The period 1860-1914 witnessed an unsurpassed proliferation in military literature of a high quality. Among the many new writers of the period was a little known major by the name of von Scherff. In 1873 he wrote a book entitled *The New Tactics of Infantry* which articulated his assessment of the role of infantry based on the Franco-Prussian War of 1870-71. In his writings he observed a phenomenon that he termed the “void of the battlefield”. This referred to his observation that the battles he had studied were characterised by a great dispersion of troops on the battlefield. It was quite unlike the deployment of densely packed forces in battle that characterised European combat prior to 1870. Von Scherff’s observation touched upon a phenomenon that eventually became known as the “empty battlefield”. Most significant was the paradox embedded within the phenomenon. This concerned the fact that while weapons were becoming more lethal, there was a relative decline in casualty rates. According to the military historian T N Dupuy, “this paradox is occasionally noted by military theorists, military historians, and operations research analysts, but for all practical purpose it is ignored in historical works, in theory, in planning and in analysis. The result has been a gross misinterpretation of recent wars, and in all probability an equally gross misperception of wars in the future”.1

Evidence of the empty battlefield

One noted military theorist and historian who had given the matter some thought was B H Liddell Hart. In 1960, writing in *Military Review*, he wrote that T E Lawrence had urged him “to do a study of the ratio of force to space in war, [Lawrence’s] own conclusions being that it was of basic importance and contained the clue to many of the puzzles of military history”.2 However, Liddell Hart was particularly interested in operational aspects of battlefield dispersion rather than its theoretical implications.

Dupuy suggested that evidence of the empty battlefield has been extant throughout history. The first manifestation of the phenomenon was the dispersion of troops on the battlefield. In antiquity, armies engaged in battle were deployed to a density of one man per ten square metres.3 During the American Civil War the density had decreased to one man per 257 square metres. Finally, by the end of the First World War the rate was one man dispersed in a 2,475 square metre area. At the end of the Second World War the density had decreased almost ten-fold to 27,500. By the end of the October War of 1973 the rate was one man per 40,000 metres.

Dupuy’s Theoretical Lethality Index

While the historical patterns of dispersion were increasing, the lethality of weapons was also increasing. Deriving an indexed proving ground value Dupuy calls the Theoretical Lethality Index he was able to provide a measure of the relative effectiveness of weapons based on such things as range, rate of fire, accuracy, reliability, radius of damage, etc.4 Thus, for example, an early nineteenth century rifle had roughly the same relative effectiveness and lethality as a longbow. However, an 1898 Mauser rifle relative to the longbow was about fourteen times more lethal.

The third characteristic of the phenomenon gives rise to the paradox itself. While weapons have become more lethal, relative casualties have declined. Dupuy notes, for example, that at the battle of Antietam the daily casualty rate for the Union forces was 17.7 per cent;5 for Soviet forces at Kursk the daily casualty rate was three per cent. At the battle of Gettysburg the daily Confederate casualty rate was 12.5 per cent; during the October war the Israeli average was 1.8 per cent.

However, these patterns of lethality first become apparent in the nineteenth century. Table 1 portrays the evolution of the phenomenon in a quantitative format. The numbers represent averages of the three primary technological epochs of interest. The table indicates two trends worthy of note. First of all, battle (strategic) and engagement (tactical) casualties as well as troop density began to decrease. At the same time the size of armies, battle duration and battlefield frontages began to increase.
The development of firearms

