why do you want to study this topic, what does existing scholarship say about this topic and what gaps are you hoping to fill, and what research questions are you hoping to answer.

Ph.D. Research Proposal Summary

Force Ratios and Relative Combat Power

Gurkan Yesilyurt

**CHAPTER 1: Introduction**

My intention is to work on relative combat power. I will collect information for the designated area wars and I will analyze these big data by the Python programming language which I gathered expertise after my military service, and I will try to reach meaningful conclusions whether our traditional belief of relative combat power 1/3 in order to plan attack operations is right or wrong based on scientific hypothesis testing. These results will be presented by Tableau, another powerful data visualization tool.

Overview of study

Explanation of project background

Briefly focus on primary issues

Why worth to attention

Present: research statement forms of hypothesis, goal statement or project statement

Rs:

* capture both essence and limitations of study
* follwed by clarification on the expected outcomes

Introduction: In the proposal introduction you should provide the following:

Research Questions: Explain the question/problem that the project intends to address to put the project in the proper context. You should develop a thesis statements that concisely sums up the question

Research approach: Explain in general the type of approach you will take and why

Significance: Explain why it is important to address the particular

Objectives: Briefly relate what you hope to accomplish through your research project

**CHAPTER 2**: **Literature Review**

+ Theory about this topic starts with Sun Tzu. He emphasizes “capturing enemy’s army intact rather than destroying”. According to him; “acme of the skill” is not winning 100 victories in 100 battle but to subdue the enemy without fighting.By this way the troops are not worn out. He terms this as the “art of offensive strategy”.

+ From this point Sun Tzu advises force ratios as; when the force ratio is 10:1 surround, 5:1 attack, 2:1 divide, 1:1 engage or elude, if force ratio is less then enemy, capable of withdraw**[[1]](#footnote-1)**.

+ **Clausewitz[[2]](#footnote-2)** refers to force ratio as “superiority of numbers” and he refers this as a most common element in victory. He specifies that it is not force ratio but strategy with deciding; time, place, and the forces of the engagement has considerable influence on engagement’s outcome.

+ Clausewitz emphasizes that if purpose and circumstances of the engagement, and the fighting value of the troops is disregarded, then distinguishing factor in battle will be the “number of troops”. In this understanding he points that “numbers” will determine victory. He further adds that when taking into consideration of circumstances, “superior numbers” may actually be contributing very “little”.

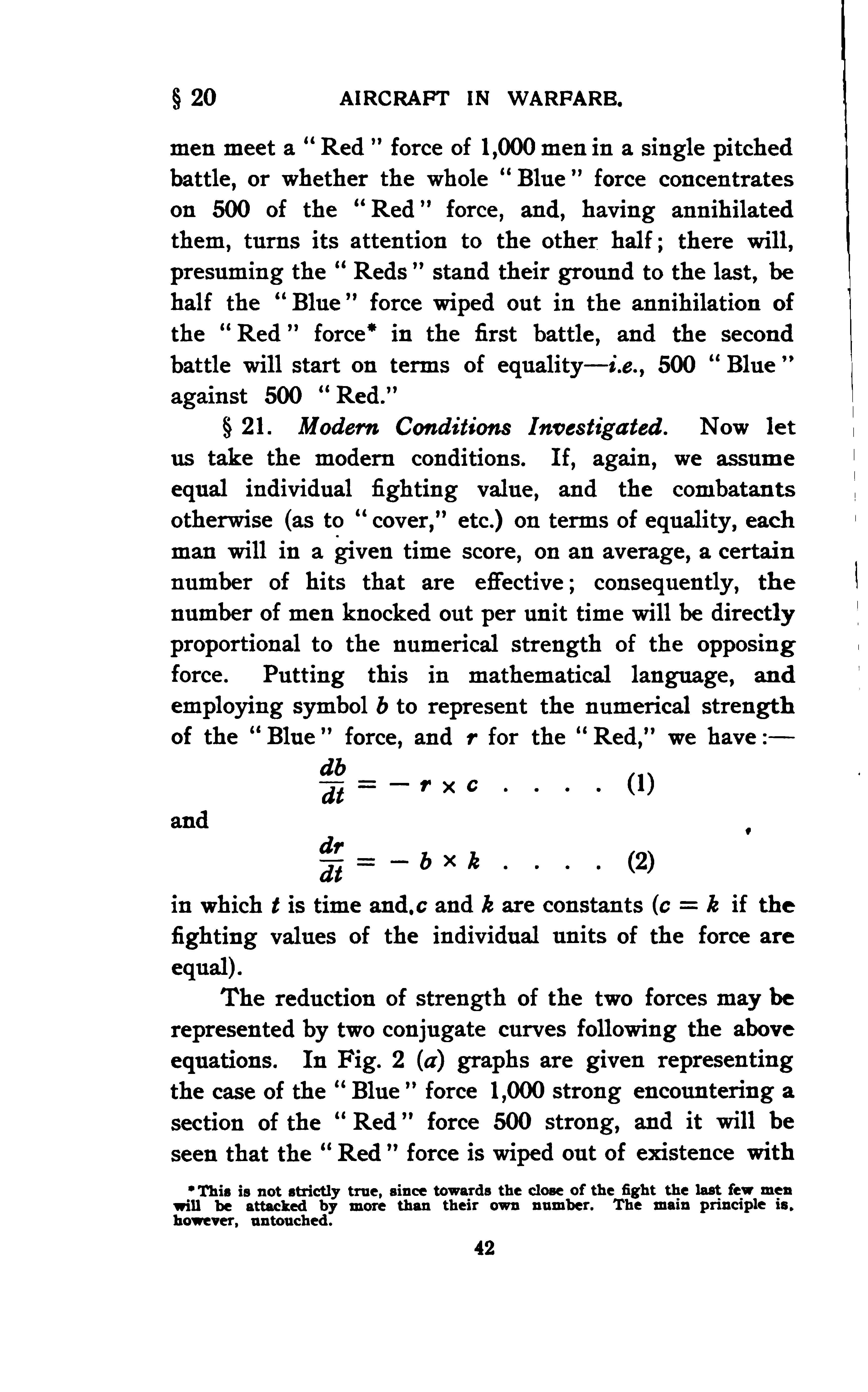
+ After this generalization, Clausewitz further goes and asserts that if superiority reach the point where it is overwhelming, superiority of numbers will be the most important factor in the outcome of an engagement, so long as it is great enough to counterbalance all other contributing circumstances. As a result of this assertion, he points out as a “first principle of strategy”: bringing as many troops as possible at the decisive point.

+ Clausewitz’s methodology on building this theory is “historical examples” (Napoleon and Frederick). He concludes that even the most talented general will find it very difficult to defeat an opponent twice his strength. He says that “when we observe that the skill of the greatest commanders may be counterbalanced by a two-to-one ratio in the fighting forces, in ordinary cases, a significant superiority in numbers (it does not have to be more than double) will suffice to assure victory, however adverse the other circumstances”.

+ **Lanchester** introduced totally new concept on subject with principle of concentration and the N-Square Law[[3]](#footnote-3). He asserts that one of the great questions at the root of all strategy is that of concentration of the main strength of forces, at one point in the field of operations.

