BRIEFING NOTES

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THE FUTURE OF WARFARE, ITS TRANSITION TO URBAN AND UNDERGROUND WARFARE AND WHAT TO DO ABOUT IT

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SUMMARY

Due to the air superiority of NATO and to the ever-increasing cost of building on the surface, potential opponents have already started and are continuing to build underground. Sewers, metros and massive shopping malls would allow the enemy to move and protect their assets with impunity if the military does not act underground. Furthermore, dropping bunker busters or solely using special forces will not suffice since the areas to cover will be too high.

Therefore, soldiers will have to learn how to fight underground and will have to be equipped with the proper tools to be combat ready in this environment. Firstly, tools to identify where the underground facilities are would be important. Using an array of seismic imaging, electrical prospection or simply sending AI controlled drones to scout the facility would be beneficial in understanding the layout and plan the mission accordingly.

Secondly, the soldiers will have to be equipped with personal tools to ensure their effectiveness and survival. Low frequency communication devices, suppressors, infrared flashlights and oxygen providing equipment will be primordial if the soldiers have to fight the enemy in an enclosed and completely dark environment.

Why Is Underground Warfare Going to be Important In the Future

Contagious diseases represent as one of the 21st century's major health challenges for humanity. Recently, the COVID-19 pandemic has affected practically all countries and has led to death of several thousands of people and many direct consequences such as economic crisis for industries and countries.
With the increase in urban population, the cities develop and create more infrastructure to accommodate those people. Metros, sewers and other subterranean facilities are a common feature of most industrialized and industrializing countries. Just in Montreal, for example, the sewer network represents around 5,000km (City of Montreal n.d., para. 2). Furthermore, with an increase in the density of the population, the land above ground becomes very expensive, forcing municipalities to expand underground. This dynamic is evident in China, where nearly 30% of all future building projects are projected to be underground (Chen, Chen Liu & Zhang 2018, 261).

In addition to these increasingly massive civilian structures, militaries around the world created underground facilities to increase their survivability in case of an attack. North Korea started building massive underground bunkers and tunnels in the 60s (Army headquarters 2019, 1-17). This includes an underground airbase to protect their aircraft from observation and attack (Army headquarters 2019, VII). States like North Korea, where 80% of the topography is

mountains or hills, geography facilitates the construction of underground facilities to protect troops (Bruner 2003, 3). Other nations are also drawn into moving underground, like China with its intricate and sophisticated network of facilities to protect their coast. They possess numerous coastal missiles hidden underground (Army headquarters 2019, 2-2). Moreover, some organizations might intentionally use civilian networks to protect themselves from air-strikes, like Hamas, whose high ranking cadres reside in the basement of Gaza's hospitals (Richemond-Barak 2018, 209).

All these nations are responding to NATO's bombardment aerial practices. These strategies are intended to nullify the immense air superiority NATO possesses. Intelligence through satellite, drone imagery, airstrikes and long-range precision bombing gives NATO a significant advantage that potential opponents fear. Instead of investing in assets to maintain a surface presence, they have decided to build underground.

This is a very common strategy used in the Near East. Due to Israel's air superiority over its neighbors, organizations like Hamas and Hezbollah have created extensive and complex networks of tunnels leading out of Lebanon and Gaza (Shapir & Perel 2014, 55). They use these tunnels to lunch surprise attacks on the IDF and then retreat in secret before retaliation. In addition to simply lunching rockets from these tunnels, these organizations also use them to bypass hard borders and attack guards from behind, even taking them hostage (Hecht 2014, 2). Lastly, as seen in the 2012 operation Pillar of Defence, Hamas tries to use an old World War One tactics, digging tunnels under a target and planting explosives to blow it up (Hecht 2014, 3).

These underground facilities have certain advantages. To begin, they allow the organizations to protect their vital strategic and tactical elements from intelligence or attacks. A lot of these tunnels, especially in North Korea, are known to be of large diameter, allowing passage for around 30,000 armed troops a day (Army headquarters 2019, 1-17). Moreover, another important advantage of underground tunnels and networks, is that it limits the enemy's intelligence. Intelligence is primordial to modern warfare. Denying information about your missile location, creating false rooms on your plans to confuse the enemy and making him overestimate your defenses is very important.

Furthermore, a lot of these underground facilities are hidden. In the cities, the enemy could hide his network within buildings. In the more rural areas, the enemy will conceal their presence by fusing with local vegetation or by creating the facility within mountains. This could potentially create a surprise factor that any invading force will have to consider. The enemy could attack the supply routes once the main force has passed or they would change the tide of a battle (Army headquarters 2019, 2-1). Lastly, creating these networks allows the defendant to control the tempo of any attack (Army headquarters 2019, 2-9). The defendant could create difficult to navigate mazes, create the layout in such a way as to restrict the passage of large

forces and create traps along the way. If the enemy expects to have few soldiers protecting a certain site, it would create narrow passages with sharp 90 degree turns to force the invading force into small groups, removing their numbers advantage.