The first of these inventions to be fielded and to make its presence felt on the battlefield was the rifled musket. The oldest known rifle seems to have been produced around 1500 for the Emperor Maximilian I. The rifle was slow in being adopted for major military employment. Its use was generally limited to hunters. The main reason for this slow adoption was the difficulty encountered in ramming a spherical bullet into a rifled barrel. The Baker rifle, for example, required a small mallet to properly seat the lead ball. In 1826, Delvigne of France sought to resolve the problem by developing a special chamber at the bottom of the barrel. However, the real breakthrough did not occur until 1849, when another Frenchman, Charles Minie, refined the cylindro-conoidal bullet, the famous Minie ball. A British captain by the name of Norton serving in the 34th Regiment is actually credited with inventing the original bullet in 1823. He observed that natives of southern India used blowpipe arrows with a base of locust pith that expanded against the inside of the blowpipe when blown. This prevented the escape of air past the projectile, which reduced windage and increased muzzle velocity. In 1836, Greener, a London locksmith, improved Norton’s original design by adding a wooden plug at the base of the bullet. However, both designs were rejected by the British Ordnance Department. Greener took his designs to France where they were quickly taken over by Minie. The rifled musket system was now complete. The rifling imparted spin to the projectile, which greatly improved accuracy over the smooth-bore. The Minie ball reduced windage, which resulted in an improvement in range and hitting power. Dupuy notes that:

These numerical trends, in and of themselves, are meaningless. They beg several questions which require answers. It is fundamentally the role of theory to provide answers that explain the facts. This brings us to the heart of the matter.

The theory

Why do armies incur fewer casualties in the face of increased weapon lethality? What are the battlefield dynamics that drive this paradox? According to Dupuy, casualties have declined in the face of increased lethality because armies have dispersed; but then, why have armies dispersed? The fundamental physical characteristic of battle is destruction. People and machines are destroyed or rendered useless. Historically this destruction has been accomplished through fire action, shock action or a combination of the two. In order to obtain maximum effect from fire or shock action it is required that maximum concentration of forces be achieved. Therefore as many men as possible must be formed into as small a space as possible in order to achieve maximum effect. This fundamental requirement gave rise to the phalanx and other close-order battlefield formations. With the development of firearms a soldier firing a muzzle-loader at a rate of roughly one aimed shot a minute stood in rank shoulder to shoulder with his comrades while occupying about one square metre of ground. This aspect of tactical dynamics dominated warfare for about two hundred years during the period of about 1650 to 1850. Then within in the space of forty years four technological inventions occurred almost simultaneously that were dramatically to revolutionise warfare. All four technological connections were linked to the rifle. One of the inventions was to increase drastically battlefield lethality; the other three provided a means whereby survivability in battle, especially for the defender, was even further enhanced.

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Smooth-bore (1750-1815)</th>
<th>Rifled Musket (1855-1877)</th>
<th>Magazine Rifle (1878-1905)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic</td>
<td>2.98</td>
<td>1.23</td>
<td>.45</td>
</tr>
<tr>
<td>Tactical</td>
<td>28</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Army Size</td>
<td>77,125</td>
<td>82,300</td>
<td>91,444</td>
</tr>
<tr>
<td>Battle Length (hrs)</td>
<td>9.5</td>
<td>12.5</td>
<td>44.9</td>
</tr>
<tr>
<td>Density (troops/metre of front)</td>
<td>8.41</td>
<td>8.16</td>
<td>3.27</td>
</tr>
<tr>
<td>Frontage (battlefield/km)</td>
<td>9.69</td>
<td>13</td>
<td>34.5</td>
</tr>
</tbody>
</table>

These numerical trends, in and of themselves, are meaningless. They beg several questions which require answers. It is fundamentally the role of theory to provide answers that explain the facts. This brings us to the heart of the matter.

Table 1. Patterns of Lethality*

The development of firearms

The second technological link began its evolution in 1812 when a Swiss firearms manufacturer by the name of Samuel Johannes Pauly took out a patent in Paris for a breech-loading system that utilised a paper cartridge with a reusable metal base. In 1827, a former employee of Pauly, Johann Nikolaus von Dreyse, developed a cartridge containing fulminate of mercury at its base. It was detonated by a needle. In 1835, after a series of experiments, von Dreyse patented the first modern bolt-action breechloader. This system was adopted on 4 December 1840 by the Prussian Army. Although the needle gun (Zündnadelgewehr) could fire five rounds for every two fired by a rifled musket with the Minie bullet, this advantage was somewhat offset by a loss of muzzle...
velocity due to a design defect in the breech-sealing mechanism. This decrease in muzzle velocity affected exterior ballistics.