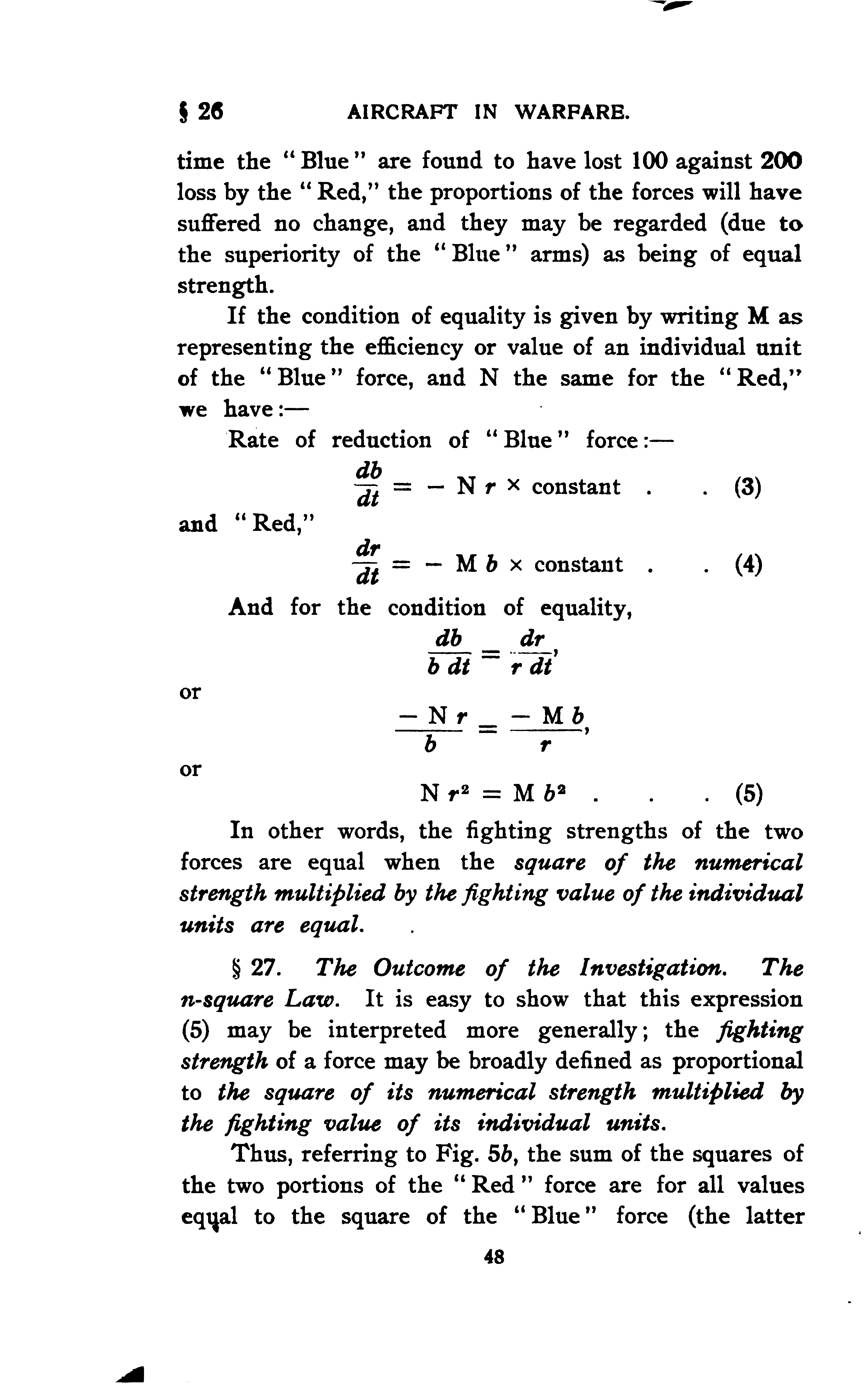
+ According to him in ancient times no matter how much strength strategy brings to the theatre of operations, ultimately men will find only men to wield its weapon. But with modern long-range weapons the concentration of superior numbers gives an immediate superiority in the active combatant ranks.

+ In the modern conditions, the number of men knocked out per unit time will be directly proportional to the numerical strength of the opposing force. He formulates this as:



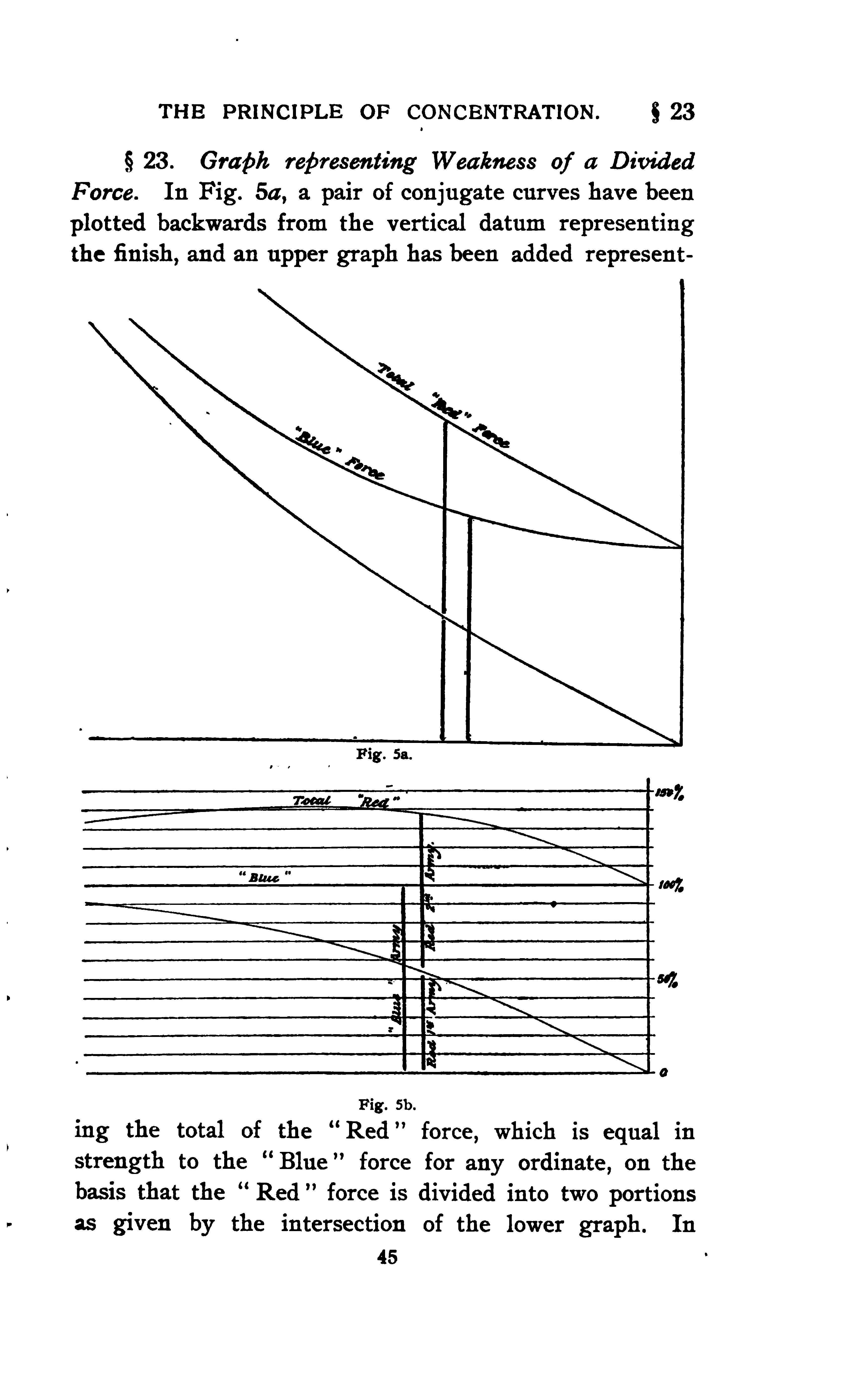
b, r: numerical strength of blue and red, t: time, c & k: constants (c=k if the fighting values of the individual units of the force are equal)

