**AD-A238 309**

# NAVAL POSTGRADUATE SCHOOL

## Monterey, California

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# THESIS

A THEORY AND MODEL FOR THE
PLANNING OF LAND COMBAT

by

Thomas Joseph Schwartz

September, 1990

Thesis Co-Advisors:                    William J. Caldwell
                                       Laura D. Johnson

91-05149

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security classification of this page

# REPORT DOCUMENTATION PAGE

| 1a Report Security Classification Unclassified | | | 1b Restrictive Markings | | | |
|---|---|---|---|---|---|---|
| 2a Security Classification Authority | | | 3 Distribution/Availability of Report | | | |
| 2b Declassification Downgrading Schedule | | | Approved for public release; distribution is unlimited. | | | |
| 4 Performing Organization Report Number(s) | | | 5 Monitoring Organization Report Number(s) | | | |
| 6a Name of Performing Organization<br>Naval Postgraduate School | 6b Office Symbol<br>(If applicable) OR | | 7a Name of Monitoring Organization<br>Naval Postgraduate School | | | |
| 6c Address (city, state, and ZIP code)<br>Monterey, CA 93943-5000 | | | 7b Address (city, state, and ZIP code)<br>Monterey, CA 93943-5000 | | | |
| 8a Name of Funding/Sponsoring Organization | 8b Office Symbol<br>(If applicable) | | 9 Procurement Instrument Identification Number | | | |
| 8c Address (city, state, and ZIP code) | | | 10 Source of Funding Numbers | | | |
| | | | Program Element No | Project No | Task No | Work Unit Accession No |
| 11 Title (Include security classification) A THEORY AND MODEL FOR THE PLANNING OF LAND COMBAT (Unclassified) | | | | | | |
| 12 Personal Author(s) Thomas Joseph Schwartz | | | | | | |
| 13a Type of Report<br>Master's Thesis | 13b Time Covered<br>From      To | | 14 Date of Report (year, month, day)<br>September 1990 | | 15 Page Count<br>64 | |
| 16 Supplementary Notation The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. | | | | | | |

| 17 Cosati Codes | | | 18 Subject Terms (continue on reverse if necessary and identify by block number) |
|---|---|---|---|
| Field | Group | Subgroup | land warfare, military planning, military science, theory of combat, categorical modeling, multivariate analysis |
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19 Abstract (continue on reverse if necessary and identify by block number)

Planning land combat operations requires a method of evaluation to determine the strengths and weaknesses of the various possible courses of action. The principal means of evaluating these courses of action is wargaming. Some research indicates that planning efforts lack a coherent set of wargaming rules and principles that are widely accepted and understood by military professionals. This thesis develops a theory of combat for use by military professionals in the planning of land combat. The theory provides a method for evaluating alternative courses of action at the brigade through corps level that can be easily applied. The theory is based on the analysis and modeling of categorical data from the U.S. Army Concepts Analysis Agency's Benchmark database. The database includes 260 combined arms battles from the period 1937 through 1982. Loglinear models provide maximum likelihood estimates of the probability of an attack's success. The principle of falsification is explained and used to validate the theory using the historical data. Applications of the theory and model to the planning of land combat are discussed and areas for further research are outlined.

| 20 Distribution Availability of Abstract<br>☒ unclassified unlimited    ☐ same as report    ☐ DTIC users | 21 Abstract Security Classification<br>Unclassified | |
|---|---|---|
| 22a Name of Responsible Individual<br>William J. Caldwell | 22b Telephone (Include Area code)<br>(408) 646-3452 | 22c Office Symbol<br>OR/Cw |

DD FORM 1473,84 MAR        83 APR edition may be used until exhausted        security classification of this page
All other editions are obsolete

A Theory and Model for the
Planning of Land Combat

by

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Captain, United States Army
B.S., United States Military Academy, 1981

Submitted in partial fulfillment of the
requirements for the degree of

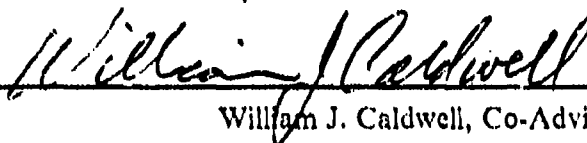## MASTER OF SCIENCE IN OPERATIONS RESEARCH

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NAVAL POSTGRADUATE SCHOOL
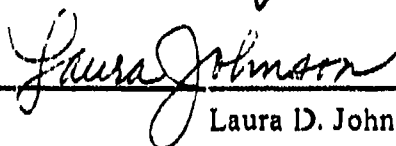September 1990

