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Lessons from Afghanistan

Fighting Asymmetric Wars: An Application of Lanchester's Square-Law to Modern Warfare

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He stood upon a little mound,
Cast his lethargic eyes around,
And said beneath his breath:
'Whatever happens, we have got
The Maxim Gun, and they have not.'
(Hilaire Belloc)

The late war in Afghanistan, which may or may not be over, is the most recent example of an asymmetric war between the ostensibly militarily powerful and the ostensibly militarily weak. It's not much different from the colonial wars of one hundred or more years ago. Common sense suggests that in a war where well armed forces face a considerably more weakly- armed enemy, assuming both sides to be equally well trained and motivated, the better-equipped side is bound to be able to make comparatively few men do the job of many. The battlefield productivity of a man armed with a machine gun, for example, is surely greater than that of a man armed with a rifle. From this it is a small step to the sort of optimism Hilaire Belloc showed at the beginning of the last century about the probable outcome of Britain's colonial wars.

At the beginning of the present century, the gap in technical war-making capacity between the leading NATO powers on the one hand and asymmetric opponents, such as the Afghan Taliban, is greater than ever. The present article attempts to show why Belloc's confidence was sometimes misplaced even a hundred years ago and to show that there remain limits to what such technical superiority can achieve, even today.

Battlefield productivity – or the killing power available per unit of armed personnel – may have been important a century ago but it certainly matters even more now. Modern societies can apparently afford relatively few men for the purpose of fighting wars. At one end of the pipeline, we see that the training grounds are not exactly awash with eager recruits (not even in the United States after the outrages of 11 September 2001), and at the other, that there is remarkably low public tolerance of battlefield casualties, even when incurred by professional soldiery. But where the modern society in question goes hand-in-hand with a modern economy, which is nearly always the case, societies that need to be sparing with their manpower can usually be lavish with how well their forces are equipped.

How far manpower may be safely economized on, and under what conditions, and with what consequences, are questions we set out to answer. And the approach taken is consciously after the manner of the great British pioneer of quantitative thinking about war, Frederick Lanchester.[1]

George Orwell said in one of his essays that the mention of the word 'poetry' can clear a crowd faster than a water cannon. One might have the same fears today about the word

* *'Asymmetric' in the title refers to a significant qualitative asymmetry in the technical level of sophistication of the armaments employed by each side.*

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'quantitative'. But the justification for the quantitative approach used here is the same as that given by Lanchester himself almost ninety years ago. Everyone, almost in spite of themselves, is in fact interested in the arithmetic of war. Numbers of casualties inflicted and on whom, and the size of losses sustained, are the staples of all war reporting, debate and discussion, today more so than ever before. This is surely an open invitation to think further about war in a quantitative manner, but an invitation all too rarely taken up.[2]

Lanchester's Square-law

Taking our cue from Lanchester, then, we can begin a productivity calculation for an asymmetric battlefield very simply by supposing that field trials show that a machine gun can account for twenty-five times the number of targets that an ordinary service rifle can take care of in the same interval of time. (The precise figure may in practice be greater or smaller than this example, and the illustration is meant to be symbolic of qualitative differences between how well two sides may be armed.)

It might now be thought that the answer to our question about economizing on manpower is perfectly obvious. Every man with a machine-gun can replace twenty-five who are armed with rifles. But this cannot be true under conditions of aimed fire and counter-fire.

Imagine a symmetric situation with 1000 rifles facing each other within range of aimed fire. Imagine also (this becomes a thought experiment on the part of the reader) the more productive but more casualty-conscious side, with the intention of shifting the balance towards itself, now replacing its 1000 riflemen by 200 machine-gunners. At first sight this would seem hugely to favour the machine-gunners, if each machine gun is as good as twenty-five rifles. But five enemy rifles would have the opportunity to concentrate fire on each machine-gunner, who would last therefore on average only a fifth of the time of each rifleman that he had replaced. This would give him the scope to do only five times the damage (or inflict five times the casualties) of one rifleman instead of twenty-five times. In other words, a force of 1000 rifles would be matched not by a force of 1000/25 = 40 machine gunners, but 1000/5 = 200. This, in fact, is the famous square-law, first put forward by Lanchester in 1914.[3]

It is called the square-law because it suggests that under conditions such as those discussed above, the fighting strength of N effectives is the fighting strength of one, multiplied, not by N, but by N^2.