**Firing positions and vulnerability**

However, the fundamental success of the needle gun over the muzzle-loader had little to do with ballistics. The significance of the breechloader in its contribution to the empty battlefield was that the firer, unlike his muzzle-loading counterpart, could fire and reload his weapon from a prone position and therefore greatly reduce his vulnerability. Since vulnerability to direct-fire weapons is proportional to the target area exposed, Table 2 demonstrates the advantage that accrues to prone firing.9

<table>
<thead>
<tr>
<th>POSITION</th>
<th>HEIGHT (Front)</th>
<th>EXPOSURE (Side)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounted</td>
<td>2.6 metres</td>
<td>1.2m² 1.8m³</td>
</tr>
<tr>
<td>Standing</td>
<td>1.8 metres</td>
<td>.5m² .3m³</td>
</tr>
<tr>
<td>Kneeling</td>
<td>1.2 metres</td>
<td>.5m² .3m³</td>
</tr>
<tr>
<td>Prone</td>
<td>.6 metres</td>
<td>nil nil</td>
</tr>
</tbody>
</table>

Table 2. Target Exposure to Firearms

<table>
<thead>
<tr>
<th>Distances</th>
<th>Metres</th>
<th>Line Column</th>
<th>Line Column</th>
<th>Line Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000</td>
<td>20.0</td>
<td>33.0</td>
<td>12.5</td>
<td>25.0</td>
</tr>
<tr>
<td>1,100</td>
<td>14.2</td>
<td>25.0</td>
<td>9.0</td>
<td>20.0</td>
</tr>
<tr>
<td>1,200</td>
<td>11.0</td>
<td>20.0</td>
<td>7.1</td>
<td>16.6</td>
</tr>
<tr>
<td>1,300</td>
<td>8.3</td>
<td>16.0</td>
<td>5.2</td>
<td>12.5</td>
</tr>
<tr>
<td>1,400</td>
<td>6.6</td>
<td>12.5</td>
<td>4.1</td>
<td>10.0</td>
</tr>
<tr>
<td>1,500</td>
<td>5.2</td>
<td>10.0</td>
<td>3.3</td>
<td>8.3</td>
</tr>
<tr>
<td>1,600</td>
<td>4.1</td>
<td>7.6</td>
<td>2.5</td>
<td>6.2</td>
</tr>
<tr>
<td>1,700</td>
<td>3.2</td>
<td>6.2</td>
<td>2.0</td>
<td>4.7</td>
</tr>
<tr>
<td>1,800</td>
<td>2.7</td>
<td>5.0</td>
<td>1.6</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Table 3. Percentage Vulnerability of Closed Line vs. Column of Sections (200 men)

Mayne provided an analysis of vulnerability based on tactical formation (line vs. column)9 and this is presented in Table 3. From Table 3 it is apparent that not only does the firing position impact on vulnerability, but the density of the tactical formation acts as a determinant as well. We will have occasion to discuss this aspect later. Not only does the prone firing position increase survivability against direct fire, it reduces troop vulnerability against artillery and mortar fire as well. Baclik provides data (Table 4) to that effect.16 When firing at targets in various positions using time shrapnel with the 77mm M96 field gun set to burst 50 metres short of the targets, the following results are expected at the various ranges:

**Table 4. Expected Hits Against Skirmishers (1 per metre)**

<table>
<thead>
<tr>
<th>TARGETS</th>
<th>500m 1,000m 2,000m 3,000m 4,000m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skirmishers Standing</td>
<td>18.4 14.2 12.0 11.0 10.4</td>
</tr>
<tr>
<td>Skirmishers Kneeling</td>
<td>10.6  8.2  6.9  6.3  5.8</td>
</tr>
<tr>
<td>Skirmishers Lying</td>
<td>Down 6.4  4.9  4.1  3.8  3.5</td>
</tr>
<tr>
<td></td>
<td>Entrenched</td>
</tr>
</tbody>
</table>

