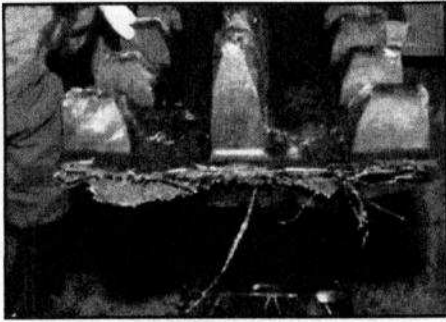
The Deihl 513 is a double pin track system using a cast steel shoe body with integral centre guides. The inner portion of the shoe contains no rubber like the Deihl 213G. The hardened round steel pins use centring studs and integral composite rubber bushings. The track shoes are connected with two end connectors; the end connectors are clamped with tightening bolts in a similar fashion to the Deihl 213G. The Deihl 513 track system weighs 10.1 Kg per shoe and is essentially the same weight as the Deihl 213G system. The track uses rubber pads and can be fitted with grousers. These are installed using a quick fit bayonet principal insertion system. This allows easy change of pads or grousers when compared to the 213G. The Deihl track passed the 10000km evaluation without wearing out¹.

The Soucy band track is a completely different track system to the traditional steel track. Soucy International has spent 20 years developing rubber track for commercial and recreational vehicles. This band track technology has been applied to Arctic Cat, Bombardier, and Polaris snow machines, snow blowers, trail groomers and BV 206 type vehicles. The track is a continuous band with imbedded steel cord. The Soucy M113 band track has been in development since the late 1990s. The United States Tank-Automotive and Armament Command at Yuma Proving Ground tested the track where it completed 2908 miles of a scheduled 3500 miles. The aim of the United States program is to develop this track for the Future Scout Vehicle, a joint venture with the British Tracer Program². The British Army tested this track on an Alvis vehicle in 1998. The Canadian Army is conducting its second part

of a buy and try trial with this track system. Four Armoured School M113A2 were fitted with Soucy Rubber track with the intent of operating this track for a year under normal operating conditions. This trial is currently in its second phase at CTC with the Armour School.



1. Comparative evaluation of the Deihl 513 and UDLP T-150 Track Systems for M113A2 Armoured Personnel Carriers, 1997.
2. CFLO Report 1 Apr 1997.



Soucy Band Track

The rubber track is grooved with a tread pattern for traction and uses a plastic sprocket and idler. The track is 700 Kg lighter than either steel track, weighing 8815 Kg, vice 9515 Kg³ for steel track set on a M113. The track is claimed by Soucy to have 30 per cent less vibration than traditional track. Significant noise reductions have been found as outlined with test data below.

The track is claimed by Soucy to offer significant advantages in maintenance, mobility, braking and acceleration and these will be discussed further. Soucy claims a life span of 8000km for their track. This has been achieved on a U.S Army test vehicle.

INSTALLATION AND MAINTENANCE

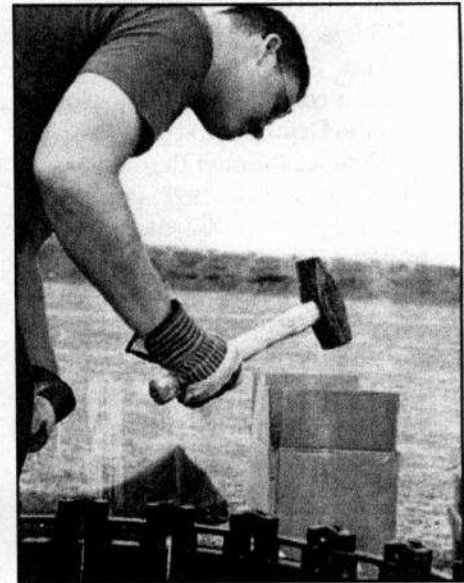
To the crewman on tracked vehicles there is a generally held perception that the army knows Deihl 213G track inside and out. After all, we have been operating either the B or G version of this track since 1976. It is not my intent to reiterate the CFTO on track installations, just to highlight the delta between systems. Both the Deihl 213G and 513 track comes in 7 shoe sections

Track Noise in dB(A)

Vehicle Crew Position	M901A3 ITV ⁴ T-130 Track	M901A3 ITV Band Track	Cdn M113A3 ⁵ Deihl 513	Coyote ⁶ (Test data range)
Driver	111.0	104.8	120	118
Commander	110.4	104.2	120	100

requiring assembly. In both cases the track instruction indicates that the soldier must remove preservative and clean the track pins and end connectors prior to assembly. Further, both track systems indicate that the end connector bolts must be *lubricated*, installed and then torqued. To the reader I raise the question, have you ever seen a soldier lubricate an end connector bolt let alone clean the pins or end connectors when assembling carrier track? So what? We have operated this track for 25 years without incident, indicating that the clamping forces applied by dry torque are obviously sufficient for the 213G. However, our soldiers torque track at a regular interval. So perhaps we don't know as much about track as we think and we must approach new track systems with a different mind set, vice "same old same old".