We can see immediately how the square-law applies to Lanchester's machine-gunner versus riflemen thought experiment. With M of the above machine-gunners matching 1000 riflemen, the square-law says:

$$25 \times M^2 = 1 \times 1000^2$$

but this is exactly equivalent to saying:

$M = 1000/5 = 200$ (the result already found).[4]

Another example of a square-law, but away from the technicalities of warfare and entirely empirical, governs the value of diamonds. The value of a diamond is a quality factor (its 'water'), multiplied not by its weight (in carats) but by the square of its weight. So cutting a heavy stone into two halves to be sold separately would normally fetch *in total* only one half of the amount the original stone would have fetched. Lanchester, thinking of warfare, saw his square-law as the basic reason why commanders should never lightly divide their forces and why they should bear in mind at all times the importance of concentration (he felt it necessary to stress that 'concentration' meant bringing all your available forces into play at the same time on the same objective, not the focusing of mental effort on the part of commanders[5] – the latter is taken for granted).

And as foreshadowed above, the square-law also applies to battlefield casualties. Armed with weapons twenty-five times more deadly than your opponent's still leaves you with a casualty ratio 5 to 1 in your favour rather than the perhaps hoped-for 25 to 1.

Lanchester and Asymmetry

So, on an asymmetric battlefield,[6] translating proving ground productivity of weapons into warlike effectiveness is not as easy as it may seem. But under conditions where fire is not aimed, possibly because the exchanges – whilst still reasonably productive, militarily – take place at too great a range for this to be a practicable matter, the situation

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changes quite fundamentally. With aimed fire now replaced by positional fire, each machine-gunner will on average survive as long as a rifleman would have done, but can himself fill a target position with twenty-five times the weight of lead that a rifleman could manage in the same time, and will produce twenty-five times the casualties. In this case, then, forty machine gunners would be an approximate match for 1000 rifles. Indeed this may be an underestimate, since it assumes that the machine-gunners are spaced or 'extended' within their position as riflemen would be, whereas in fact were the forty to be holding the same position as an equivalent number (1000) of riflemen, they will be more sparsely distributed and hence even less rewarding targets for unaimed fire.[7]

Different audiences will read these lessons differently. In asymmetric warfare, the more weakly-armed but manpower-rich side will manoeuvre to try and have its numbers play to its strengths – that is, it will seek out engagements that permit aimed fire. This will normally mean a preference for daylight, engaging the enemy closely, and a relative absence of cover. For the better-armed but more casualty-conscious side, the reverse applies. In all circumstances, the better-armed but casualty-conscious side can always improve its relative position by withdrawing to longer range and engaging the enemy less closely. Discretion, indeed, becomes the better part of valour; or, an indirect approach makes more sense than a direct one.

In short, Lanchester's message is this: the square-law comes to the fore where aimed fire is paramount and positional fire irrelevant. In such cases numbers tend to matter more than quality – the graph allows the reader to determine how far and in what circumstances. A 16 to 1 proving-ground qualitative superiority matches a 4 to 1 superiority in numbers; or a 10 to 1 proving-ground superiority in weaponry can be matched by an opposing superiority in numbers of just over 3 to 1.