* **Weakness of a Divided Force** (p.43-46)**:** 
  + He gives graphical explanation of “divided forces” weaknesses. He analyses situations and concludes that if a superior strategy compels one part to fight in two parts, results would be like the conditions explained below;
    - In a 1:1 force ratio, one could defeat the divided side,
    - In a 1:1 force ratio without division of forces battle would prolong,
    - In a 1: √2 superior force ratio, if inferior force divides superior one, the battle end with no winner.
* **Validity of Mathematical Treatment** (p.46-47)**:**
  + After analyzing these force ratios, he further asserts that “the direct numerical comparison of the forces engaging in conflict is almost universal”. He further goes and asserts that “counting the pieces as of value, and to deny the more extended application of mathematical theory, is illogical and unintelligent.”
* **Fighting Units not of Equal Strength** (p47)**:**
  + He made these force ratio analyses with the assumption of fighting strengths of two sides are equal. In mathematical terms c=k.
  + At this point he asserts that “this condition is not necessarily fulfilled if the combatants be unequally trained or of different morale or if their weapons are of unequal efficiency.
  + He asserts that while we cannot judge on these two factors but we can calculate weapons efficiency.
* **Influence of efficiency of weapons** (p.48)**:**
  + He asserts that “any difference in the efficiency of weapons may be presented by a disparity in the constants c and k in equations”.
  + With a Blue force of 500 that use rifle and lose 100 man would eventually be equal force of Red with 1000 man that use breech-loader gun with 200 casualties. Here we have different constants and Lanchester shows this again with mathematical equation.

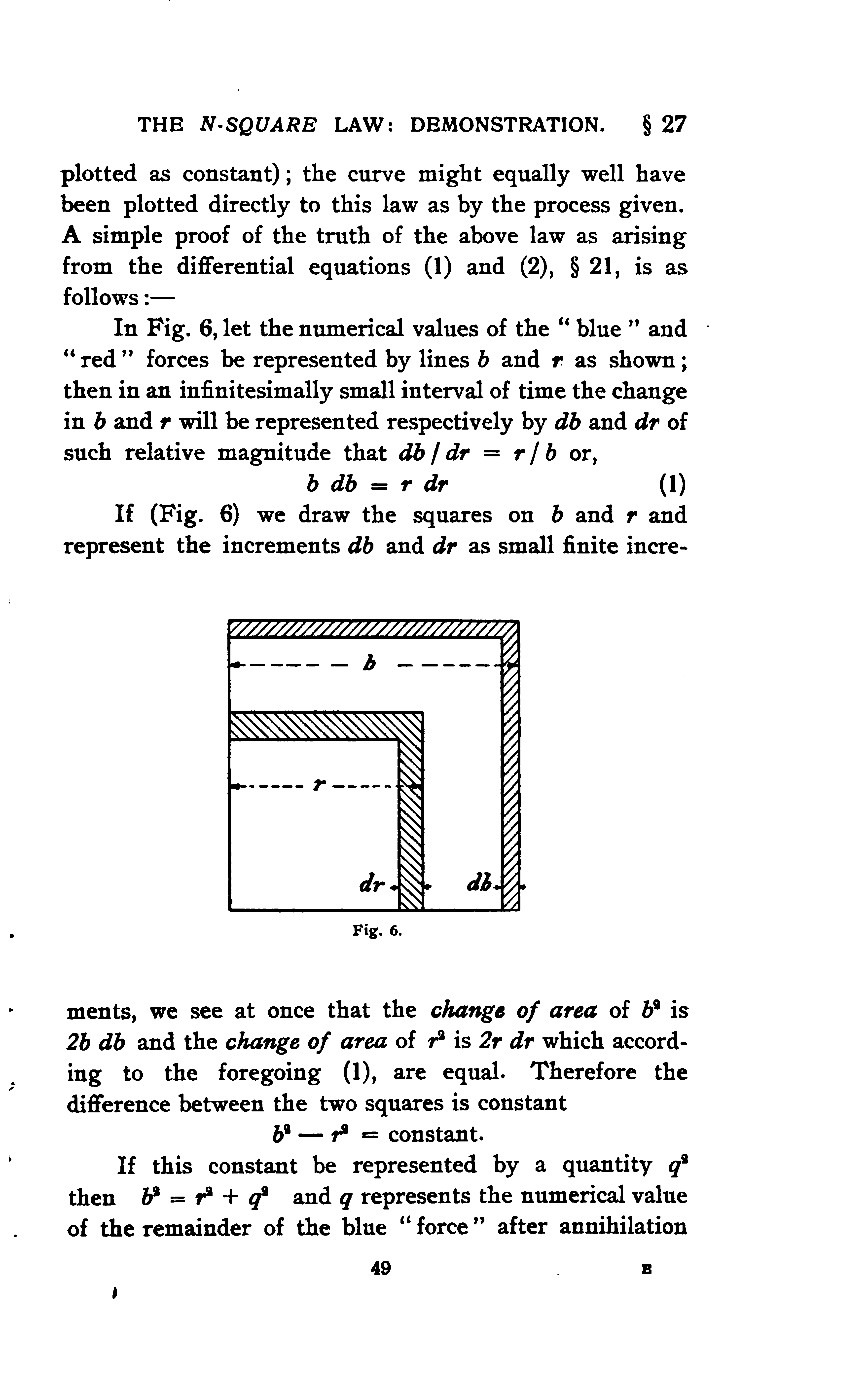


M, N = representing the efficiency or value of an individual unit of Blue, Red Force

* + He explains this formulation as “fighting strengths of the two forces are equal when the square of the numerical strength multiplied by the fighting value of the individual units are equal.
* **Outcome of this investigation: the n-square law and its proof (p.48-50)**
  + Within this law he defines **the fighting strength of a force**: it is proportional to the square of its numerical strength multiplied by the fighting value of its individual units.
  + Thus, (referring to fig. 5b) he made conclusion of divided forces: sum of squares of two portions of the divided forces are for all values equal to the square of the other (not divided) force.