The introduction of the Deihl 513 is designed to significantly reduce the life cycle cost of M113 track. This is achieved by a more robust design, having the sprocket drive the track shoe and not the end connectors and in changing to round track pins that require no machining in the manufacture process. The net result is that



the soldier's burden of constant track torquing is reduced. In a recent track trial to determine if the Deihl 513 was fit for service, it was apparent to trial staff that the soldiers paradigm for track installation was not in accordance with the Deihl 213G installation instruction as laid out in the CFTO. Unlike Deihl 213G, the trade-off made to achieve a reduced soldier's maintenance load at the end of a torque wrench was the requirement that the

3. Interim Report – Soucy M113A2 Rubber Track System User Evaluation, 9 Feb 01.
 4. Summary of Test Report of the Experimental Band Track for the M113 Armoured Personnel Carrier, U.S. Army Yuma Proving Ground, May 1997.
 5. Environmental Test data from M113-LE Project.
 6. Test Data from Computing Devices Canada during TCCCS Veh Testing, Yuma Proving Ground.



513 must be assembled correctly. The *clean* end connector bolt is lubricated using Molykote grease (the German army has authority from Deihl to lubricate using motor oil). It is then torqued to 420 Nm and the track break-in procedure is conducted. Achieving the requisite torque is essential for safe installation. A survey made during the Deihl 513 Track Trial of one unit's torque wrenches indicated none had been calibrated recently, or were even registered on Test Equipment Maintenance Management Information System (TEMMIS)⁷. Once the track break-in procedure is completed no further torque of the track is required. This represents a significant reduction in a soldier's time spent on servicing track.

The wet torque provides 40 percent more clamping force than a dry torque of the same value and this is necessary to keep the end connector on. The project staff of M113-Life Extension and DEW Engineering personnel has learned from experience that failure to do this correctly will result in the loss of a track. However, if this is done correctly, "the Deihl track link was very reliable, and has reduced the burden on daily crew maintenance..."⁸ The new Deihl track represents a significant improvement in servicing over the previous generation of track. The track will ensure an operating cost reduction over the in service track but is less tolerant to improper track installation or short cuts.

Both versions of the steel track installation procedures are familiar and similar; the Soucy band track follows a completely different installation procedure. The idler is split and comes apart in halves, allowing enough slack to fit the track. It is then rotated into position and bolted together. The vehicle is lifted and the track is pushed under the vehicle with the outer portion of the sprocket being bolted together to complete the track system. The track fitting is more analogous to a tire change than a traditional track change. During the trial it took three soldiers five hours to replace the rubber track for a total of 15 man hours. To replace the 213G it took four soldiers eight hours for a total of 32 man hours. The track tensioning is a common procedure between all the track systems as fitted on the M113. Track maintenance, however, is significantly different between track systems.

The Soucy rubber track is virtually maintenance free once track tension is done. Screw-in ice studs are available, with two soldiers taking 15 minutes to screw in 52 ice studs into the rubber. The band track offers significant advantages in track related maintenance. Steel track, with its steel centre guides, causes significant wear on road wheels. The rubber centre guides of the band track eliminated this wear, reducing the overall number of road wheels that need changing. From a maintenance and installation perspective the rubber band track is clearly superior to the steel track.



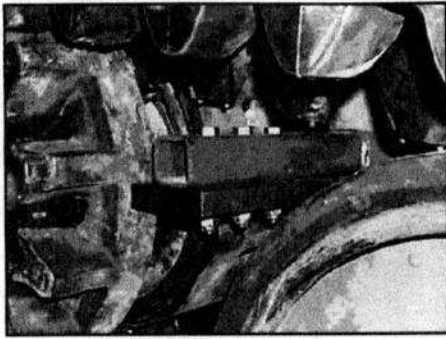
DRIVING CHARACTERISTICS

Handling characteristics between the two sets of Deihl track are not significantly different. The Soucy band track demonstrated acceptable performance in handling during summer driving conditions in Gagetown. Difficulties were encountered with soft mud clogging up the initial tread pattern and reducing traction. Soucy has attempted to address this by adopting a more aggressive tread pattern, which is currently being tested. Performance in snow conditions with the initial batch of rubber track was disappointing due to the build-up of snow between the sprocket/idler and track, resulting in track breaking or idlers shearing off. Subsequent improvements to clean the idler of this build-up have since been introduced and were based on soldiers' recommendations to the company.

