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P2_1 Assault and Battery

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Abstract

This paper aims to calculate the intensity of counter-battery artillery fire required before there is an equivalent explosive yield to the atomic bomb dropped on Hiroshima being fired every minute. This value is found to decrease exponentially as the number of guns in each artillery battery increases, but remains so high that we suggest that tactical nuclear weapons have no practical application as the scenarios in which they become more effective than conventional weapons are ridiculous. Therefore we conclude nuclear weapons are excessive in any battlefield scenario.

Introduction

In military terminology, using artillery to target an enemy artillery unit, or "battery", is called counter-battery fire. If the enemy then returns fire against this with further artillery, this is called counter-counter-battery fire. The number of times "counter" must be said to describe the situation can be described as the intensity of counter-battery fire, which we will allocate the symbol C. This paper aims to explore what intensity of counter-battery fire is required for the initial attackers to be firing an explosive load per minute equivalent to that of the atomic bomb dropped on Hiroshima, as this is a commonly used value for lower-power nuclear bombs. We will use this information to suggest whether situations can realistically arise where conventional explosive artillery is no longer sufficient and tactical nuclear weapons become a more effective option, or if they are more useful as weapons of terror. We will also look at how the number of guns in each battery modifies this conclusion.

For the purpose of this paper, we will assume that the artillery units are equipped with British army 3 inch infantry mortars from the second world war, as data on them is readily available and they are from a comparable era of time to the Hiroshima bomb.

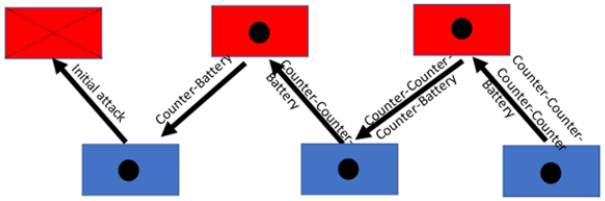

Figure 1: - An illustration of counter-counter-counter-counter-battery fire. Dots indicate artillery, and crosses indicate infantry. Infantry are included here as an initial target for illustrative purposes.

Theory

A single battery of X guns, each firing rounds of explosive yield Y at a rate of R has an explosive yield output of XYR. We will say that the initial attackers have N batteries of artillery, so that side has an output of

$$NXYR. \tag{1}$$

If the explosive yield of the Hiroshima bomb was L, then when firing this yield per minute we can say

$$NXYR = L, \tag{2}$$

which rearranges to give

$$N = \frac{L}{XYR}, \tag{3}$$

where N is the number of batteries needed to achieve the required explosive output per minute. Given that we are looking at the number of batteries on the initial attackers' side, the intensity of counter-battery fire C will be given by

$$C = 2(N - 1). \tag{4}$$

Substituting equation (3) into equation (4) gives

$$C = 2(\frac{L}{XYR} - 1). \tag{5}$$

This equation now expresses the intensity of counter-battery fire in terms of quantities we can determine from research.

Methodology

A British army 3 inch mortar can fire $10lb$ high explosive (HE) rounds at a rate of 10 rounds per minute [1]. Assuming that a HE round is 80% TNT by weight, with the remaining 20% being the casing and propellant, each round has a yield of approximately $3.6kg$ of TNT. The atomic bomb dropped on Hiroshima had a yield of 15 kilotons of TNT [2], which is equivalent to $15 \times 10^6 kg$. Substituting these values into equation (5) gives

$$C = 2 \times (\frac{15 \times 10^6}{X \times 3.6 \times 10} - 1) \tag{6}$$

Discussion

When plotting equation (6) over a range of X values from 1 to 30, the curve shown in figure 2 is created. This shows that as the number of mortars per battery increases the intensity of counter-battery fire required decreases exponentially. However, there are still of the order of 10^4 artillery batteries at the asymptotic tail in order to meet the constraint on the total amount of explosives being fired.

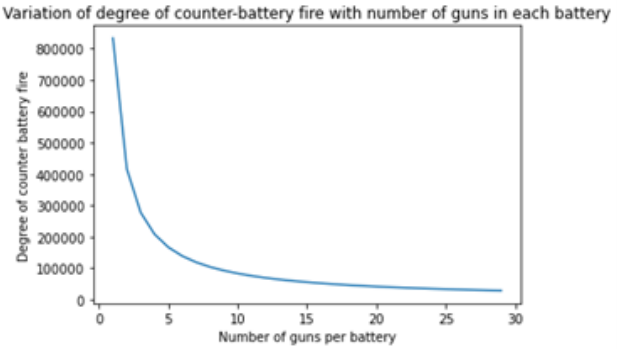

Figure 2: A graph showing the variation of the intensity of counter-battery fire require to be firing an equivalent explosive load to the atomic bomb dropped on Hiroshima every minute with the number of mortars in each artillery battery.

Conclusion

While increasing the number of guns per battery does decrease the intensity of counter-battery fire required to be equivalent to a nuclear bomb every minute, it remains very high, and an unrealistic scenario for a real battlefield. This suggests that tactical nuclear devices would never realistically be necessary on the battlefield, as the situation in which conventional weapons no longer suffice is absurd making nuclear weapons excessive under almost any conditions. Their value is more as a weapon of terror to demoralise and intimidate the enemy. Further work could expand on this by considering that radioactive material from nuclear weapons denies enemy forces access to certain areas, a factor which this paper does not consider.

References

[1] The Encyclopedia of Infantry Weapons of World War II by Ivan V. Hogg, 1977, Bison Books, London, pages 106-107

[2] `https://www.icanw.org/how_destructive_are_today_s_nuclear_weapons#:~:text=The%20two%20nuclear%20weapons%20dropped,20%20kilotons%20of%20dynamite%20respectively`, International Campaign to Abolish Nuclear Weapons (ICAN), accessed 30/9/2022