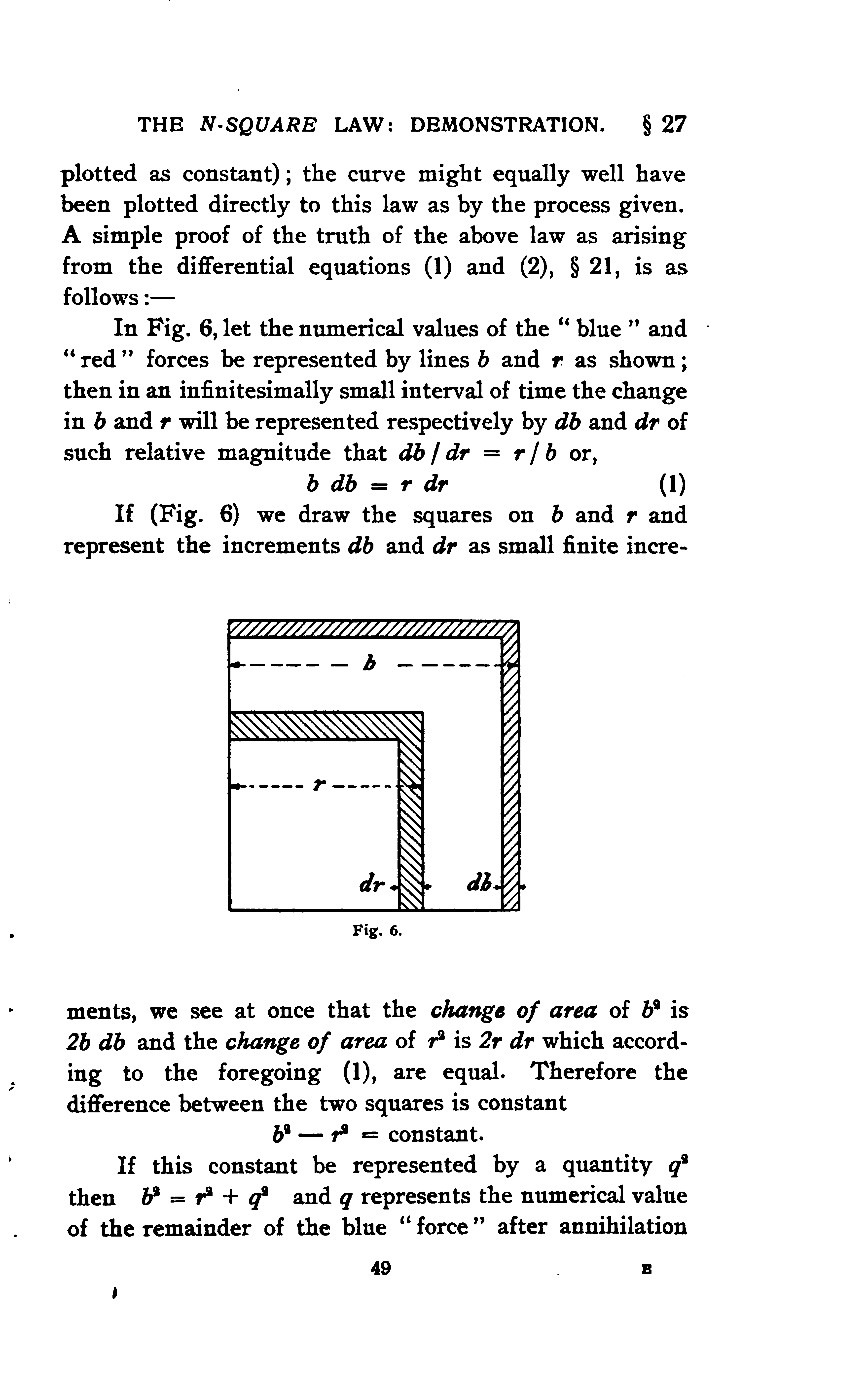


* + **Simple proof of this law arising from equations 1 and 2:** Let the numerical values of the blue and red represented by b and r, then in a small interval of time the change in b and r is represented by db and dr of such relative magnitude that db/dr=r/b or



* + If we draw the squares on b and r and represent the increments db and dr as small finite increments, we see at once that the ***change of area*** of ***b²*** is *2b db*, and ***change of area*** of ***r²*** is *2r dr* which according to foregoing (1), are equal.
  + Therefore, the difference between the two squares is constant. q represents the numerical value of the remainder of the blue force after annihilation of the red.

b²-r² = constant ------> b²-r²=q² ---------> b²=q²+r²



* + Example of this is an army of 50K giving battle in turn to two armies of 40K and 30K respectively, equally well armed; then the strengths are equal, since 50K²=40K²+30K². But if divided force fight in one part then the army of 50K will be overwhelmed.
* **Example involving weapons of different effective value:** 
  + He gave an example with this assumption: 1 man employing machine-gun can punish a target to the same extent in a given time as 16 riflemen. He analyzes number of men armed with machine-gun necessary to replace a battalion (1000 men strong) in the field?
  + From n-square law: **N r² = M b² -🡪 16\*r²=1\*1000²-🡪r²=√1000²/16 = 1000/4=250** or one quarter the number of the opposing force (p.50).
  + According to him this example exhibits at once the utility and weakness of the method. Basic assumption is that the fire of each force is definitely concentrated on the opposing force. Thus, the enemy will concentrate on the 1 machine-gun operator the fire that would otherwise be distributed over four riflemen. And so, on an average he will only last for one quarter the time, and at 16 times the efficiency during his short life he will only be able to do the work of 4 riflemen in lieu of 16 (p.51).
  + When, on the other hand, the circumstances are such to preclude the possibility of such concentration the value of the individual machine-gun operator becomes 16 riflemen. The same applies when he is opposed by shrapnel fire or any other weapon which is directed at a position rather than individual. So, he concludes that one might pay attention to these variations when assessing the theory (p.51). According to him these variations are less common in naval then in military warfare; the individual unit -the ship- is always the gunner’s mark. He points out that aircraft is more similar to navy ship (p.51).
* **The Hypothesis Varied-modifying initial hypothesis to harmonise with the conditions of long-range fire (p.51-52):** 
  + Assumption: fire concentrated on a certain area known to be held by the enemy, and take this area to be independent of the numerical value of the forces, then, with notation as before, we have;

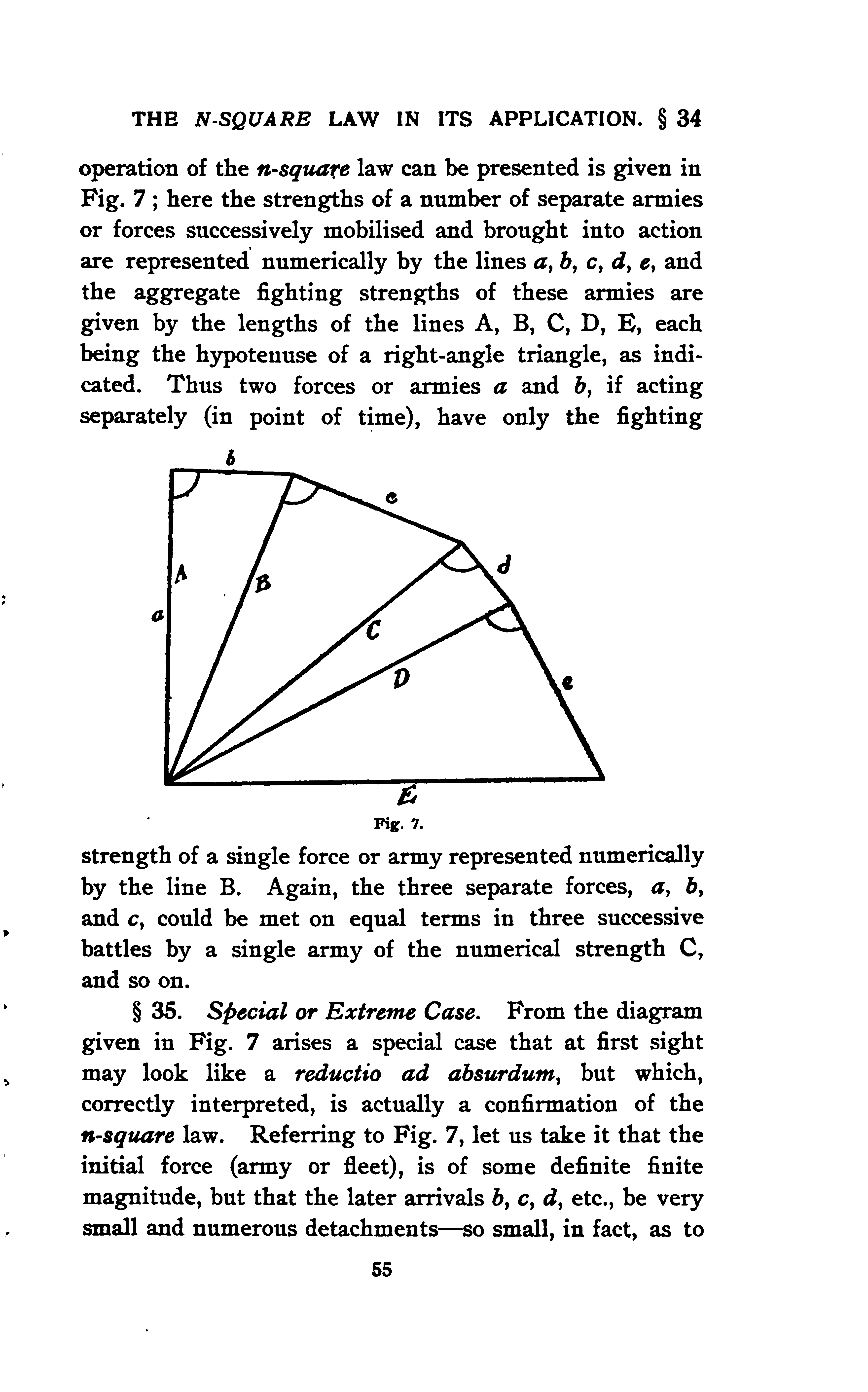
-db/dt = b\*Nr\*constant

-dr/dt = r\*Mb\*constant ----->M db/dt = N dr/dt --->or the rate of loss is independent of the numbers engaged, and is directly as the efficiency of the weapons.