The third link in the technological chain of events was perhaps the most decisive. This was the invention of the magazine. In 1849, the first rifle with a magazine was patented by the American, Walter Hunt. This was a tubular magazine of essentially the same design found today in shotguns and small calibre rifles. It became the basis for the famous 1866, 1873 and 1876 model Winchester repeating rifles. One of the main defects of the tubular magazine was the constant tendency for the weapon's centre of gravity to shift upon firing large calibre cartridges. The second drawback of the tubular magazine was the relatively long time required to reload. These shortcomings were eliminated with the invention of the vertical magazine fitted below the breechlock. James P Lee, a Scotsman, patented the first effective vertical magazine in the United States in 1879. Lee's magazine was also detachable, and was made even more effective with the development of cartridge recharges. With the integration of the breechloader and magazine into one improved firearm system, the modern smallarms weapon had come into existence. It would exhibit little fundamental change over the next one hundred years.

**Rate of fire and survivability**

This brings us to the dynamic relationship between rate of fire and survivability which has dominated the battlefield for roughly the same time period. We begin by recalling that the smoothbore muzzle-loader had a rate of fire of about one aimed round per minute. Thus it was imperative that as many men be packed together as possible in order to generate a high rate of fire. But even more important was the imperative to maintain control and direction of troops in battle. In fact this must be recognised as a dominant imperative in all of organised warfares. Thus not only were dense formations more fire-effective, they were easier to control and direct in battle. This, of course, was also true for formations designed for shock action. At the rate of one round per minute, a man could cover one metre of frontage. With the development of the breechloader, the rate of fire of infantry weapons increased. Now, where previously five men each armed with a muzzle-loader covered a five-metre front, a single soldier with a needle gun could do the same. We note, then, that the frontage (F) controlled by fire is proportional to the rate of fire (R) of the weapon system:

\[ F = kR \]
where $k$ is a constant of proportionality. Of course, herein lay the primary efficacy of the machine gun. Firing at, say, 120 rounds a minute, it could cover 120 metres of front provided that a suitable field of fire was available. What is more, there was now additional empty frontage available to concentrate still more machine guns.

This increased rate of fire simultaneously provided the tactician with a means to reduce his vulnerability. Coupled with the advantage of firing from the prone or entrenched position, the tactical commander could now reduce his target density without decreasing aggregate firepower, i.e., rate of fire per metre of front. Men firing breechloaders could now present one-fifth the target area, as in the case of von Dreyse's needle gun, than troops firing the muzzle-loading Lorenz rifled musket. Thus potential target density ($D$) can be viewed as being inversely proportional to the rate of fire ($R$):

$$D = \frac{x}{R}$$

where $x$ is some constant of proportionality. Increasingly with magazine rifles and machine guns, the potential was present to greatly reduce target density and vulnerability while still maintaining effective fire. This point needs to be seized upon, because it is at the crux of the empty battlefield.

Several years ago studies conducted by the French Commission d'études pratiques de ter examined the effects of shrapnel fire upon targets of varying densities. The results of their studies are depicted in Table 5. Balck cites another firing test conducted against thin and dense skirmish lines. The firing was conducted freehand, at will from a prone firing position. The results are tabulated in Table 6. Balck concludes that "the superior effect of fire on the dense skirmish line, as expressed by the greater number of hits, and in consequence thereof, by the gradually growing number of figures hit, is apparent". It is also worth noting that the rate of fire against the more dispersed target array is about one third less and indicative of more careful and slower aiming procedures required in order to get a hit.

### Table 5. Percentage Hits Against Various Service Targets

<table>
<thead>
<tr>
<th>TARGET</th>
<th>DENSITY (number of targets)</th>
<th>Rifles</th>
<th>No. of Shots (min)</th>
<th>Time</th>
<th>Figures</th>
<th>Figures Hit</th>
<th>Figures Missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skirmishers in open or single rank line</td>
<td>4 8 16 32</td>
<td>166</td>
<td>1268</td>
<td>5</td>
<td>54</td>
<td>49</td>
<td>131</td>
</tr>
<tr>
<td>Skirmishers prone; gun crews protected by shields</td>
<td>25 40 65 90</td>
<td>166</td>
<td>1268</td>
<td>5</td>
<td>54</td>
<td>49</td>
<td>131</td>
</tr>
<tr>
<td>Infantry prone behind knapsacks</td>
<td>7.5 15 25 40</td>
<td>166</td>
<td>1268</td>
<td>5</td>
<td>54</td>
<td>49</td>
<td>131</td>
</tr>
</tbody>
</table>