The State of Underground Warfare and Modern Preconceptions

There are two main approaches states are taking to tackle underground warfare are bunker busters and massive utilization of special forces to accomplish underground missions.
To begin, bunker busters are weapons with an outer shell hard enough to sustain the impact between the bomb and the ground. Some are bombs with a fuse designed to use the velocity of the bomb to pierce trough the ground and then detonate at a specific depth where the interior of the bunker is expected to be. This type of weapon requires precision because missing the tunnel will completely nullify the shockwave due to the earth's absorbing qualities and little damage will be done to the target. Another type of bunker busters is the nuclear one. Using a special nuclear warhead that will create such an underground wave that it will hopefully collapse the facility below (Nelson 2003, 33). The other, and most utilised, approach to accomplishing underground military operations is using the special forces. These specialised units are usually better trained and equipped to deal with underground fighting than regular forces. Today, most underground operations are done by the special forces.

Unfortunately, in the case of a future war, we cannot rely solely on either of these options to reliably gain control of the underground world. Since these facilities are so close to the civilian population, utilizing nuclear or a massive ordinance risks to collapse the city above these tunnels, the civilian population would therefore be at the great risks. In addition, it might be illegal according to the laws of war. Furthermore, since so much of the urban space is underground, the special forces will not have enough time to deal with all facilities, thus the need to train the regular infantry for this new, yet old, type of environment.

Israel is already applying this perspective and the United States invested 600 million dollars in training and equipment for their units. Israel tried to bomb from the surface the tunnels in hope of collapsing them (Shapir & Perel 2014, 54), but in the end, training soldiers to go in and fight the enemy where they hide is the cheapest and most reliable method.

Future of Warfare and What to Do About It

Because of all these reasons, the only logical evolution of urban and asymmetric warfare will be going underground. Therefore, armies must start training their soldiers and investing in specialized equipment for this type of warfare.

To start, intelligence is still the most important asset a leader can have. It is important for the unit to understand the extend of the network they are about to clear and to possess the proper

equipment for the job. Since intelligence is limited underground, there will be a need for cross reference and a need to obtain the intelligence from multiple sources (Army headquarters 2019, 6-6).

One of such sources will have to be external. There is civilian equipment available today that creates an overview of the crust of the earth. This technique is called seismic exploration and it uses wavelets of sound to create a 3D image of the ground below. In a nutshell, it uses a vibrator installed on a heavy vehicle, that generates those wavelets (Krawczyk et al. 2019, 5). In addition, at a distance, a receiver is installed to catch and record those wavelets. Lastly, a computer analyzes the recorded data and generates a 3D visual of the crust of the earth that will allow scientists to understand its contents (Krawczyk et al. 2019, 6).

Unfortunately, this process is very long and dangerous. It takes months to receive the results of those seismic explorations and it would be dangerous and unprecise to even try to use such a technique on the battlefield (Krawczyk et al. 2019, 9). The technicians will likely be targeted, and the ambient noise of warfare will distort the data. Nevertheless, it could provide an invaluable data to commanders and it would be much cheaper than losing men.

In addition to this technology, local knowledge, geophones (Shapir & Perel 2014, 56) and electric prospection methods will be crucial in detecting where the enemy digged or will dig their facilities. To start, before doing an operation in the region, commanders should understand the topography of the land. In places where there is Karst formations, the ground is made of limestone which cracks and create long and intricate natural tunnels in the rock, allowing the enemy to hide and attack (Beyr 2011, 43). Understanding the layout of the land also allows the commanders to predict the enemy and where he is going to be.

If the land is very soft and easily dug, then the enemy is likely to use the opportunity to connect houses and move incognito. Already available tools like geophone, to hear any digging, and constant satellite imaging are required to see signs of underground construction. Piles of earth, sinkholes and denivelations could be indicators of a collapse in a tunnel (Beyr 2011, 45). Lastly, utilising electrical prospecting could be very important in finding tunnels since today, organizations like Hamas create electrified tunnels where their fighters can move and live comfortably (Watkins & James 2016, 93). There are many tools used by civil engineers to detect electricity but none of them are really applicable to finding deep underground tunnels. Tools using electromagnetic location rely on the conductive properties of earth to detect signals, but if the cable is not in contact with the earth, the loss rate will be too significant to detect with normal tools (Radiodetection n.d., 14).

In addition to this external intelligence. Drones could provide intelligence from the interior. Indeed, drones are becoming cheaper, lighter, smaller and more intelligent. When mixed with AI and the scanning technology of robots, they could provide important information to units

trying to clear the underground facilities. They could be programmed to fly and record their path. Once they see movement, they turn back and signal the position of the enemy to the unit, showing the last recorded images. If this type of technology becomes cheap enough to allow for multiple drones, these drones could be sent in multiple directions to survey the tunnels. Mixed with an external idea of the facility, these two types of intelligence could tell where the enemy are and what type of defence he prepared.