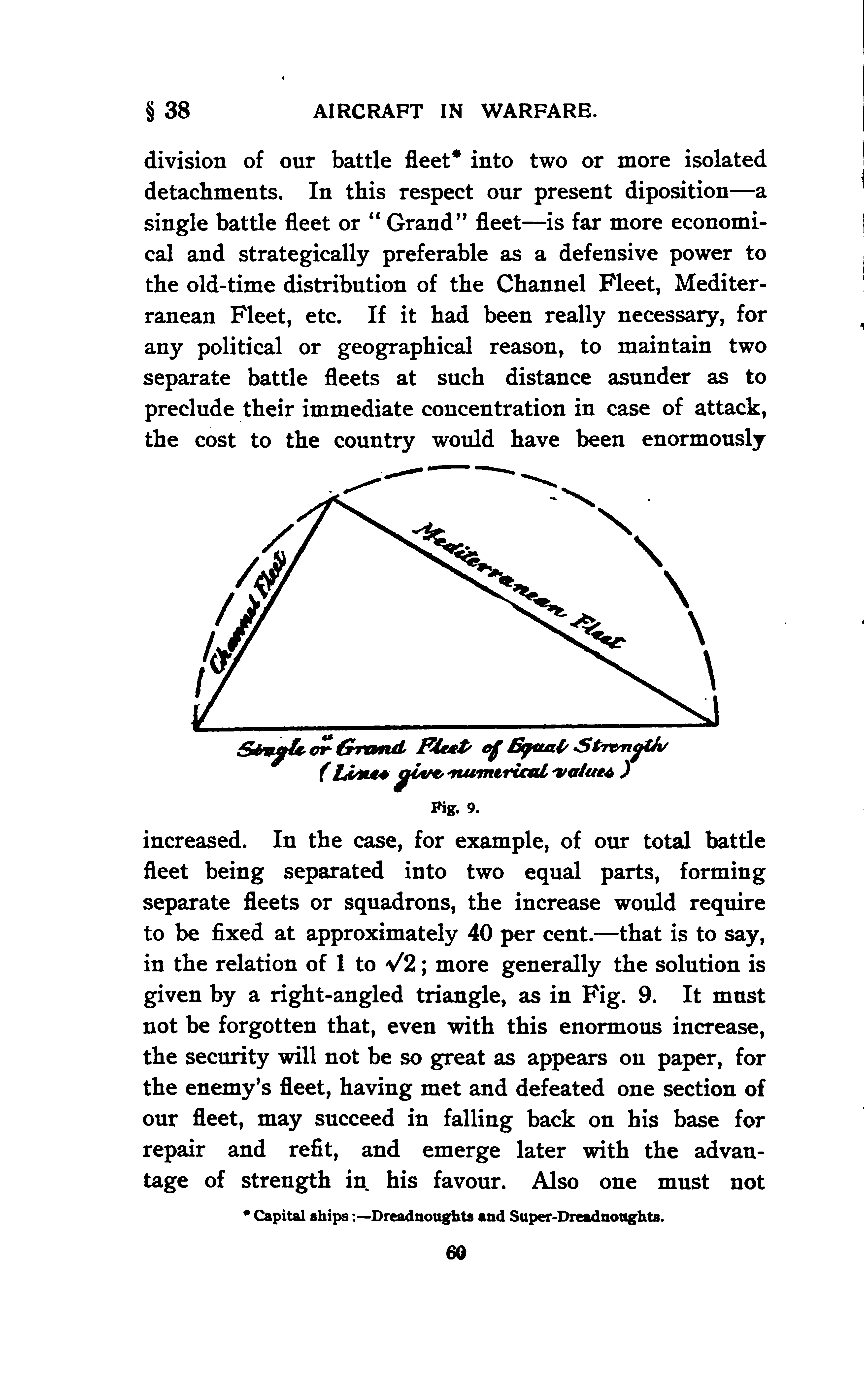
* Under these conditions the fighting strength of the forces is directly proportional to their numerical strength; there is no value in concentration, qua concentration, and the advantage of rapid fire is relatively great. This is more likely to ancient warfare.
* **An Unexpected Deduction (p.52):**
  + Better for numerically superior force to come to close quarters,
  + Blue force of 100 men with machine-gun vs red force of 1000 men with rifle
  + 1st assumption: both forces are spread over a front of given length at long range.
  + Red force loses 16 men to the blue force loss of 1 man. Red lose.
  + If red come closer enough for each individual have mark, red would lose half to come closer, **but would win, by n-square law: 600²\*1>100²\*16**
* **Examples from history (p.53):**
  + Principle: on the field of battle “concentration” matter of the most vital importance.
  + Controlling factors both in strategy and tactic.
  + Attacking of opposing force before concentration gained: defeat of Napoleon in Italy campaign.