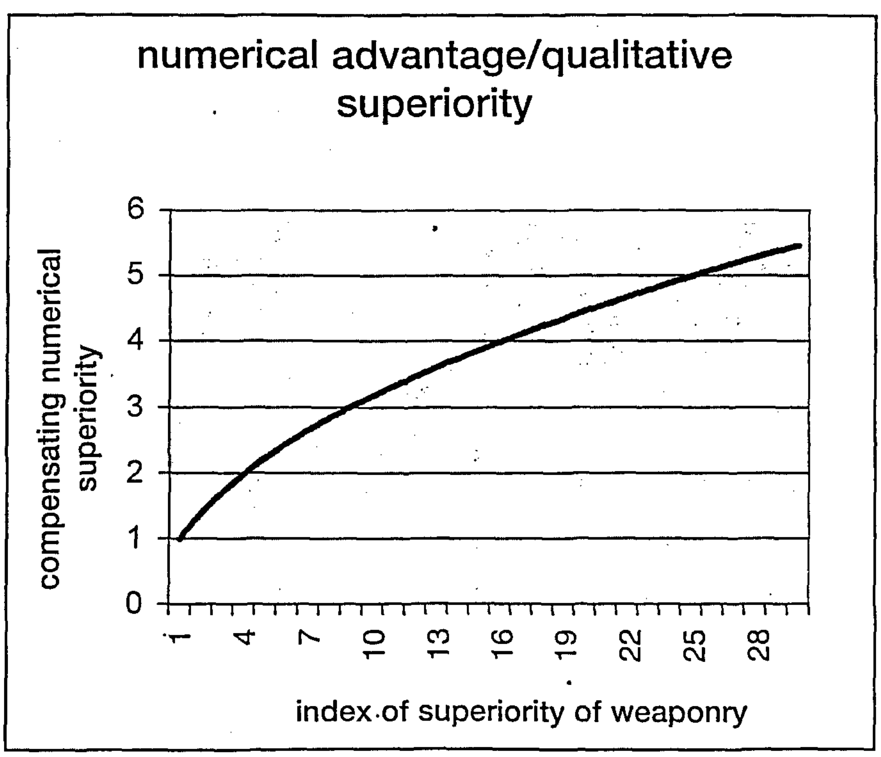
Lanchester was not very confident that the operation of his square-law would ever be clearly seen to operate in land war. The one exception he seems to make to this rule is asymmetric war and in particular the Second Anglo-Boer war. He cites it as a probable instance where British battle-management fell foul of the implications of his square-law.[8] In most complex land wars (e.g., the First World War), by contrast, he felt that both sides would invariably be employing a mixture of aimed and positional fire and that square-law considerations would be diluted in ways that were not very amenable to analysis. Later analysts sympathetic to Lanchester's methods have tended to agree.[9] In addition to asymmetric land war, Lanchester felt that in practice his square-law would normally be seen to its best advantage in symmetric wars at sea and in the air.[10] At sea – and he was thinking of surface engagements – there can be no such thing as positional fire. Everything is, or ought to be, aimed at a specific target. Sea engagements should find the square-law operating with a free rein, such that even a small numerical advantage (whether arising as a result of strategic or tactically achieved numerical superiority), as between comparably well-equipped fleets, would quickly be amplified into a decisively favourable outcome for the larger side. There is ample empirical evidence that naval battles are particularly decisive.[11] Perhaps evidence from war in the air (of which Lanchester at his time of writing had no empirical experience worth speaking of) is not quite so clear-cut.

Turning again to asymmetric land war, it follows that the most difficult kind of opponent for an army sensitive to casualties, but justifiably expecting to enjoy a substantial superiority in the quality of its armaments, is the sort of enemy who offers few or no opportunities to have positional fire used against him. This is almost precisely contrary to what common sense would seem to suggest. If you have more effective weapons than your opponent, Lanchester says you must engage the enemy less closely if you want to make this advantage really tell.[12] Difficulties arise when the enemy is able to deny you this option and force you into the sort of battles where your qualitative superiority counts for least. And it is here where battlefield mobility begins to matter as a means of extricating the qualitatively superior side from unrewarding 'square-law engagements' that may have been thrust upon it, perhaps as a result of ambush.

Implications

The sense in which any of this may turn out to be a problem in an asymmetric war like the one in Afghanistan depends to some extent on how far it has been anticipated. A century ago, as hinted above, the Boer War was the classic case of asymmetric warfare where the better-armed side was caught napping. The original confidence of Whitehall that poorly-armed farmers could be no match for the British army soon drained away. Hilaire Belloc's optimism was small compensation at the time. Actually the Boers did have the Maxim gun too, but not so many; what they certainly did have was a fluid ability to concentrate their forces and to engage the enemy closely whenever the opportunity arose.

The indications so far from the war in Afghanistan are, on the whole, that the lessons of the Boer War – or what comes to the same thing, the implications of Lanchester's square-law – have by now been implicitly or explicitly understood by American and British commanders. To recapitulate, the main point is that technical superiority is not to be risked by engaging with the enemy closely, with aimed fire. Positional fire – with aircraft supplementing long-range artillery, for example – is to be preferred.



But in avoiding one set of pit-falls, new difficulties inevitably present themselves. That the outlines of these difficulties are already beginning to become apparent in Afghanistan is itself the main evidence that the mistakes of the Boer War are not being repeated.