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# ABSTRACT

Planning land combat operations requires a method of evaluation to determine the strengths and weaknesses of the various possible courses of action. The principal means of evaluating these courses of action is wargaming. Some research indicates that planning efforts lack a coherent set of wargaming rules and principles that are widely accepted and understood by military professionals. This thesis develops a theory of combat for use by military professionals in the planning of land combat. The theory provides a method for evaluating alternative courses of action at the brigade through corps level that can be easily applied. The theory is based on the analysis and modeling of categorical data from the U.S. Army Concepts Analysis Agency's Benchmark database. The database includes 260 combined arms battles from the period 1937 through 1982. Loglinear models provide maximum likelihood estimates of the probability of an attack's success. The principle of falsification is explained and used to validate the theory using the historical data. Applications of the theory and model to the planning of land combat are discussed and areas for further research are outlined.

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# I. INTRODUCTION

## A. THE COMMAND ESTIMATE

The process of making an estimate, or estimating the situation, has always been an integral part of military planning. Sun Tzu, a Chinese general wrote about 500 B.C. in *The Art of War* :

> Now if estimates made in the temple before hostilities indicate victory it is because calculations show one's strength to be superior to that of his enemy; if they indicate defeat, it is because calculations show that one is inferior. With many calculations, one can win; with few one cannot. How much less chance of victory has one who makes none at all! By this means I examine the situation and the outcome will be clearly apparent. [Ref. 1: p.71]

The recommended command estimate process for the development of estimates in the United States Army is stated in *Field Manual 101-5, Staff Organization and Operations*, and Command and General Staff College *Student Text 100-9, The Command Estimate*. The command estimate process is outlined in Figure 1 on page 2. Alternative courses of action are formulated during this process. These alternative courses of action must be compared with each other using criteria set by the commander to determine which will be adopted. These criteria may include, for example, minimizing friendly casualties and equipment losses, adherence to certain doctrinal concepts (e.g. principles of war, Airland Battle doctrine), or the development of an acceptable force ratio. The focus of this thesis is to compare these courses of action based on a quantitative evaluation of the relative probability of success of each one as estimated from the historical data.

Research in the course of action analysis process is ongoing at the Army Research Institute (ARI) Fort Leavenworth Field Unit. The following statements characterize the preliminary results. First, the process as outlined in *ST 100-9* is not being used in observed staff planning situations [Ref. 2: p. 1]. *ST 100-9, The Command Estimate*, is the instructional text used to instruct future general staff officers in the application of the command estimate process, and is also intended for use as a reference by units in the field. In a number of observed battalion and division level command post exercises only one course of action was generated and all efforts were focused on the development of the plan for that course of action. Notable weaknesses discussed in the published report included the comparison of the alternative courses of action, and in particular, that there is no recommended means of predicting battle outcomes [Ref. 3: p. 8]. The few tables

RECEIVE THE MISSION

LIST FACTS AND ASSUMPTIONS

ANALYZE THE MISSION

RECEIVE THE COMMANDER'S GUIDANCE

DEVELOP COURSES OF ACTION

ANALYZE COURSES OF ACTION

RECOMMENDATION/DECISION

ACTIONS AND ORDERS

SUPERVISION

**Figure 1.  The Command Estimate Process**

that are provided in *ST 100-9* enable the user to compute a force ratio but give no estimate of the chance of a successful battle outcome. The same observation is made by the Center for Army Tactics, the author of *ST 100-9*, in a memorandum addressing priorities for the development of automated staff planning aids [Ref. 4: pp. 24 and 37].

A possible reason for staffs not using the command estimate process and in particular, the wargaming of alternative courses of action, is a lack of understanding and confidence in the model itself. There are currently hundreds of combat models and computer simulations that attempt to replicate combat, and we are spending millions annually to develop improved versions of these and new models. J.A. Stockfisch suggests in a 1975 RAND report that a reason for the proliferation of combat models is the degree of immaturity of the study of combat. Immaturity in this context refers to the poor development of the correspondence between theory and reality [Ref. 5: p. 6]. Stockfisch notes that physics is an example of a discipline in which the correspondence between theory and reality is highly developed. Another analogy is particularly

applicable to the analysis of alternative courses of action. A doctor of medicine presumably would not use a laboratory test to diagnose a patient's condition if he did not at least know the reliability of the test. Similarly, a mili~ry professional should not use a method to evaluate alternative courses of action if he does not have confidence in it. Professional military education in the United States Army does not address a theory of combat or combat processes other than the reading of military history for qualitative lessons and insights.

## B. HIERARCHY OF COMBAT AND SCOPE OF THIS THESIS

Before defining the scope of this thesis it is necessary to define combat and the levels of combat that will be addressed. Military combat is the employment of weapons by organized forces with hostile intent for the purpose of protecting, controlling, or seizing territory, people or resources [Ref. 6: p. 64]. This definition will be used wherever combat is discussed.