**CHAPTER VI: The N-Square Law in its Application**

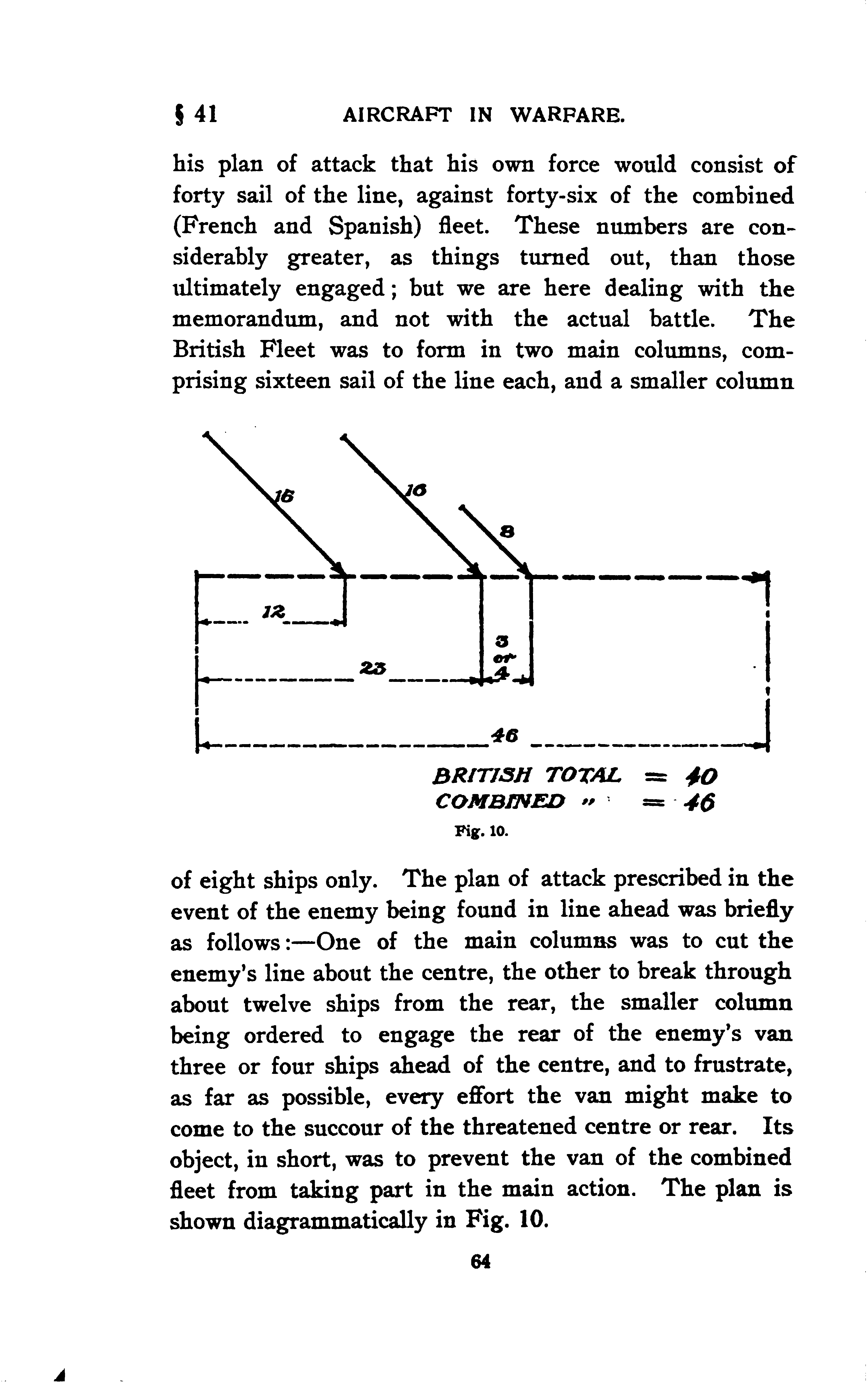
* The N-Square Law in its Application to a Heterogeneous Force (p.54-55):
  + **chapter V summary:** Fighting strength of a force, so far as it depends upon its numerical strength, is best represented by the square of the number of units.
  + Where individual fighting strengths of the component units (land, navy or air) may be different, it has been shown that if a numerical fighting value can be assigned to these units, the **fighting strength of the whole force** is as the square of the number multiplied by their individual strength. Nr²=Mb²
  + Where the component units differ among themselves, as in the case of a fleet that is not homogeneous, the measure of the total of fighting strength of a force will be the ***square of the sum of the square roots of the strengths of its individual units.***
* **Graphical Representation** (p.55)**:** 
  + The strengths of a number of separate armies of forces successively mobilized and brought into action are represented by the lines a,b,c,d,e, and aggregate fighting strength of these armies are given by the lengths of the lines A,B,C,D,E, each being the hypotenuse of a right-angle triangle, as indicated.
  + Thus, two armies a and b, if acting separately (in point of time), have only the fighting strength of a single force or army represented numerically by the line B.



* **N-square law in naval warfare (p.57-58):**
  + N-square law applies to military operations;
    - on land: there may be special conditions to the hypothesis whereby its usage maybe masked.
    - naval warfare: however, the conditions strictly conform to basic assumptions. Thus, when battle fleet meets battle fleet, there is no advantage to the defender analogous to that secured by the entrenchment of infantry.
  + In a naval battle every shot fired is aimed at one enemy’s ship; there is no firing on the mass.
  + Old conditions (1000-yard effective range): advantage could be taken of concentration within limits. 18th century tactics makes it apparent that with any ordinary disparity of numbers (probably in no case exceeding 2 to 1) the effect of concentration must have been not far from that indicated by theory.
  + With a battle-fleet action at the present day the conditions are still more favorable to the weight of numbers, since with the modern battle range-some 4 to 5 miles- there is virtually no limit to the degree of concentration of fire.
  + Further than this, there is in modern naval warfare practically no chance of coming to close quarters in ship-to-ship combats, as in old days.
  + Thus, the conditions are to-day almost ideal from the point of theoretical treatment. Numerical superiority of ships of individually equal strength will mean definitely that the inferior fleet at the outset has to face the full fire of the superior.
  + The same observations will probably be found to apply to aerial warfare when air fleets engage in conflicts, more especially so in view of the fact that aeroplane in three dimensions of space instead of being limited to two, as in the case with the battleship. This will mean that even with weapons of moderate range the degree of fire concentration possible will be very great.
* **Individual value of Ships or Units (p.59):** 
  + Deciding the value of individual units is difficult.
  + Fighting value of ship depends not only to armament but also to protective armor. Question of fleet strength can never be reduced quite a matter of simple arithmetic.
  + May be gauged by the weight of its “broadside” or more accurately, taking into account the speed with which the different guns can be served, by the weight of shot that can be thrown per minute.
  + Another basis may to compare energy per minute for *broadside fire*, which represents, the horsepower of the ship as a fighting machine.
  + Similar means of comparison for aeroplane, though it may be that the *downward fire* capacity will be regarded as of vital importance.
* **Applications of the n-square Law (p.59-61):**
  + The **n-square law** tells us at once the price or penalty that must be paid if elementary principles are outraged by the division of battle fleet into two or more isolated detachments.
  + If battle fleet separated into 2 equal parts, increase would require to be fixed at approximately %40 percent – that is to say, in relation of 1 to √2; more generally the solution is given by a right-angled triangle.



* **British Naval Tactics in 1805 (p.62):**
  + Not form in a line-of-battle parallel to the combined fleet
  + Break the line, envelop rear, overpower with groups of ships, isolate enemy and cut off.
  + First tactics according to Lancaster, advantages of fire concentration.
  + Van cannot help rear
* **Nelson’s Memorandum and Tactical Scheme (p.63, 64):**
  + British formed 2 main columns.
  + One of the main columns was to cut the enemy’s line about the centre,
  + Other to break through about 12 ships from the rear,
  + Smaller column being ordered to engage the rear of the enemy’s van 3 or 4 ships ahead of the centre, and to frustrate, every effort the van might make to help centre or rear.



* **Nelson’s Tactical Scheme Analysed (p.65-66):**
  + Nelson planned to envelop the half of -23 ships- combined fleet with 32 ships. This, according to n² law would give him superiority of fighting strength of almost exactly 2 to 1[[4]](#footnote-4).
  + Strength of British in arbitrary n² units:32²+8²=1088
  + Combined fleet: 23²+23² = 1058
  + British advantage:30, remaining British ship: √30=5.5 ships
  + If they had engaged in older times tactics:
  + strength of combined fleets 46²=2116
  + strength of British fleets: 40²=1600, Balance in favor of combined fleet would be 526, in ship terms √516= 23.
  + Thus, we are led to appreciate the commanding importance of a correct tactical scheme. If old-time method of attack had been adopted, British could not avert defeat.
  + First: Definite statement of cutting the enemy into two equal parts – according to n-square law the exact proportion corresponding to the reduction of his total effective strength to a minimum
  + Second: the selection of a proportion, nearest whole number equivalent to the √2 ratio of theory, required to give a fighting strength equal to tackling the two halves of the enemy on level terms, and the detachment of the remainder, the column of 8 sail, to weaken and impede the leading half of the enemy’s fleet to guarantee the success of the main idea.