Before proceeding it is perhaps appropriate to review some of the ground covered thus far. We noted that with the development of the rifled musket and Minié bullet, firearms dramatically increased in lethality. The British and American response to this lethality was to increase the use of field fortifications, especially entrenchments. Due to the early adoption of an effective breechloading rifle the Prussian experience was somewhat different. The prone firing position in part mitigated the need for the extensive use of field fortifications. Effectively, the prone firing position provided each Prussian with a portable trench. The development of a rapid-firing magazine and, later, belt-fed breechloading weapon system created the potential for battlefield dispersion with little degradation in firepower on the cutting edge of the firing line.

### The impact of smokeless powder

The final factor that contributed to the phenomenon of the empty battlefield was the invention of smokeless powder. The first smokeless powder appears to have been produced in 1864 by the Prussian artillery captain E Schultze, using a mixture of sawdust and potassium nitrate treated with nitric and sulphuric acids. Although Schultze's mixture burned more slowly than guncotton, its ignition rate was still too fast for the weapons of the time. As a result its role was largely relegated to use in sporting weapons in a blasting powder. While there is some contention that colloidal smokeless powder was invented in 1883 by the German Max von Duhkenhofer, who used acetic ether to gelatinise nitrocellulose, the credit is generally given to the French chemist Paul Vieille and his famous "B powders" which he produced in 1884.

The value of smokeless powder is, of course, that it renders the firer invisible to the enemy upon the discharge of his weapon. Another chief attribute of smokeless powder has to do with the characteristics of its internal ballistics. Smokeless powders of the type developed by Vieille are called "colloidal powders" because their primary constituents are derived from precipitate material originally in liquid form. The precipitate matter is first formed into cakes which can then be made into a variety of flakes, threads and other forms. By varying the form of the powder the manufacturer is able to vary the ignition rate. With long-barrelled rifles it was thus possible to develop greater muzzle velocities at lower internal energies. This property led directly to the decline of such artillery designs as the Rodman and Dahlgren variety with their distinctive bottle shape.

### The 'big bang'

The essence of the Vieille discovery concerns the fact that when nitrocellulose is dissolved in ethyl ether and alcohol, an explosive is created that imparts the destructive properties of the nitro-derivatives into an extremely effective propellant force. In 1888, Alfred Nobel, the inventor of
dynamite, developed another type of smokeless powder called Ballistite. This was derived directly from nitroglycerin. The following year Sir Frederick Abel produced the most important of the nitroglycerin powders: cordite. This was made from a mixture of nitroglycerin, acetone and guncotton. A small amount of petroleum jelly was also added to reduce excessive barrel corrosion and to maintain climatic stability. Cordite was adopted in 1891 for use in the .303 (7.7mm) Lee-Metford cartridge.

The expansion of the battlefield

The effects of smokeless powder in contributing to the empty battlefield are difficult to quantify. The data presented thus far (Table 1) suggests that the expansion of the battlefield began to accelerate after the introduction of smokeless powder. There is, however, ample qualitative evidence also extant. With the outbreak of the Second Anglo-Boer War on 11 October 1899, all four of the technological links discussed above were wrought together in the chain of battle.