Braking distances and acceleration of the vehicle has been improved from the steel track, this being a function of the lighter track and wider footprint

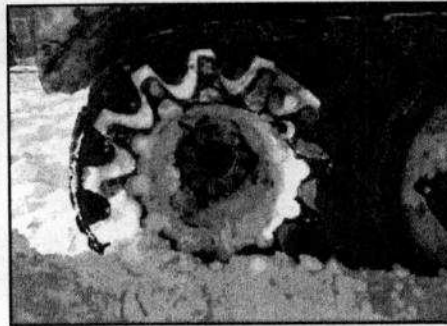
7. TEMMIS is an army wide information system designed to ensure maintenance test equipment is properly calibrated, Annex C, USER EVALUATION REPORT Deihl 513 TRACK FOR M113 FAMILY OF VEHICLES 11-22 Jun 01.

8. Australian Army After Action Report – East Timor, Observations B Sqn ¼ Cavalry Regt.



Ice Scraper

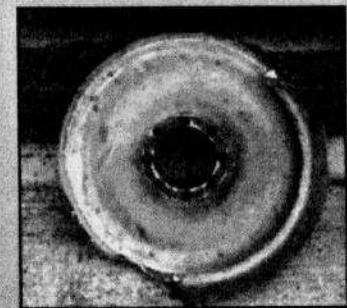
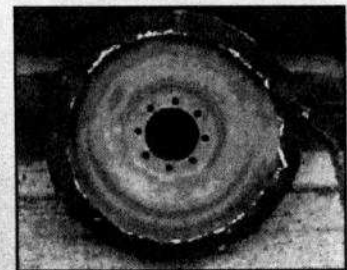
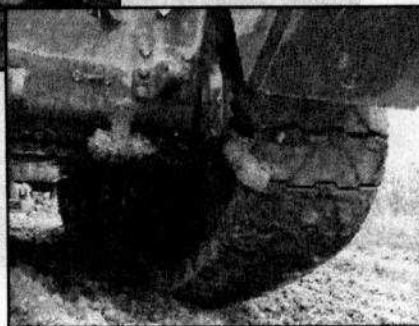
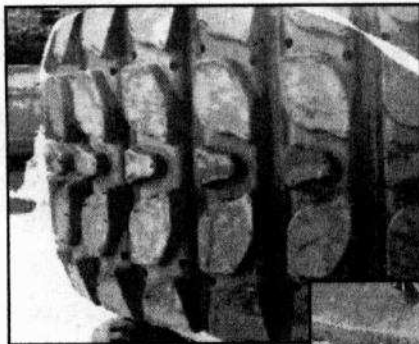
OPERATIONAL CONSIDERATIONS



on the ground. The U.S. Army test indicated a braking distance of 26-28 feet for a M113 at 20 mph. Drivers noted that the rubber track was easier to steer but less stable while turning, with less traction. On paved surfaces the rubber track was noted to be a bit harder to steer. The trial report indicated that the handling differences between the steel and rubber track were not significant enough to warrant additional formal driver training.

The Deihl track system was developed to reduce the overall soldier's maintenance burden and the vehicle's life cycle cost, which currently amounts to one third of the cost of operating a M113. The trade-off for these savings is a system that is less tolerant of improper installation procedures. Currently, tracked vehicles require a disproportionate amount of maintenance if the vehicle is driven on prolonged road moves. This is a significant issue in terms of maintenance

overhead, cost, soldier's time, and operational factors involved in high VOR rates. Consequently, the accepted practice is to ship tracked vehicles whenever there are significant distances involved. The band track offers a much more revolutionary improvement once the track reaches its final form. With a rubber track there is no restriction on prolonged road moves because of traditional track mobility limitations. The higher sustained speeds that the new M113A3/MTVL are capable of, in conjunction with the rubber track's deployability, will allow commanders to more viably operate mixed AFV fleets. The inability to quickly break the rubber track to affect recovery of a thrown track puts this vehicle into the same category as the wheeled AFV with a flat tire. Reduction in the total weight results in better acceleration, deceleration and ground pressure for the vehicle so equipped. Track noise is significantly less, changing the acoustic profile of the vehicle significantly and reducing crew fatigue.





CONCLUSIONS

The introduction of Deihl 513 represents an improvement in life cycle cost for the M113 vehicle fleet. Less time will be spent on driver maintenance but the track maintenance that is conducted must be to a higher standard than the current Deihl 213G requires. The development of the rubber band track offers significantly greater potential improvements to the tracked vehicle fleet. Although the track currently has not been proven to last as long as the steel

track, individually the overall life cycle cost of the vehicle should be reduced. This results from reduced road wheel usage, maintenance man-hour time saving, and reduction in vibration induced damage on vehicle systems (comms, fire control, etc). Enhanced deployability of the tracked vehicle fleet is a significant operational consideration that should be reviewed when this track technology matures. The ability of tracked vehicles to maintain a higher convoy speed without all the inherent maintenance associated with end connectors,

track pads, road wheel replacement makes tracked vehicles just as viable as wheeled vehicles deployed overseas and in mixed fleet operations. By reducing the operating cost of tracked vehicles, reducing the soldiers maintenance burden, and maintaining the inherent mobility of tracked systems rubber track will allow the army to continue to leverage its tracked fleets operationally. Canada is currently at the forefront of this technology and should continue to be proactive in advancing this innovative technology into the inventory.