**CHAPTER VII: Attack by Aeroplane on Aeroplane. The Fighting Machine and Its Armament**

* **Attack by Aeroplane on Aeroplane (p.67-68):**
  + Lancester emphasize that in the 1St World War period main duty of aeroplane was reconnaissance, but he foresaw that by the next war they will be used to attack each other.
  + He says that, with the technology by this time, it is not easy to attack to aeroplane on the air. So, it is not easy to give casualties to enemy.
* **The Fighting Machine as a Separate Type (p.68-69):**
  + Long distance reconnaissance flights or strategic scout should not be deemed fighters, but tactical scout should be engaged by enemy so it has to defend itself or some other fighters defend scout planes.
  + So, he foresaw need of rendering the tactical reconnaissance type capable of taking the offensive, so that it may establish its ascendency over the similar craft of the enemy.
  + But he emphasizes heavily armed fighting machine will provide air supremacy. Until this time tactical scout is playing double role (recce and fighting).
* **The Question of Armament; Treaty Restrictions (p.70-72):**
  + Int the specification of a fighting type of aeroplane the consideration is means of attack. These fall two main categories:
    - fire-arms (machine-gun, mitrailleuse) and
    - gravitational weapons (bombs, grenades etc.)-ill suited to conditions of aircraft.
  + Light artillery may be mounted, but only the very smallest calibre -namely, the “one pounder” can be considered suitable for present day machines.
  + The use of smaller size of projectiles is prohibited by treaty obligation. Any explosive projectile less than 1 lb. weight (400 gr) is banned by the Declaration of St.Petersbourg of 1868.

**CHAPTER VIII: Rapidity of Fire and Its Measure**

* **Rapidity of Fire and Its Measure (p.77-78):**
  + Index of fighting value: rapidity of gun-fire from aeroplane or dirigible depends on nature of target.
  + Some cases: number of projectiles per minute is most important factor, as, for example, in attacking any object in which hit is hit whether the projectile be large or small.
  + Other cases: where the mischief done is in any reasonable relation to the weight of the projectile, the total weight of projectiles discharged per second affords better criterion.
  + In view of comparatively fragile nature of aircraft, it is doubtful whether the energy equivalent of the discharge will ever be of the importance which it in the case of the battleship, where the destruction of the enemy depends to a very large extent upon the number of foot-tons with which he is assailed.
  + Thus, it is doubtful whether a factor representing the hp of the offensive armament would, as applied to the fighting aeroplane, will have any useful significance.
  + Not probable, fighting machine have complete bullet proof protection, at short range. So unimportant which bullets used in its destruction. Weight and size is only important when a single hit is sufficient to carry away an important structural member which would have been penetrated without great injury by a bullet of ordinary size.
  + So long as we are dealing with ordinary rifle, pistol or mg fire, we are concerned merely with the ***number of bullets that can be discharged per unit time***. This number express **value of armament.**
* **Measure of Fire Value in the case of Explosive Projectiles (p.78-79):**
  + In the context of throwing explosive projectiles, it is impossible to maintain any direct basis of comparison.
  + Effectiveness of the shell fire depends upon the conditions (range must be known, time-fuse mechanism perfect, nature of target).
  + Granted that necessary conditions exists, destruction wrought by any given type of explosive projectile maybe taken as, in a measure, proportional to its weight. However, there are cases where 3 lb. high explosive maybe effective than 18 lb. if hit at the motor.
  + Comparing the relative value of armament of diverse type for aeroplane (mg or small artillery) we need to examine the service for which the armament is required; it is impossible to institute a direct quantitative comparison which would be generally applicable.

Trevor Nevitt Dupuy (May 3, 1916 – June 5, 1995) was a colonel in the United States Army and a noted military historian. Dupuy's main contribution to military operation analysis is the assessment method Quantified Judgment Method or QJM, where the outcome of a battle is predicted using a fairly complicated multiplicative-additive formula in which various factors relating to the strength and firepower of the fighting parties as well as the circumstances are taken into account. Dupuy and his associates adjusted the parameters of his model by using known statistical facts of several recorded battles[[5]](#footnote-5).

The equation to assess combat power is as follows[[6]](#footnote-6): P = S x OE x Q, where:

P = combat power

S = force strength (number and types of weapons plus personnel)

OE = operational environmental factors

Q = quality of troops

Academic Studies:

**Soviet Correlation of Forces and Means:** Quantifying Modern Operations[[7]](#footnote-7):

WOMACK: By the early 1960's, the mathematics of armed conflict was categorized as a branch of Soviet operations research (OR)-- the special science that rationally organizes goal-directed human activity. 3 It appears that original Soviet OR theory borrowed heavily from Western works; specifically, from their

1950's consumption of N. Wiener's Cybernetics or Control and Communications in the Animal World and in Machines and Morse and Kimball's Methods of Operations Research.4 However, their applications of OR theory to the problems of operational and tactical decision-making were unique. One such application was the correlation of forces and means (COFM). The Soviet Dictionary of Military Terms defines correlation of forces and means as p.2-3);

“an objective indicator of combat might/power of opposing sides which makes it possible to determine the degree of superiority of one side over another. This is determined by means of comparing the quantitative and qualitative characteristics of subunits, units, and formations and the armaments of one's own troops (forces) and those of the enemy. ("Correlation of forces and means," Soviet Dictionary of Military Terms, (Moscow: Military Publishing House), 1988, p. 255.)

In his master’s thesis WOMACK is trying to describe how the Soviet COFM methodology is applied in Soviet operational and tactical decision making.

**The Calculus of War:** The Role and Use of Quantitative Decision Aids at the Tactical Level of War[[8]](#footnote-8)

The current command estimate process used by the U.S. Army is largely personality driven. The desires and vision of the commander serve as the primary focus of this process. While this relationship is functional for the U.S.Army, more attention needs to be given to the physical aspects of land warfare - most of which are quantifiable with simple decision aids. The thesis traces the use of quantitative decision aids through history to develop the schools of thought that impact on the issue. It then isolates several different quantitative decision aids, and then uses them in three case studies to demonstrate their utility to the tactical decision maker. Finally, the thesis explores some problems with the current contributions of Operations Research to tactical decision making.

Smith points out that there are two schools of thought--moral and quantitative--are not competitors. They are, in fact. complimentary. The main requirement for the decision maker and leader is to keep them in balance (p.139).

Smith says: If we cannot come to grips about the appropriate balance between the moral and quantitative schools, the Army will never realize its full combat potential. I do not argue for an adoption of a Soviet-style system of norms. Instead, the rational approach is one where the quantitative school builds the unassailable physical foundation upon which the moral school erects the tactical work of art (p.141).

Yigit, having analyzed the Force Ratio concept with the CDB90FT data set, concludes that as a gross measure for campaign planning, FR is useful and stands up quite well under historical scrutiny. As a basis for forecasting battle outcomes, however, it seems to be more probabilistic than deterministic. As such, the FR is less reliable in terms of predicting the battle outcome. He also gives the formula for FR as A/D where A and D is total force strength of the attacker and defender in manpower(p.xii).

After analyzing 660 battles of CDB90FT data set which covers the period of Netherlands War of Independence in 1600 and Israel-Lebenon War in 1982 he concludes that even though it is more probabilistic than other battle outcome predictors, the FR is a valid estimator of battle outcome. His final conclusion is like that: “despite some slight differences among probability of winning values corresponding to specific FR values of the data set, the general trend remains applicable for the overall analysis of the campaigns, emphasizing that the P(Attacker wins given FR) value increases as the FR value increases (p.xv).

CDB90-CAA Database of Battles, Version 1990

**Predicting battle outcomes with classification trees[[9]](#footnote-9):**

COBAN, analyzed the same but updated data set of CDB90G with classification trees. He pre-selected three variables namely Objective, Relative and terrain and weather variables. FR together with, tank, artillery, cavalry ratio is analyzed in Objective Variables (p.xvii).

COBAN concludes that the descriptive statistics reveal that the objective variables are not highly correlated with victory. However, some of the relative variables, such as leadership, have a strong relationship with the battle outcome (p.xvii).