Within the overall concept of combat there exists a hierarchy of levels of combat. These levels of combat are illustrated in Figure 2 on page 4 and are adapted from Dupuy's *Understanding War--History and Theory of Combat*. Three of these levels of combat are applicable to the theory and model of combat that will be developed here and are further defined [Ref. 6: p. 65] below.

- **Campaign:** A campaign is a series of military operations coordinated in time and space and directed toward a specified strategic objective. Campaigns are usually composed of several battles and may last several weeks to a year.

- **Battle:** A battle is combat between major forces with an operational mission and may last several days to a few weeks.

- **Engagement:** An engagement is combat between forces of company through division strength and is often part of a larger battle. Engagements may last several hours to a few days.

The data that will be used to develop the theory and validate the model consists of campaigns, battles and engagements from the period 1937 to 1982.

There is a division of military theory that will further narrow the scope of this thesis. Military theory, as seen in Figure 3 on page 5 is divided into the philosophy of war and the theory of combat. The philosophy of war deals with the political, economic and social context of warfare and the aims of war detailed by the nation's political leadership. The theory of combat utilizes the expertise of the professional soldier and frames the study of military organizations, operational concepts, and military endeavors. Military strategy, jointly formulated by the political and military leadership, is common to the

```
        LEVEL OF COMBAT                    UNITS INVOLVED

              WAR                          NATIONAL FORCES

           CAMPAIGN                     FIELD ARMY/ARMY GROUP

            BATTLE                     ARMY GROUP/ARMY CORPS

          ENGAGEMENT                    DIVISIONS-COMPANIES

            ACTION                       BATTALIONS-SQUADS

             DUEL                     TWO SYSTEMS/INDIVIDUALS
```

**Figure 2.** Hierarchy of Combat

philosophy of war and the theory of combat, serving as a bridge between the two [Ref. 6: p. 65].

With regard to military expertise and professionalism the following point will be a recurring theme throughout this thesis. Stockfisch in *Models, Data and War: A Critique of the Study of Conventional Forces*, stated:

> There also exists a body of knowledge relevant to military operations, which is possessed by the Officer Corps and is the product of both experience and intensive study. This body of knowledge is often referred to as military judgment. That expression is unfortunate whenever the context suggests that the kind of information it incorporates is either inferior or superior to knowledge that is produced by application of scientific quantitative methodology. Particularly misleading is the idea that knowledge produced by the application of quantitative methodology is objective, whereas military judgment is subjective. Assertions or beliefs along these lines may not even be meaningful hypotheses that can be tested or resolved in any satisfactory way. [Ref. 5: p. 6]

This statement further refines the requirement that the theory and model to be developed be understood by the user, the military professional. Not only must the inputs and