Stuart M3 Tank



The Need for Gunnery Currency Training



Captain Steve Wilson has served as OIC Gunnery Troop and as Instructor Gunnery Team Leader at the Armour School in Gagetown. He is presently serving with The Royal Canadian Dragoons in Petawawa.

By Captain S.M. Wilson

“...computer-based gunnery simulators provides the Corps with the opportunity to establish and, more importantly, mandate training requirements for individual gunnery currency training.”

The Army invests considerable time and resources in training Armoured officers and crewmen in what is one of the most difficult skills to master – AFV crew commanding. A large part of this training centers on AFV gunnery. To acquire these skills, candidates spend a substantial amount of time learning the theoretical aspects of gunnery and honing their skills through the practice of various engagement techniques. By the end of any given gunnery course, a candidate is proficient in equipment handling skills as well as the application of techniques of fire. To be proficient in gunnery at the completion of a course, however, does not infer the eternal maintenance of skill currency. By this, I mean to define ‘currency’ as the perpetual re-assessment of a qualification throughout a soldier’s career as measured against an established standard of proficiency.

An article of this scope cannot endeavour to lay out in detail the various tables and engagement serials for proposed currency training. This would require substantial work

by a group of gunnery experts over a period of time. The tables would have to be drafted, reviewed, revised, and validated before they could be presented and applied in practice throughout the Corps. I can, however, establish an initial argument to spur discussion and champion the need for such training. To this end, I will attempt to identify some of the parameters of currency training as well as some of the limitations.

The bible of AFV gunnery, CFP 305(13) Armour Gunnery Training, provides no direction for the maintenance of individual gunnery skills outside of firing tables established for annual unit continuation training. The recent acquisition and introduction of computer-based gunnery simulators provides the Corps with the opportunity to establish and, more importantly, mandate training requirements for individual gunnery currency training. Gunnery currency training is needed by the Corps in order to maintain a fighting force in which any gunner or commander is immediately capable of fulfilling their primary function at any given time.

CFP 305(13) details the parameters around which the Armour Corps plans and conducts individual and collective AFV gunnery training. The recent acquisition of the LCGT, CCGT, and LAV CGT has caused a paradigm shift in the manner in which crews conduct dry engagement training prior to live fire training.



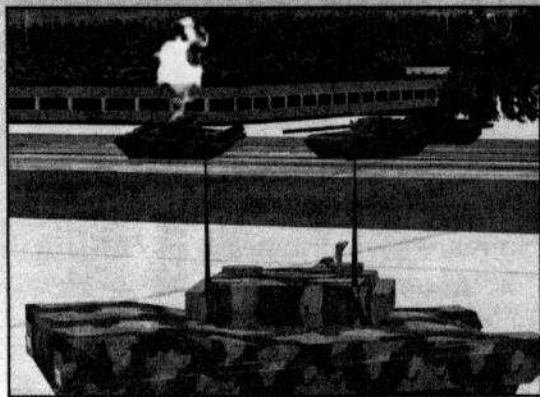
LCGT

The new simulators are capable of much more than the old IMR by way of training realism and the extent of trainable engagement types. This translates into a greatly heightened value of training for the crew even before the first live round is fired. A Training Transfer Study currently being conducted jointly by the Defence and Civil Institute of Environmental Medicine (DCIEM) and LFDTS in Kingston will assess the effectiveness of computer simulation in gunnery training in order to maximize the potential of simulator training prior to conducting live fire ranges. It is anticipated that more live fire training can be effectively replaced with computer simulation without jeopardizing or degrading the proficiency of crew skills. The recently introduced computer based gunnery simulation suites are ideally suited to the task of periodic refresher training for gunners and commanders. The new simulators are of a level of sophistication that gunnery currency training can be

entirely conducted using simulation. They readily permit accurate and quantifiable assessment results for individual engagements. These results can easily be collated and tabulated to produce a meaningful assessment of a candidate's overall skills on that particular vehicle. With this in mind, and given the financial and physical resource efficiency of computer based simulation training, it will be much easier for individual gunners and commanders to find the time during their work schedule to practice their gunnery skills. This will permit crewmen to effectively maintain their skill currency on each of the vehicle types in the Armour Corps. The only real limitation of the simulators is that they lack the ability to replicate many of the physical consequences of fire experienced during live fire training. For example, the LCGT, which is fixed mounted as a stand-alone box simulator, cannot replicate the pitch and roll of a tank on the move. Nor can it permit the crew to experience the

platform rock of a tank as it fires a live round. While these limitations would be serious impediments to individual qualification training and unit continuation training, they have a minimal effect on currency training given that the purpose of currency training is simply to maintain an established skill set at a minimum level of proficiency. Whether or not a trained crewman experiences the physical consequences of fire during currency training will have nominal impact on his/her ability to effectively apply the required skills in order to maintain their proficiency.