“In the small battles fought during the opening months of the war,” wrote Fuller, “it became apparent that, due to smokeless powder, the old term of a visible foe had given way to the paralyzing sensation of advancing on an invisible one. A universal terror, rather than a localized danger, now enveloped the attacker, while the defender, always ready to protect himself by some rough earth or stone-work, was enabled, because of the rapidity of rifle fire, to use extensions unheard of in former battles, and in consequence overlap every frontal infantry attack. Thus, at the battle of the Modder River, the Boers extended 3,000 men on a frontage of 7,700 yards; at Magersfontein, 5,000 on 11,000; and at Colenso, 4,500 on 13,000. Yet in spite of this human thinness, these fronts could not be penetrated.14

The empty battlefield had become full reality. “In the face of . . . rapid fire from the small-bore magazine rifle . . . no army should have attempted the attack over the open smokeless battlefield”.15

Apart from the purely tactical aspects of the empty battlefield, one must especially consider the psychological implications. To begin with, the accumulation of losses during a short period of time among closely-formed troops has always been morally devastating. However, as Lindenau notes above, this was further compounded by two new factors: the smokeless battlefield and enemy dispersion. A British officer noted that:

the blankness of the battlefield [italics in original] was the most unpleasant element in modern offensive warfare. One experiences the feeling, by reason of the distant ranges at which firing commences, of being opposed to an invisible foe, against which one has scarcely a single weapon to hand. And if one does make use of one’s rifle at long ranges, one is shooting more or less by guesswork. But the defender may fire, as soon as he sees anyone getting up and moving forward, without being visible himself. At every forward rush the losses become...
heavier. And soon the moment arrives when any further movement, whether it be forwards or sideways, or backwards, becomes an impossibility.\textsuperscript{35}

We noted earlier how the density of target arrays, ceteris paribus, gives rise to proportionally higher losses. This fact when considered in relation to moral cohesion is important to understanding the theory of the empty battlefield:

A dense firing line suffers critical losses, as already pointed out, in proportion to the density of the space occupied. For example, suppose a dense line, in a given space, contains 140 men; a shallow line in the same space would contain 70 men. Of these in a given period of time there would be hit of the former 30; of the latter 20. The moral effect of the greater number of losses is all the more felt by the men who are lying near to one another, than the smaller number of losses in the long line of men lying down at greater intervals.

A really moral disintegration of the troops is therefore easier to bring about when firing against dense shooting lines, in which the losses mount up in a confined space.\textsuperscript{15}

\textbf{Invisibility of the enemy}

Another observer of the Boer War, the French General de Negrier, noted that “the invisibility of the enemy directly affects the morale of the soldier, the sources of his energy and his courage. The soldier who cannot see his enemy, is inclined to see him everywhere. It is but a step from this impression to hesitancy and then to fear”.\textsuperscript{14} In the end it is the destruction of the enemy’s will that causes defeat. The paralysis of will causes physical paralysis: one cannot act without the will to act. Morale then must be viewed as the magnitude of will. It is the unabashed fear of death that corrodes the will: “troops do not retreat because they are unable to maintain themselves owing to their numerical inferiority, but because they fear losses which they would suffer if they advanced further. The determination to conquer has been overcome by the desire to live”.\textsuperscript{16} In battle, as in all human endeavour, it is man who is the final arbiter and it is man himself who unknowingly provided the solution to the empty battlefield. Quite simply, man “decided” to reduce his vulnerability through dispersion in order to save himself from annihilation in combat.

The technological means became available in a relatively short period of time to accomplish this: an effective breech-loading system, a reliable magazine, smokeless powder, and (increasingly for the defender) entrenchments. With the potential for survivability at hand, what was the nature of this decision?

This decision certainly was not wilful and in any case it was made during the heat of battle. Ultimately the technological tools discussed above only provide the means for dispersion, not necessarily absolute survivability. What was to prevent a commander from maintaining his forces in combat until they had sustained casualty rates similar to those incurred during previous periods of military history?