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│                                                             │
│  ┌─────────────────────────┐                                │
│  │  NATIONAL OBJECTIVES    │──┐                             │
│  └─────────────────────────┘  │                             │
│   ┌───────────────────────┐   │                             │
│   │   NATIONAL POLICY     │   │   ┌──────────────────────┐  │
│   └───────────────────────┘   ├───│  PHILOSOPHY OF WAR   │  │
│  ┌─────────────────────────┐  │   └──────────────────────┘  │
│  │  NATIONAL STRATEGY      │  │                             │
│  └─────────────────────────┘  │                             │
│  ┌─────────────────────────┐──┘                             │
│  │  MILITARY STRATEGY      │──┐                             │
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│   │     OPERATIONS        │   │   ┌──────────────────────┐  │
│   └───────────────────────┘   ├───│  THEORY OF COMBAT    │  │
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│   │       TACTICS         │   │                             │
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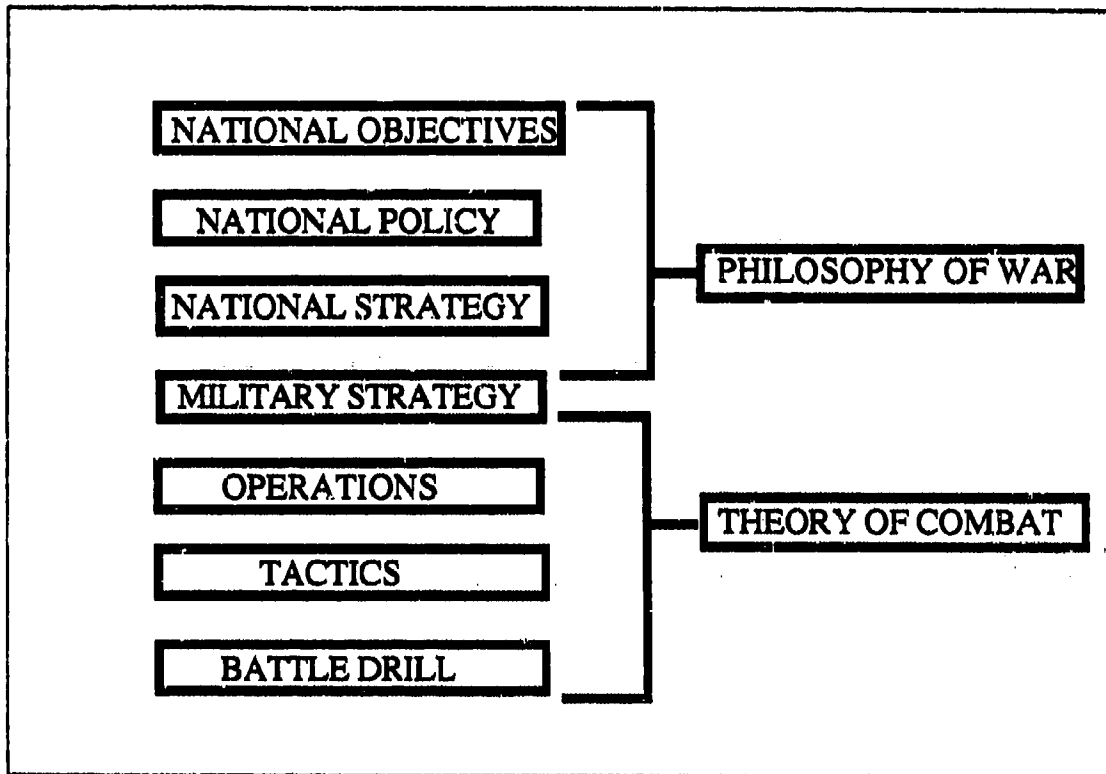
**Figure 3.   Spectrum of Military Theory**

outputs of the model be understandable, but also the relationships must not run counter to military judgment.

## C.  THESIS GOAL AND OUTLINE

The goal of this thesis is to develop a theory for use by military professionals in evaluating alternative courses of action for land combat operations by units at the brigade through corps levels. The theory is intended to be understood by the user, credible by means of historical validation, and easily applied to the planning of land combat operations without need for computational support.

Chapter I has addressed the framework of military planning and the hierarchy of combat. In Chapter II the concept of a theory of combat will be introduced and a theory intended for planning purposes will be detailed. Chapter III will define the assumptions, database and methodology used to analyze the historical data. Validation of the theory from the results of the data analysis will be discussed in Chapter IV.

Chapter V will propose applications of the theory to the planning of land combat operations. The final chapter, Chapter VI, contains concluding remarks and recommendations for further study.

# II.  A THEORY FOR PLANNING LAND COMBAT

## A.  DEVELOPMENT OF A THEORY OF COMBAT

Two sources that establish a need for the development of a theory of combat are Huber, Low, and Taylor in *Some Thoughts on Developing a Theory of Combat* (1979) [Ref.7], and T.N. Dupuy's *Understanding War-History and Theory of Combat* (1987) [Ref.6].  Dupuy defines a theory of combat as *an organization of fundamental laws about combat that explain the interaction of combat forces and processes* [Ref.6: p.79].  Huber, et.al. has the same definition and further defines a law of combat as a "confirmed hypothesis" about combat [Ref.7: p.4,30].  The combat processes that are the subject of the theory of combat and the hypothesized laws of combat may include:

- **Attrition:** the infliction of casualties on an opposing force
- **Manuever:** the movement of forces to gain advantage
- **C3I:** command, control, communications, and intelligence functions of commanders and their staffs
- **Support:** the logistical support of forces in the field

The approaches to developing a theory of combat, that is developing the hypotheses about combat are three:

- **Historical:** based on the analysis of historical data from combat
- **Judgmental:** based on field experiments, exercises and military judgment
- **Operational analysis:** based on physical or formal models

These three approaches are complementary, and an adequate theory may combine these approaches [Ref.7: pp.8-9].  The theory developed here combines these approaches by analyzing historical data and comparing the results with military judgment.

## B.  A THEORY FOR PLANNING LAND COMBAT

The following statements are the hypotheses about combat that will compose the theory for the planning of land combat in this thesis.  These hypotheses will then be tested using the statistical methodology discussed in the next chapter.