Lastly, another form of intelligence the soldiers should acquire before going in and clearing the network is to know the integrity of the whole structure. The standards of construction are very different in different area of the world and the surface warfare could have damaged the integrity of the structure. Therefore, before using any breaches or adventuring forward, the soldiers must ensure that it is safe. In addition to the previous concerns, the enemy could have sabotaged the structure to trap and kill friendly units (Army headquarters 2019, 1-5).

An easy and relatively low-cost solution would be to teach them some key concepts they can apply when inspecting the structure. An example of that can be: how it's built, its shape and its materials. To codify the how the infrastructure is built, the soldier should look at the age of the tunnel, the existing deformations or the engineering behind it. For the shape variable, soldiers could analyse the shape of the tunnel to understand the forces applied to the structure. If the tunnel has an arc shape, the forces are distributed more or less equally throughout the structure. On the contrary, if the tunnel has a flat roof, the force is concentrated in the middle of the roof, potentially bending it. Therefore, soldiers should analyze the shape of the tunnel and look for cracks in the middle of the roof, indicating structural failure. Lastly, the materials variable should be analyzed as well. If the tunnel is made of reinforced concrete, it will probably stand heavy surface bombardment, contrary to a mud tunnel with simple wood reinforcements.

More Soldier-Based Technology Needed in Underground Warfare

Modern warfare is based on maneuver. Coordination and combined arms tactics are the base of most operations. To achieve maneuver and be able to properly move, engage and retreat, the army must be able to communicate. One major issue with underground facilities, is that earth blocks high frequencies radio waves used in modern communication devices. Since it is primordial to be able to communicate, the army will have to change some their communication means to adapt to this new environment (Army headquarters 2019, 1-). The US Army chose to replace their devices with mobile ad hoc network devices. In a nutshell, these devices will serve as a communicator and as a router at the same time (Army headquarters 2019, 6-15). This will allow to connect all the units within the facility and might even create a chain link to the exterior. An alternative to this problem would also be to use digital through the earth communication systems. These systems use very low frequencies to penetrate the rock and

soil and allow units to communicate. Its range is around 1,000 fts (Office of energy efficiency & renewable energy n.d.).

In addition to communication, underground facilities block any sort of ambient light. If the power goes down, the soldiers will be very limited in their movements and combat capabilities. They need a proper night vision system that will allow them to see were they are going and engage any enemy. The US Army opted to use an ENVG system, that will replace their old PVS system (Army headquarters 2019, 6-16). The PVS is simply an image intensification technology. It takes the ambient light, visible and non-visible, and enhances it electronically to allow the operator to see in the dark. Unfortunately, since there will be no ambient light in the tunnels, this technology is not very useful. The ENVG, is simply a superposition of the PVS and the thermal vision technology, that perceives heat, working even in complete darkness. An alternative to this issue would also be to equip every soldier with infrared flashlights on their weapons. This will provide the necessary light for the PVS and will maintain the soldier concealed in the dark since it is invisible with the naked eye. Moreover, Canada possesses already PVSs. There would be no need to purchase expensive thermal vision or ENVG systems.

Another very important technology soldiers should have while fighting underground are suppressors. Due to the elongated shape of the tunnel, the soldiers will experience reverberations of the shots fired, making them hear the shots multiple times. In addition to reverberations, multiple sources of noise in an underground facility can significantly increase the noise level in it (Kang 1997, 17). Having multiple soldiers shoot and not having the adequate protection could be very dangerous for their hearing and will definitely reduce voice communication.

Lastly, a critical limitation to underground warfare will be the carbon dioxide and potential chemical or smokes intoxicating the units operating in that environment. Ventilation will probably be problematic, especially if the designers counted on electricity to power a ventilation system. In addition, firing the weapon, throwing grenades and breaching obstacles will eat oxygen and release toxic fumes (Army headquarters 2019, 1-5). The soldiers, therefore, will need oxygen detectors and will need integrated oxygen provided systems that will be able to maintain a good level of oxygen to allow the soldiers to fight and breathe in combat situations, while not being heavy and encumbering enough as to completely impede their movement.

Conclusion

To conclude, due to the increasing urbanisation of states, the future of warfare will probably bring soldiers underground. They will need to fight off the enemy in these valuable infrastructures since using bombs will be too risky and inefficient and there will not be enough special forces to root out the enemy in future wars with peer to peer adversaries.

Therefore, the army should start training and equipping soldiers with the tools necessary for accomplishing their mission. Instruments like seismic exploration, ai controlled drones and a basic understanding of structural forces could help soldiers navigate unknown infrastructures. Additionally, tools like better communication devices, suppressors, ENVGs or infrared flashlights with PVSs, and oxygen providing systems will help soldiers fight and communicate better.

Despite all these technologies, gaining local support could be even be more valuable. People who live in the area knows the location of underground facilities and the actors operating in them. Therefore, gaining the support of the locals by using regular forces, to clean out underground infrastructure, instead of bombs will be further amplified.

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