In fact commanders of the period were exhorted, in light of the new improved technology, to maximise the added lethality of these improvements rather than to maximise the survivability that they presented. In reviewing the infantry regulations of several national armies, an American infantry officer noted in 1909: “The point to be observed is clear. When struggling for supremacy of fire, the line must be maintained at not less than one man per yard and the losses must be accepted. It is as Napoleon said, ‘One cannot make an omelette without breaking eggs’” [Italics in the original].\textsuperscript{36}

\textbf{Tactical formations}

It must be remembered that the raison d’etre of tactical formations is to maintain troop control for purposes of achieving fire direction and superiority against an enemy force. The use of massed formations also imparts a singular moral advantage to all those who fight in ranks: moral cohesion is greatly strengthened. It was the American military historian and analyst S L A Marshall, echoing Ardant du Picq, who wrote:

I hold it to be one of the simplest truths of war that the thing which enables the infantry soldier to keep going with his weapons is the near presence or the presumed presence of a comrade. The warmth which derives from human companionship is as essential to his employment of the arms with which he fights as is the finger with which he pulls a trigger . . . the other man may be almost beyond hearing or seeing distance, but he must be somewhat within a man’s consciousness or the onset of demoralization is almost immediate and very quickly the mind begins to despair or turns to thoughts of escape . . . It is that way with any fighting man. He is sustained by his fellows primarily and by his weapons secondarily. Having to make a choice in the face of the enemy, he would rather be unarmed and with comrades around him than altogether alone, though possessing the most perfect of quick-firing weapons.\textsuperscript{37}

But in spite of all this it was the soldier’s overwhelming desire to live, above all other considerations, that led to battlefield dispersion by expanding the cohesive proximity of troops, while at the same time reducing fire control and moral cohesion.

\textbf{The fragility of moral threats}

By 1905 the full realisation of the empty battlefield was even more apparent. The ubiquitous De Negrier, referring to the Russo-Japanese War, wrote “that the tactical lessons of the South African War have not only been confirmed, but still more emphasized, principally as regards the great extensions of the fighting front”.\textsuperscript{22} And elsewhere, “invisibility has become an essential condition; this is the dominating fact of the whole war”.\textsuperscript{23} The Russo-Japanese War gave clear indication of the fragility of the moral threads that bind an army together. The proximity of comrades in arms spins the invisible
cohesive threads, but in an ever expanding battlefield these threads are stretched to the breaking point. Once they are snapped, moral disintegration immediately follows. A particularly eloquent portrayal of the moral dynamics of the war was provided by a Russian combat veteran who commanded an infantry company in Manchuria. He wrote that "the first characteristic of the field of battle of today is, that one has to deal with an invisible enemy". Not only does the soldier have to contend with the increase in weapon lethality, he must contend with an invisible enemy without the moral support of his equally invisible comrades. He feels terribly alone. Not only is the battlefield empty, it is psychologically desolate and forlorn. The veteran continues: "This struggle, feeling one way, it may be termed, in the dark, created a painful feeling of uncertainty and distrust". Because of the long ranges at which the engagement began, moral disintegration occurred immediately: "A company begins to suffer from the fire of an enemy at several thousand yards from him, and even when separated from him by heights. Before the men can engage in the fighting... they are already materially and morally weakened. Sometimes they are obliged to remain several hours under this preliminary fire, from which ensues physical and sensible moral depression, even before they take part in the fighting". As the attacker advances further, more losses are incurred and the skirmish lines thin further and the feeling of moral desolation increases. Somewhere to the rear are the supports, perhaps misnomered because they are too far away to provide moral support. And now:

the enemy fire builds up. Its aim becomes truer. The men spread farther from each other, moving individually to whatever cover is nearest or offers the best protection. A few of them fire their pieces... others do nothing. Some fail to act mainly because they are puzzled what to do and their leaders do not tell them; others are wholly unnerved and can neither think nor move in sensible relation to the situation. Such response as the men make to the enemy fire tends mainly to produce greater separation in the elements of the company, thereby intensifying the feeling of isolation and insecurity in its individuals [emphasis added].