### 1.  Superior Combat Power Wins

The statement that superior combat power wins on the battlefield may be an obvious one, but the measurement of combat power is a subject of considerable

discussion. The Army's principal doctrinal manual, *FM 100-5, Operations* , has this to say about combat power:

> The dynamics of combat power decide the outcome of campaigns, major operations, battles and engagements. Combat power is the ability to fight. It measures the effect created by combining manuever, firepower, protection and leadership in combat actions against an enemy in war. [Ref.8: p.11]

It is traditionally thought that a three to one superiority in combat power, measured by some kind of force ratio, is required for an attack to succeed [Ref.9]. This thesis attempts to develop a statistically significant measure of combat power for use in the planning of operations. The measures of combat power that will be considered include the ratios of attacking to defending troops, attacking to defending artillery pieces and attacking to defending tanks, and combinations of these three.

### 2. The Law of Diminishing Returns/Economy of Force

While superior combat power may win battles, at some level of combat power the "marginal value of an increment of combat power is less than the marginal value of the incremental results achieved." [Ref.7: p.125] The hypothesis to be tested is that as combat power is increased at a constant rate, the likelihood of an attack's success will increase more rapidly than combat power to a certain point, after which the rate of increase will be less than the rate at which combat power is increased. This effect, if present, would support the military principle of economy of force, which is "Allocate minimum essential combat power to secondary efforts." [Ref.8: p.175]

### 3. Combat Multipliers: Terrain, Posture and Surprise

A combat multiplier is a factor that increases the combat power of one side relative to the other. This theory hypothesizes that the terrain on which the battle is fought, the posture of the defending force, and whether or not the attacking force achieves surprise are combat multipliers.

The defender has an advantage in that he usually chooses the terrain on which the battle will be fought.

> Terrain forms the natural structure of the battlefield. Commanders must recognize its limitations and possibilities and use it to protect friendly operations and to put the enemy at a disadvantage. [Ref.8: p.76]

Terrain is categorized as flat, rolling or rugged in these data.

The defender's posture refers to the amount of preparation that he makes of his position and the level of resistance that he offers the attacker.

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The defender arrives in the battle area before the attacker. He must take advantage of his early occupation of the area by making the most thorough preparations for combat as time allows. [Ref.8: p.132]

Classifications of the defender's posture will be discussed with the database in Chapter III.

Surprise is a characteristic of combat that is difficult to achieve for either side but may have decisive results.

Surprise is important at the operational and tactical levels for it can decisively affect the outcome of battles. With surprise, success out of proportion to the effort expended may be obtained. Surprise results from going against an enemy at a time and/or place or in a manner for which he is unprepared. It is not essential that the enemy be taken unaware, but only that he become aware too late to react effectively. Factors contributing to surprise include speed and alacrity, employment of unexpected factors, effective intelligence, deception operations of all kinds, variations of tactics and methods of operation, and operations security. [Ref.8: p.176]

The hypotheses that surprise, posture and terrain affect battle outcomes will be tested.

## C. SUMMARY

We have defined a theory of combat as an organization of fundamental laws about combat that explain the interaction of combat forces and processes. These laws, or confirmed hypotheses, may be developed using analysis of historical data, experiments, exercises and military judgment, and physical or formal models. Three hypotheses have been proposed for inclusion into a theory of combat. They are, first, that superior combat power wins on the battlefield; second, that the law of diminishing returns applies to combat power; and finally, that terrain, defender posture, and surprise have a multiplicative effect on combat power. These hypotheses will be examined using the methodology discussed in Chapter III.

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# III. METHODOLOGY

## A. THE BENCHMARK DATABASE

The data used for this thesis were assembled for the U.S. Army Concepts Analysis Agency and is contained in its research paper *Historical Characteristics of Combat for Vargames (Benchmarks)*, written by Robert McQuie [Ref. 10]. These data, from now on referred to as the Benchmark database, contain information on 260 combined arms battles from the period 1937 through 1982. Forty-five characteristics or data elements are listed in the database for each battle. The locations, time periods and numbers of battles in the database are listed in Table 1 on page 11. It should be noted, however, that approximately one-fifth of the data elements in the database are empty. This is due to the loss of records in war, inaccuracies and contradictions in historical records. Fortunately, the missing data elements are scattered about the data in a fairly random manner. The observations were censored if they contained a missing value for a variable that was to be analyzed. Even with this censoring, the smallest number of battles that were used in an analysis was 243. This means that the maximum number of censored observations was 17, less than seven percent of the total. The reliability of the available data has been checked, as noted in McQuie's report, with the most reliable data being that from battles in Western Europe and Italy, and the least reliable being that from the Korean War. The reliability of the remaining data falls between these two. [Ref.10: pp.4-8] An extract of the data from this database is given in Appendix B, and includes all of the data values and characteristics used in this report.