Firstly, sitting as it does at the opposite end of the spectrum from those naval engagements where all fire is aimed, a war marked by reliance on positional fire is correspondingly apt to be very indecisive by comparison. This certainly seems to be true of the war in Afghanistan. The better-armed side seems to be winning (or to have won), but it is difficult to point to an enemy defeat. Secondly, such a war is profligate with munitions (only a small proportion of shot expended will actually hit enemy war-like targets) and hence is an expensive way to fight; but possibly that does not matter when the asymmetry of the contest means one-sided advantage in all resources other than manpower (except that, in coalition warfare, one member of a coalition is always richer than the rest). It is too soon to say for certain if the war has cost a lot; the bills have not yet been presented. Thirdly and most problematic of all, positional as opposed to aimed fire, and not engaging the enemy closely, means far less control over who (or what) may turn out to be the actual target of the fire on any given occasion, whatever may have been the intention. This means greater scope for mistakes, or – to put things more charitably – greater reliance on that ever-scarce commodity, good intelligence. It means

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relatively more casualties as a result of 'friendly fire'. It also means that civilian targets may be more easily mistaken for, or poorly discriminated from, military ones. And the difficulty with this, finally, is that the home populations of the British and American forces, whose intolerance of casualties to their own side has helped propel commanders to choose the tactics discussed in the first place, have also developed an intolerance to the killing of enemy civilians. ■

FOOTNOTES

1. *F.W. Lanchester,* Aircraft in Warfare: The Dawn of the Fourth Arm *(California: Lanchester Press Inc., 1995), originally published in London by* Constable *in 1916.*

2. Ibid., *pp. 53-4.*

3. Ibid., *pp. 46, 73.*

4. *It might be asked how the actual square-law is arrived at as a general proposition. One way is to repeat the thought experiment using a little algebra. Begin with R riflemen opposed to each other in a state of parity. One side – technologically-rich but manpower-poor – replaces its riflemen with M machine-gunners, each machine gun having k times the proving-ground fire-power of the rifle, which we can take to be unity, but leaving the balance of fighting strength between the two sides at parity. But each machine-gunner is now the target on average for not one rifle but R/M rifles, so the nett effectiveness of M machine-gunners is k x M/(R/M) (because he survives now only M/R times as long as the rifleman he replaced). But for parity with the R opposed riflemen, we must have* $1 \times R = k \times M/(R/M)$, *or* $R^2 = kM^2$. *(Strictly speaking, each machine-gunner becomes a target for at least the nearest whole number below R/M riflemen; with some exposed to 1 more than this number). Lanchester's own derivation of the square-law* (Ibid., *p. 55) is more demanding of the reader's mathematics. But he is also responsible for the persuasive original version of the riflemen versus machine-gunner thought experiment* (Ibid., *pp. 57-8).*

5. Ibid., *p. 46.*

6. *For a discussion of symmetry and asymmetry with a bearing on the 2002 war in Afghanistan, see Lawrence Freedman, 'The Third World War?',* Survival *(Vol. 43, No. 4, 2001), pp. 64, 67.*

7. *Lanchester,* op. cit., *pp. 58, 59.*

8. Ibid., *p. 58.*

9. See, *for example, Paul K. Davis,* Aggregation, Disaggregation and the 3:1 Rule in Ground Combat, *MR-638-AF/A/OSD, Rand Corporation, Santa Monica, 1995, and Joshua M. Epstein,* Conventional Force Reductions: A Dynamic Assessment *(Washington, DC: Brookings Institution, 1990).*

10. *Lanchester,* op. cit., *p. 58.*

11. *Jack Hirshleifer, 'The Macrotechnology of Conflict',* Journal of Conflict Resolution *(Vol. 44, No. 6, 2000), p. 786. Hirschleifer cites Trafalgar and Midway as examples of precisely this. We might add Leyte Gulf. Lanchester had trouble persuading some naval doubters of his day that numerical superiority is used to bring the fire of more than one of your own ships onto each of the enemy's. Some professional opinion seemed to think that this would confuse the aim of gunners by depriving them of clear-cut feedback from the fall of shot. Lanchester's retort was to emphasise that some loss of accuracy was a small price to pay for the huge advantage of being able to pit, for example, two ships against one.*

12. *Common sense is even more outraged by the advice the square-law gives to the less well-armed side. 'When faced by a qualitatively superior opponent, engage him as closely as possible'.*