Innovations to AFV weapons systems have made mastering gunnery much more difficult to achieve and even more difficult to maintain. Vehicles such as the 25mm Coyote have a very technically advanced gunnery fire control system employing such tools as Thermal Imaging, multiple round burst capability, and a tactical navigation system. This weapons



Simulated engagement

platform demands considerable skills on the part of the crew for its effective operation. These skills, once learned, require frequent practice in order to maintain peak proficiency and weapons handling competency. Proficiency with such complex weapons systems can quickly suffer at the hands of neglect. Units do not have the time nor the money to “re-train” newly arriving gunners and commanders as they return from extended periods of extra-Regimental duty. Qualified soldiers must maintain their professional competence in those skills for which they are primarily employed – fighting in an AFV. To do this, they must have the means and the direction to conduct currency training. The current suite of AFV gunnery simulators provides the ideal means to effectively conduct this type of training. The direction to conduct currency training can be easily incorporated within the existing framework of gunnery training as detailed in CFP 305(13).

The required document around which to establish this framework could take the form of a matrix that provides information on gunnery serials, environmental conditions, targets, ranges, and standards of achievement. Incorporated into CFP 305(13), it would augment the directed gunnery training already established as unit continuation training. Currency training tables could be designed to identify required levels of training on a monthly, quarterly, or semi-annual basis. The firing serials listed within these tables would be conducted under the supervision/assessment of an IG and the results could be entered into the member’s unit employment record (UER) which should then be used for future employment considerations within a Regiment. Armour soldiers at all rank levels could then conduct mandated gunnery currency training at various times throughout the training year using clearly defined standards that are designed to measure skill proficiency.

Many NATO countries currently employ computer-generated simulation in not only the initial training of their soldiers but also in the continuous assessment of their skills. This continuous assessment of skills is essential in order to maintain the professional competence of AFV crews. We now possess the technology to effectively accomplish this task through the employment of computer simulation and the implementation of a currency-training program. ■



Coyote Primary Combat Function Training: Train to Need vs Operational Requirement

By Captain C.S. Fifield

“...it is necessary to have a minimum of four soldiers in the patrol who are qualified surveillance operators in order to give the individuals time to rest, wash or perform other tasks.”

INTRODUCTION

Prior to deploying the officers and soldiers of B Squadron were employed on the Leopard tank. Once the decision was made to deploy B Squadron to Bosnia with the 2 Princess Patricia's Canadian Light Infantry Battle Group, the squadron commenced a Primary Combat Function training cycle to convert all of its soldiers to Coyote. It was the desire of the squadron leadership to provide all crewmen with minimum of two PCF's, and preferably three, prior to deployment. However, due to budgetary and time constraints, the squadron was directed that it was to be 'train to need' only. That is to say one PCF per person in accordance with their position within the crew.

DISCUSSION

In order to fully understand how much time, effort and resources are involved in producing a well-trained and sustainable squadron, I will summarize each of the PCF courses in brief detail. Each of the courses, gunnery, driving and maintenance, and surveillance operator, differ as far as course duration and cost.

GUNNERY COURSE

This course is designed to train a crew commander/gunner to perform the duties and responsibilities of a 25mm Gunner. The two major subject areas covered are the firing and servicing of the 25mm Turret Weapons Systems. The duration of this course, including course administration time and other mandatory activities, is nineteen training days. The following instructor time (Table 1) is allocated based on a maximum course load.

This time does not include course preparation, post-course review, re-write or other administrative requirements. An instructor must be qualified 25mm Gunner Basic and,



Captain C.S. Fifield was the Battle Captain of B Squadron deployed on OP PALLADIUM Roto 7 at the time the article was written, and is currently the Second in Command of C Sqn LdSH(IRC).



Table 1. Instructor Time Allocation

Instructor	Rank	Number	Days
Course Officer	Capt/Lt	1	19
Course WO	WO	1	19
Instructor	WO/Sgt/Mcpl	5	19
Course Adm NCO	MCpl /Cpl	1	19

as a minimum, is JNCO qualified. As well, they must have at least one year's crew commanding experience including a minimum of one gun camp. The instructor ratio is based upon one instructor per crew of four trainees and the maximum course capacity is sixteen students, with the minimum course load being eight.