**Table 1. LOCATION OF BATTLES-BENCHMARK DATABASE**

| Location | Number of battles |
|---|---|
| West Europe (1940) | 5 |
| East Asia (1938-45) | 6 |
| East Europe (1939-42) | 4 |
| North Africa (1943) | 8 |
| Italy (1943-44) | 64 |
| East Europe (1943-45) | 28 |
| West Europe (1944) | 25 |
| West Pacific (1944-45) | 32 |
| Korea (1950) | 11 |
| Israel (1948) | 9 |
| Israel (1956) | 4 |
| Israel (1967) | 22 |
| Israel (1973) | 33 |
| Other locations | 9 |

The **Benchmark** database is particularly suited to the development of a theory of combat for planning purposes. While discussing the available data about combat and its uses, Taylor stated "the available real combat data does not support verification of detailed combat models, but it only supports such investigations of relatively simple aggregated large-units models." [Ref.7: p.34] This purpose is consistent with the models that are developed as a result of this research.

A number of military terms are used to characterize the battle conditions in the **Benchmark** database. The most frequently used terms are given below to facilitate understanding of the theory and model. The definitions are taken from the glossary of the **Benchmark** report to insure consistency in the interpretation of the data and models [Ref.10: p.B-1].

- **Success.** The resolution of the combat in favor of one side or the other, considering how well each force accomplished its' mission. In some battles, neither force or both forces have been successful.

- **Surprise.** Surprise occurs when one force is able to confront its opponent with tactical circumstances that the opponent did not anticipate or adequately prepare

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for. Surprise may be achieved with respect to time, location, manuever or firepower.

- **Terrain.** The total topography of the battlefield as described in the sources; categorized as rough, rolling or flat.

The defender's posture has five different categorizations that are defined as follows:

- **Delay.** A retrograde movement in which the defender slows down and damages an advancing enemy to gain time, but does not beome decisively engaged in combat or allow himself to be outflanked.

- **Fortified defense.** A coordinated defense system prepared with sufficient time and material to complete planned entrenchments, field fortifications, and obstacles.

- **Hasty defense.** A defense normally organized while in contact with the enemy or when contact is imminent and time for battle preparation is limited. It involves the use of foxholes, emplacements and obstacles. With enough time, usually taken to be one day, a hasty defensive position can be improved to a prepared or fortified defense.

- **Prepared defense.** A defense prepared with time, often considered to be one day, to improve the position, but which due to lack of time and material has less than the strength of a fortified postion.

- **Withdrawl.** A movement in accordance with the will of a force's commander away from the enemy that terminates combat or contact with the enemy force.

Force ratios are traditional measures of combat power. These ratios are often used to estimate "how much is enough" in the preparation of courses of action and in making tactical decisions. The three most commonly used force ratios are attacking to defending troops, attacking to defending artillery pieces, and attacking to defending tanks. Firepower indices are sometimes used as measures of combat power. Each weapon system is assigned a firepower score, a value relative to the other weapons systems considered. For example, a soldier may be equal to a score of one, an artillery piece equivalent to a score of 65, and a tank may be 100. These scores are multiplied by the number of their respective systems on a side and summed to give a firepower index for that side. The attacking to defending indices are then formed into a ratio to evaluate the relative strength of each side.

## B. DATA PREPARATION

To simplify the modeling of the response variable, success, any battle that was classified as a draw or victory for both sides was recoded as a defender success. Because there were relatively few battles that were categorized as draws or decisions for both sides, this simplification had very little effect on the overall analysis.

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The majority of the data contained in the Benchmark database is categorical in nature, meaning that the data type consists of ordered or unordered classifications of the data. For instance, temperature on the battlefield is classified as hot, mild or cold (an ordered classification); defender posture is classified as hasty defense, prepared defense, fortified defense, delay or withdrawl (an unordered classification). In addition to the categorical data, numeric data is given for each side regarding the numbers of troops and weapons systems employed as well as casualties and equipment losses as a result of the battle. These numeric data were computed and then recoded into a categorical classification that could be analyzed in a contingency table and used in loglinear modeling. The classifications for all ratio scale data are listed in Table 2.