He got this same result when he conducted his first analysis with the model in which only Objective variables are used in classification analysis. Prediction with only Objective variables yielded high misclassification rates. And he concludes as “Objective variables alone are not sufficient to classify battle outcomes”. He tried second model with both Objective and Relative variables. The result classification models have relatively low misclassification rates (p.xvii).

The classification models in Chapter III reveal that the battle outcomes can be predicted by using classification tree models built by with historical combat data(p.93). However, classification models provide information on how the importance of variables changed thorough history and which factors have most affected the battle outcome(p.94).

**An Examination of Force Ratios[[10]](#footnote-10):**

Christian points out in his master’s thesis that US Army is currently undergoing a transition from focusing on counter insurgency operations to large scale combat operations. As it undergoes this transition, the organization should reflect on its current doctrine and the use of heuristics such as force ratios. Therefore, the primary research question asks whether force ratios and quantitative models are valid tools for commanders and planners going forward. The underlying thesis of this study argues that force ratios are invalid and their continued use may develop unwanted mental constraints. By understanding the origins of force ratios and their evolutions, this study identifies a complete lack of consensus about the applicability of force ratios at various levels of war as well as challenges with common planning tools often associated with force ratios (Report Documentation Page).

Christian refers to Force Ratio as “heuristics” (p.1, 2) and points out the most common force ratio as the 3:1 rule, stipulating that success when attacking a prepared defensive position requires an offensive force with three times more troops than the defenders. He also makes reference of USA Army Doctrine (US Army Field Manual 6-0) historical minimum planning ratios as below (p.2):

|  |  |  |
| --- | --- | --- |
| Friendly mission | Position | Friendly:Enemy |
| Delay |  | 1:6 |
| Defend | Prepared or fortified | 1:3 |
| Defend | Hasty | 1:2.5 |
| Attack | Prepared or fortified | 3:1 |
| Attack | Hasty | 2.5:1 |
| Counter-attack | Flank | 1:1 |

**Conclusion (32-34):** Acknowledging the role that chance plays in war, Clausewitz stated that “so-called mathematical, factors never find a firm basis in military calculations.”110 As the modern Army struggles to transition from counter-insurgency to large scale combat operations, it should encourage a debate over its practices, specifically the heuristic approaches that military planners rely on to save time during planning. Despite flaws, the prevalence of force ratios within Army doctrine and culture remains. Force ratios are a derivative of Lanchester’s early work on concentration and attrition but do not account for technological developments and the multiple domains of warfare that make up the modern battlefield. 111

The Army must differentiate force ratios from correlation of forces models. Force ratios should be abandoned as invalid heuristics. Correlation of forces models, with some effort, may provide utility to planners if they can be separated from force ratios and altered to present the results of its comparison in terms of anticipated effects and expenditures. By continuing to present results in the form of a force ratio that is not valid to begin with, the tool will lack utility. If altered, COFMs could be used to identify likely casualty numbers and expenditure rates for ammunition that would be required to achieve a desired effect (both the QJM and the TNDM support such applications).

As Kahneman cautioned, relying on heuristics may lead to prediction errors. Bradley observed this danger, observing that force ratios led commanders to constrain their options when assessing the battlefield. For this and other reasons previously identified, the US Army should abandon force ratios as a planning heuristic. Planners should focus on operational art and achieving surprise to give tactical commanders the best chance at success.

As the Army continues to expand simulations as cost-effective means of training, it should cultivate further debate into the quantitative analysis that they are built on. At a minimum, a renewed debate around force ratios could result in updating, centralizing, and publishing the analysis that goes into calculators such as the correlation of forces models. The debate could also settle on definitions and explanations, informing leaders at all echelons so that they will be better prepared for large-scale combat operations.

Finally, and not addressed previously in this monograph, is the opportunity that the study of force ratios affords the military. Studying other nations’ development and adherence to force ratios, such as Russian doctrine, may provide an advantage in the event of any future conflict. Just as understanding the bias within our own way of thinking and adherence to force ratios is a risk, understanding an adversary’s quantitative or scientific approach to warfare may provide an opportunity.

**Chapter 3 Research Objectives and Methodology**

Detailed account of how you intend to conduct your research.

Discuss equipment, tools, techniques and anything else that will be used in conducting project.

You won’t be expected to know precisely everything involved but you will need to demonstrate that you have given it serious thought.

U.S. Concepts Analysis Agency (CAA): updated version of the historical combat data set[[11]](#footnote-11)

**Chapter 4 Current Work & Initial Results**

**Chapter 5 Work Plan and Potential Implications**

outline of your proposed time frame with specific targets at certain intervals.

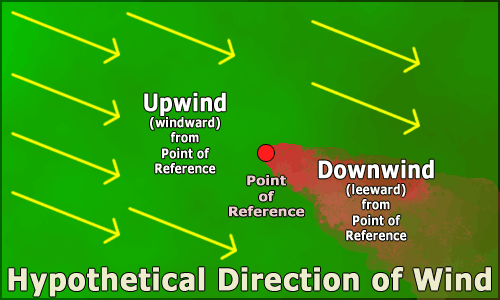
Make sure your proposed time frame fits within the programs schedule to complete a PhD.

This section isn’t always required or may be combined with the methodology section. Check with specific programs for their requirements.

**Chapter 6 Conclusion**

**References**

Bibliography: This is a page of all references that you have used, will use or think you might use in your research project including the literature review. The bibliography will be used to determine if you have a good background in the relevant literature and haven’t overlooked an important source. Use the citation style appropriate for your particular field.



1. TZU, Sun. The Art of War, Translated and with an Introduction by Samuel B.Griffith, Oxford University Press, p.77-80. [↑](#footnote-ref-1)
2. Clausewitz, Carl Von. On War, Edited and Translated by Michael Howard and Peter Paret, Princeton University Press, Princeton, New Jersey, 1984, p. 194-195. [↑](#footnote-ref-2)
3. LANCHESTER, F.W. Aircraft in Warfare, London, 1916, p.39-42. [↑](#footnote-ref-3)
4. Though explanation is given like this: 23\*√2=32.5, means since combined fleet is divided, they need √2 plus force to make equation with the UK fleet. I make this deduction to reach 2/1 force equation: 32²=23²+23², thus in the first battle would be fight with 32²=23² this portion. Equals to 1024 vs 529. [↑](#footnote-ref-4)
5. https://en.wikipedia.org/wiki/Trevor\_N.\_Dupuy [↑](#footnote-ref-5)
6. Dupuy, T.N., Numbers, Predictions & War: The Use of History to Evaluate and Predict the Outcome of Armed Conflict, Hero Books, 1985. [↑](#footnote-ref-6)
7. WOMACK, James K., “Soviet Correlation of Forces and Means: Quantifying Modern Operations”, Master’s Thesis, US Army Command and General Staff College, Fort Leavenworth, KS, 1990. [↑](#footnote-ref-7)
8. SMITH, Kevin B., “The Calculus of War: The Role and Use of Quantitative Decision Aids at the Tactical Level of War”, Master’s Thesis, US Army Command and General Staff College, Fort Leavenworth, KS, 1993. [↑](#footnote-ref-8)
9. COBAN, Muzaffer. “Predicting battle outcomes with classification trees”, Master’s Thesis, Monterey, California. Naval Postgraduate School, 2001. [↑](#footnote-ref-9)
10. CHRISTIAN Jashua T., “An Examination of Force Ratios”, Master’s Thesis, US Army, School of Advanced Military Studies, US Army Command and General Staff College, Fort Leavenworth, KS, 2019. [↑](#footnote-ref-10)
11. Requirements and Resources Directorate, “Combat History Analysis Study Effort (CHASE): Progress Report for the Period August 1984-June 1985,” U.S. Army Concepts Analysis Agency, 1986. [↑](#footnote-ref-11)