Of all the Coyote PCF courses, this course is by far the most expensive and resource intensive course that can be run. At the end of the classroom/ indoor miniature range portion the course must deploy to the open range to conduct the final practical checks. This involves the deployment of many regimental resources such as weapons technicians, mechanics, cooks and medics. Adding to the cost are fuel, targetry, field pay allowances and, of course, ammunition. In order to qualify, one hundred and sixteen rounds of 25mm TPDS-T and seven hundred and seventy rounds of 7.62mm coax are required for each student on the open range. Assuming there is a maximum course load that

comes to one thousand eight hundred and fifty six rounds of main armament and twelve thousand three hundred and twenty rounds of coax per course serial. It should be noted that both crew commanders and gunners require this qualification for employment. In a standard reconnaissance squadron, that means that a minimum of 32 personnel will require this qualification.

DRIVING AND MAINTENANCE COURSE

This course is designed to train soldiers to perform the duties of a Basic Driver. Major subject areas that are covered are drive and service a Coyote. The duration of this course is 12 training days including administration. The maximum course capacity is twenty students, with the minimum course load being eight. The instructor ratio is based upon one instructor per crew of four trainees. The following instructor time (Table 2) is allocated based on a maximum course load.

The course can be run at very little cost, as the course can be run and all testing take place in garrison and the local training area. There is not necessarily the requirement for a field deployment. The only direct cost involved is fuel used during the road and cross-country driving performance checks.

SURVEILLANCE OPERATOR COURSE

This course is designed to train a NCM to perform the duties and responsibilities of a Coyote Surveillance Operator. The major subject areas covered are the operation and servicing of selected components of the Coyote ancillary equipment, which includes the operation and servicing of the Coyote Remote Surveillance System (RMSS) and the Mast Mounted Surveillance Systems (MMSS).

The AN/PPS-501 radar is a self-contained, man-portable, battlefield ground surveillance set used for detecting moving objects and directing

Table 2. Instructor Time Allocation

Instructor	Rank	Number	Days
Course Officer	Capt/Lt	1	12
Course WO	WO	1	12
Instructor	WO/Sgt/MCpl	6	12
Course Adm NCO	MCpl/Cpl	1	12



Table 3. Instructor Time Allocation

Instructor	Rank	Number	Days
Course Officer	Capt/Lt	1	21
Course WO	WO	1	21
Instructor	WO/Sgt/MCpl	5	21
Course Adm NCO	MCpl/Cpl	1	21

artillery fire. The radar is capable of detecting and locating individual and multiple moving objects over selected ranges up to 24 kilometres. For example, the detection of large vehicles (trains, tractor-trailers) is effective over a 24-kilometer range, the detection of medium vehicles (tanks) is effective over a 12-kilometer range, small vehicles (jeeps) over a 10-kilometer range and infantry over a 4.5-kilometer range. Also taught are the effective use of the Forward Looking Infrared Radar (FLIR), and the earlier version the Night Observation Device Long Range (NODLR). Rounding out the system is the day camera capable of magnification of up to several times. All of these information-gathering systems are incorporated into one

user's station manned by a qualified surveillance operator.

The Surveillance Operators course is without a doubt the easiest and least expensive to conduct. The course requires no other resources than those already found on the Coyote, however it is the longest of Coyote PCF courses at 21 days. The instructor ratio is based upon one instructor per crew of four trainees. The maximum course capacity is twenty students, with the minimum course load being eight. The following instructor time (Table 3) is allocated based on a maximum course load.

The course can be run at very little or no cost, as the course can be run

and all testing take place in garrison. There is no requirement for a field deployment.

DISCUSSION

Assuming that you begin with soldiers of varied experience and qualifications, it would be most beneficial if all three Coyote courses were run consecutively. It would be much easier to pool resources, instructors and students for fifty-two days during a regimentally programmed PCF training cycle. The staff and students would benefit from the training cycle, as it would provide the soldiers with an opportunity to concentrate on becoming intimately familiar with all of the crew stations within the Coyote.

Figure 1. Coyote Remote





It would also help crew commanders become more familiar with their crews and it would provide an invaluable opportunity for the building of team cohesion and overall have a positive effect on morale. At the end of the training period the squadron would be able to field a well-trained, well-rounded sub-unit capable of easily fulfilling any and all reconnaissance tasks assigned and be able to sustain those tasks for an indefinite period of time.

Should the time or financial resources not be available to train soldiers in all three PCF'S, I would recommend that Gunnery and Drivers course could be run simultaneously, followed by all personnel then participating in the Surveillance Operators course. This would provide all of the soldiers with a primary PCF consisting of driver or gunner, and a secondary PCF of surveillance operator. The training timeframe would be shortened to forty days and would fulfil all of the manning requirements.