Table 2. CATEGORIES FOR RATIO SCALE DATA

| Value | Code |
|---|---|
| 0.0-0.5 | L |
| 0.5-1.0 | M |
| 1.0-1.5 | N |
| 1.5-2.0 | O |
| 2.0-2.5 | P |
| 2.5-3.0 | Q |
| 3.0-3.5 | R |
| 3.5-4.0 | S |
| 4.0-4.5 | T |
| 4.5-above | U |

At this point it is appropriate to discuss why the force ratios were categorized in this manner when procedures for logistic regression exist. One alternative approach would be to use logistic regression with ordinal categorized variables recoded to a number code. Unordered categorical data, such as defender posture, would be recoded using several dummy variables. This was attempted using the same procedures described below for categorical modeling, but the likelihood ratio statistic used to assess model goodness of fit showed a very poor model fit to the data This may be because the variables are not linear in the logit function. Rather than finding a non-linear relationship, the ratios were categorized in a sensible manner to develop an easily understood model. The

recoding of the ratios into categories and the use of all categorical data in the model produced satisfactory results.

The assumption was made that the method of categorization of numeric variables did not significantly affect the modeling result. This assumption was tested by the use of several scalings. Scalings that were more coarse did not produce statistically significant models, and finer scalings produced significant models but reduced cell size to the point where the models became unusable. The current scaling balances these considerations.

## C. CATEGORICAL MODELING

Loglinear models of the categorical data were used to analyze the data. These models attempt to describe the interaction between or among variables in multidimensional contingency tables based on cross-product ratios of expected cell values. The contingency table describes the structural relationship among the variables that compose the dimensions of the table. If $N$ is the total number of battles in the contingency table, $x_{i+}$ is the total number of observations in the $ith$ row, and $x_{+j}$ is the total number in the $jth$ column, then under the assumption of independence between the row and column categories, $\hat{m}_{ij}$, the maximum likelihood estimator of expected value of the $ij$ cell, is

$$\hat{m}_{ij} = \frac{x_{i+} x_{+j}}{N} .$$

Taking the logarithms of both sides,

$$\log \hat{m}_{ij} = \log x_{i+} + \log x_{+j} - \log N.$$

Thus $\log \hat{m}_{ij}$ is linear in the log of the marginal totals. Under independence, $\log m_{ij}$ is modeled as

$$\log m_{ij} = \mu + \alpha_i + \beta_j$$

where

$$\mu = overall\ mean\ effect$$
$$\alpha_i = mean\ effect\ for\ variable\ i$$
$$\beta_j = mean\ effect\ for\ variable\ j.$$

In the fully saturated loglinear model

$$\log m_{ij} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij}$$

where $\alpha\beta_{ij}$ is the interaction term. For the models used in this research, the response variable was always success, defined as whether or not the attack succeeded.

$$Let \ y_i = \begin{cases} 1 \ \textit{if the ith attack was a success} \\ 0 \ \textit{if the ith attack was not a success} \end{cases} \quad i = 1,...,N$$

The explanatory variables included the categorized ratio of attacking to defending tanks, troops, and artillery (each with ten levels), the defender's posture (five levels), the terrain (three levels), and whether or not the attacker gained surprise (two levels). Because there are thirty thousand cells in the fully saturated model and only 260 battles, the approach used was to search for significant subset models. Suppose we were to model success as a response to defender posture and surprise. Posture represents the rows and surprise represents the columns of the model's associated contingency table. The expected value for the number of successes in the $ith$ row and $jth$ column without interaction between posture and surprise can be denoted $m_{ij}$, where

$$\log m_{ij} = \mu + \alpha_i + \beta_j$$

where

$\mu$ = *overall mean effect*

$\alpha_i$ = *mean effect for posture i*

$\beta_j$ = *mean effect for surprise j.*

The CATMOD procedure of the SAS statistical analysis package was used as the tool for the categorical data modeling. This procedure uses maximum likelihood to estimate parameters for loglinear models [Ref.11: p.174]. The parameters $\mu$, $\alpha_i$, and $\beta_j$ are estimated using an iterative method to maximize the likelihood function. The emphasis of the procedure is on model building, goodness of fit testing, and the estimation of cell frequencies and probabilities of the underlying contingency tables. The procedure's output includes profiles of the data, actual and predicted cell probabilities, analysis of parameters and effects, and the likelihood ratio statistic for assessing goodness of fit.

The following table illustrates an application of the test statistics output by the CATMOD procedure to the modeling results. One model hypothesized that defender posture and surprise could predict attack success. As seen in Table 3 on page 16 the

p-value for the explanatory variable posture, which tests to see if the explanatory variable posture has an effect on success in the presence of the explanatory variable surprise, is 0.03. Thus, at a reasonable level of significance (less than 0.03), the null hypothesis that posture has no effect would be rejected.