In isolation and desolation, the soldier faces the yawning abyss of the empty battlefield; threatening to engulf him in the black jaws of moral destruction. This then is the resolution to the riddle of the empty battlefield. Armies incur fewer casualties in the face of more lethal weapons, because they are unable to sustain themselves psychologically and with sufficient strength of will to continue and press the fight to its ultimate conclusion. Ardant du Picq, writing before the use of smokeless powder, put the matter most succinctly when he asked: "Does war become deadlier with the improvement of weapons? Not at all. Man is capable of standing before a certain amount of terror; beyond that he flees from battle". Specifically moral cohesion, as the unity of will (I), is proportional to the density of troops (D) and the number of leaders (L):

\[ I = mDL \] (3)

Where \( m \) is some constant of proportionality. Thus, for example, one would expect that a machine gun crew would have greater moral cohesion than a squad of infantry, the density per square metre being greater. In his countless after-action interviews during the Second World War, Marshall noted that "men working in groups or in teams do not have the same tendency to default or fire as to single riflemen. This is such a well-fixed principle in human nature that one rarely sees a [machine] gun go out of action simply because the opposing fire is too close".

The close proximity of troops to one another is an important psychological factor contributing to group cohesion in battle. Tactical formations provide such closeness, but one must consider another factor quite apart from morale. As we noted earlier, formations are used primarily to control troops to ensure that maximum combat force is achieved through the projection of firepower. Control ensures that deviation from the object to be attained is minimised and unity of effort is achieved. In a tactical engagement the object sought is the enemy, whose destruction occurs through the instrument of fire action. However:

controlled fire can only be executed when the men are collected into organized tactical groups or massed
bodies... because under an enemy’s fire, one leader alone cannot control a large number of individual men... To get the maximum efficacy of fire a large number of men must be brought into the firing line, and the fire must be concentrated... In obtaining the number of rifles required in the firing line they must not be pushed in without order or organisation, else control will vanish. For this purpose, regular organized units only must be put into the line at a time.20

Whether tacticians throughout history have clearly understood the significance of Du Picq’s and Marshall’s principal of mutual proximity is unclear. It appears that the psychological value of tactical formation was seen simply as an unexpected dividend.

The ever expanding battlefield had a direct influence upon the entire process of troop morale. As troop density decreased, the formations began to lose “the moral feeling of physical support in battle derived from the presence of another soldier”.29 By the time of the Boer War, tactical formations no longer had the moral resiliency of denser formations. Where units can mass to the extent that control, mutual assurance and moral association is achieved, formations will continue to fight and sustain relatively greater losses. The massed attack of Pickett’s charge at Gettysburg leading to a casualty rate of 67 per cent, or the massed attack of the First Newfoundlanders which resulted in the destruction of 91 per cent of the battalion on the first day of the Somme are awesome examples that war fundamentally is a terrible endeavour that is largely possible because of the social nature of man, and a reaffirmation that “friends are dear on the day of battle”.30

To summarise, we recall that with the development of the rifled musket and Minié bullet, battlefield lethality dramatically increased. Concurrently the development of the breechloader, the magazine and smokeless powder created a dynamic that rendered the potential for increased survivability through battlefield dispersion. This potential was exploited to varying degrees during the subsequent course of military history. As units took advantage of the survivability derived from dispersion, the moral cohesion, brought about through the social associations of troops in close physical proximity to one another, was attenuated. Due to the resultant moral and psychological fragility of combat troops, units were unable to maintain the same level of attrition to sustain the intensity of the engagement. At the same time, control and command of the firefight as well as its intensity was also degraded due to the ensuing dispersion. Thus, while weapons became more lethal, casualty rates declined.

3 Dupuy, op cit, p 312.

5 Ibid, p 315.
8 Dupuy, op cit, p 191.
12 Cited in Balck, op cit, p 124.
13 Ibid, p 177.
14 Ibid, p 140.
15 L Lindenau, “What has the Boer War to Teach Us, as Regards Infantry Attack?”, Journal of the Royal United Service Institution, Volume XLVII, p 53.
16 Ibid, p 320.
17 Ibid, p 324.
18 De Negrier, cited in Balck, op cit, p 195.
19 Kuropatkhin-Krahmer, cited ibid, p 191.
23 Ibid, p 805.
26 Marshall, op cit pp 48, 76.
28 Mayne, op cit, pp 543, 406.
29 Marshall, op cit, p 65.
30 Gaelic inscription on Fifty-first Division Memorial at the Somme battlefield.