OPERATIONAL REQUIREMENTS VERSUS TRAIN TO NEED

The train to need concept is a function of the reality of unit operating and training budgets. As the brigades and regiments are pressed harder to perform more tasks with fewer resources, eventually something has to be sacrificed. Unfortunately, in some instances it is the training of our soldiers that must be pared back. Gone are the days when we could provide our soldiers with a course merely to aid in their professional development or provide the regiment with the employment of their troops. In some instances,

Commanders are now forced to justify training soldiers with an operational or employment based criteria. Unfortunately, this simple solution to aiding commanders with helping solve the complex problems of fiscal management has, for reconnaissance squadrons, created a potentially serious problem. As a result of the 'train to need' decision, many Coyote crews are made up of soldiers who can only perform one function. This lack of depth limits effectiveness of that soldier and, by extension, the effectiveness of the crew, troop and squadron.

A standard tank crew with singularly qualified soldiers can operate effectively, because the secondary duties on which they are called upon to perform are not technically challenging. Examples of these secondary duties include harbour guide, sentry, and radio watch etc. All armoured soldiers easily learn these skills during Armoured QL 3 training, or during their first exercise with their Regiment. While deployed, the tank squadron is also relatively close to the administrative assets of the regiment. Should there be a requirement to replace an individual, and assuming a soldier was available, this can be done relatively easily.

The reconnaissance squadron is the premier information-gathering resource on the conventional battlefield. The squadron is prepared to move out and conduct surveillance operations such as screens, observation posts, point reconnaissance and area reconnaissance for extended periods of time. The squadron is far out of reach of administrative support. Replacements, if required, can be

brought forward, but it will take time. As a result, the reconnaissance troop must be fully self sufficient.

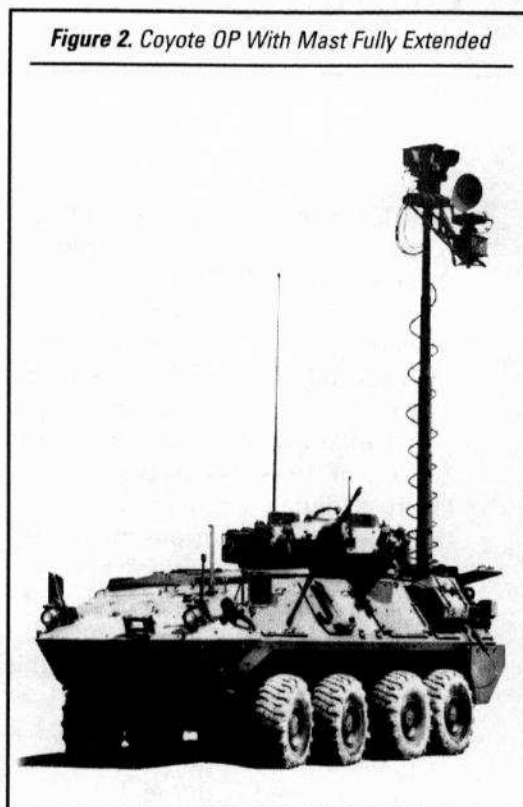
The OP screen (Figure 2) is the task best suited to make maximum use of the sensor package found on the Coyote reconnaissance vehicle. Whether it's the radar, the FLIR or the day camera, a well-sited Coyote OP can detect a wide range of targets within the area of observation, from zero up to twenty-four kilometres. Depending on the pace of operations and the tasks given, reconnaissance patrols can find themselves holding in an OP screen anywhere from a few hours to a week or more. Well-trained surveillance operators are the key to get to gathering and interpreting the information provided by the sensor array. While any member of the crew can sit in front of the operator's console and look at the monitor or the radar screen, they must be properly trained to be able to set up the equipment and to accurately interpret the information provided, particularly in the case of the radar. After interviewing a number of surveillance operators and troop leaders, the consensus seems to be that approximately two hours is the maximum time that an operator can be expected to perform before eye strain, boredom or fatigue begin to have a detrimental effect on operator effectiveness. It therefore follows that, as with any other task within a patrol base, a rotation schedule must be made up to ensure that soldiers don't become complacent or to give them some down time. As a result, it is necessary to have a minimum of four soldiers in the patrol who are qualified surveillance operators in order to give the individuals time



to rest, wash or perform other tasks as detailed. It also follows that in the event that an operator cannot perform his duty due to injury, death, repatriation etc, there is no one left in the crew to assemble / disassemble to gear, perform the start- up procedures, conduct fault finding on the equipment or properly use the suite.

The AN/PPS-501 radar is capable and extremely effective at directing artillery fire. Coyote crew commanders must therefore be able to effectively interpret the correct the fire of artillery resources, or at the very least be able to supervise the surveillance operator as they perform the task. As it becomes less and less acceptable for collateral damage on the battlefield, this becomes a critical task. As a result, crew commanders, as with the rest to the crew, must be able to employ the surveillance gear and therefore require the qualification in addition to gunnery.

On an operational deployment there will inevitably come a time when at least twenty five percent of the squadron will be away on HLTA or R&R. During these periods it will become increasingly difficult to maintain a high level of operational effectiveness if there is no depth of qualifications within the troops. During OP PALLADIUM Roto 7, B Squadron at times had to rely heavily on augmentation from members of the 2 PPCLI Recce Platoon in order to maintain the operational tempo. Had the augmentation not been available the squadron may have been reduced to two effective troops. As one troop



is required to be on two hours notice to move as the battle group reserve, that would have only left one five car troop to conduct surveillance operations throughout the entire Canadian area of operations. Had some of our soldiers had multiple qualifications, the squadron would not have had to rely as heavily on augmentation and the adjustments could have been made internally.

CONCLUSION

In order for a reconnaissance troop or squadron to operate effectively in an operational theatre or while deployed

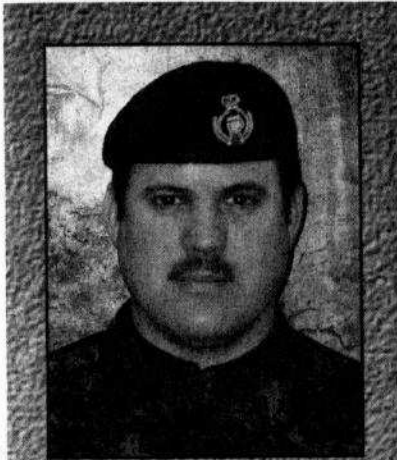
on exercise, the crew members must possess multiple Coyote qualifications. The 'train to need' philosophy should not be applied when conducting training in preparation for an operational tour or field deployments. By employing soldiers with multiple qualifications it will allow enough flexibility to continue to conduct a wide variety of missions for extended periods, while at the same time meeting the administrative requirements of R&R, HLTA, repatriation due to injury or administrative problems etc.

RECOMMENDATION

In order to field a well trained and operationally sustainable reconnaissance squadron, I recommend that all reconnaissance soldiers be trained with a minimum of two PCF'S, with three being preferential. As a minimum, all crewmen must be qualified either Gunner or Driver and everyone in the crew should then be qualified Surveillance Operator. This qualification forms the backbone of an effective reconnaissance squadron capable of maintaining operations for extended periods of time. ■■■



Corps Adjutant's Corner



The Corps Adjutant is a secondary duty of the Armour School Adjutant. Like the Corps RSM (a.k.a. RSM Armour School), the Deputy Director Armour (a.k.a. Commandant Armour School) and the Colonel Commandant, the Corps Adjutant wears the Corps cap badge and accoutrements with all orders of dress. The duties of the Corps Adjutant are to act as a conduit between the various members of the Corps, both serving and retired as well as the Regiments and Association. This includes supporting the Director Armour, managing the RCAC Association Memorial Suite and maintaining the Corps Appointment List. The Corps Adjutant is not involved with the duties normally assigned a unit Adjutant such as discipline or personnel administration.


While most of the Adjutant's work, on behalf of the Corps, occurs behind the scenes, there is one aspect of the duties which is visible to all visitors to the Armour School – the RCAC Memorial Suite. The Memorial Suite is a living memorial. The central features of the Suite are the Regimental chairs, tables, and buffets. There are a total of 56 chairs, eight tables and

two buffets in use at the Armour School. These were produced after the Second World War to preserve the memory of the members of the Corps who had died in the service of their country as well as to commemorate the wartime Regiments of the Corps. The RCAC Association voted to begin the Suite during their annual meeting of 1957 and the last pieces were procured in 1965. The furniture was intended to be for everyday use in order to remind us of the sacrifices of the past. It is in this spirit that the furniture forms a part of many Armour School offices and the conference room.

All of the furniture in the Memorial Suite is made of oak. The chairs are covered in red leather and each has a carved head cap featuring a Regiment of the Second World War. All chairs have a silver commemorative plaque as well as a small number plate to aid in inventory. The original cost of each chair was \$185.00 in 1957. This rose to \$291.98 by 1965. This year a local carpenter presented an estimate of \$2800.00 in order to produce a single chair in leather and oak with a carved head cap.



The Memorial Suite also contains an impressive number of Corps trophies, paintings, portraits, parade swords, silverware and china. These items are displayed throughout the Armour School with some pieces in the Camp Gagetown Officers' Mess as well as the Camp Gagetown Museum. The Armour School maintains the Memorial Suite with funds provided by the RCAC Association.

For those who are interested in reading more on the RCAC Memorial Suite, Major Mike McNorgan wrote an excellent article in the Winter 1989 edition of the Armour Bulletin. Don't have a copy? Come and visit the Armour School for a tour of our excellent facilities and a chance to see our Corps heritage. Finally, for those who would like to contact the Corps Adjutant, I can be reached by phone at (506) 422-2000 extension 2616 or on the Internet at bailey.pa@forces.ca 

PA Bailey

Captain Pat Bailey, CD
Adjutant RCAC



Lee Tank



BCR Tank Maintenance



Otter Recce Vehicle