Table 3. MODEL RESULT FOR LOGLINEAR MODEL SUCCESS = POSTURE SURPRISE

| Response variable | Explanatory variables | P value of explanatory variables | P value of likelihood statistic |
|---|---|---|---|
| Attack success | Defender posture | 0.03 | 0.95 |
| | Surprise | 0.60 | |

On the other hand, surprise has a 0.60 p-value, so that it is unlikely in the presence of the explanatory variable posture that surprise is a significant factor for predicting success. The p-value for the likelihood ratio statistic for the model is 0.95, meaning that the similarity between the observed battle outcomes and those predicted by the model is very high. Overall, this is not a bad model but there may be other combinations of explanatory variables with posture that may produce good models of battle outcomes. The results of this type of modeling will be discussed in the next chapter.

## D. PLOTTING AND ANALYSIS OF OUTPUT

Predicted cell probabilities using the maximum likelihood estimates were input into GRAFSTAT, a statistics and graphics package on the IBM mainframe system. These cell probabilities were plotted for models that were found to be statistically significant using the tests previously discussed. The cell probabilities are an estimate of the probability of an attack's success given the conditions that define that cell in the model. The plots of the cell probabilities were smoothed using LOWESS, a locally weighted regression scatter plot smoothing method which employs weighted least squares to fit a line to a set of points on a scatter plot [Ref.12: p.94]. An example plot is given as Figure 4 on page 17, where the traditional force ratios and the maximum likelihood estimates of the attack probability of success are plotted. This plot is based on all of the observations in the Benchmark database. These plots were then compared with the hypotheses in the theory of combat, with historical data, and military judgment to determine lessons and insights which may be helpful for the planning of land combat.

16
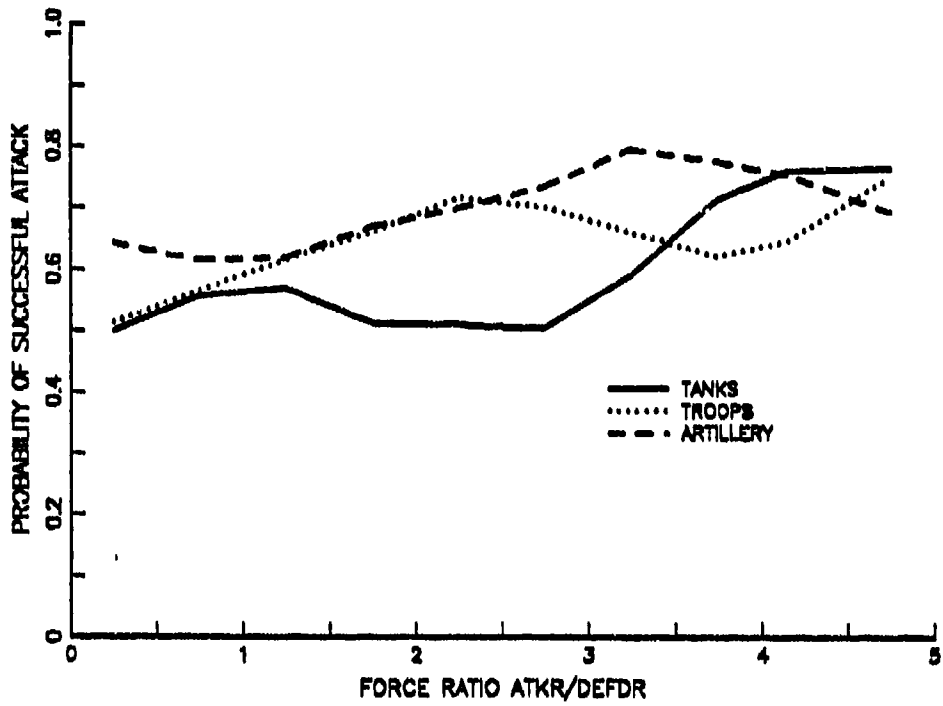
**Figure 4.   Traditional Measures of Combat Power**

## E. SUMMARY

In this chapter the methodology for the development of hypotheses about combat based on historical data and military judgment was discussed. The Benchmark data base was introduced as well as the modeling assumptions used. The analysis of categorical data with the use of loglinear models and appropriate test statistics was also discussed. In the next chapter the validation of the theory and results of the analysis will be discussed in detail.

# IV. VALIDATION AND ANALYSIS OF THE THEORY AND MODELS

## A. THE PRINCIPLE OF FALSIFICATION

In the previous chapter the methodology and data used to model battle outcomes were discussed. This chapter begins with a discussion of a principle for model validation, and then describes in detail the research conducted and results observed. Validation in this context means the determination of whether or not the results output by a model are a faithful representation of the actual system being modeled.

An approach to validation is to validate the underlying theory on which the model is based. In the case of this research, the theory to be validated consists of a set of hypotheses about combat and combat processes. The method of falsification as developed by Huber states that a deductively derived hypothesis about combat may be considered usable as long as historical research does not provide statistically significant evidence for its rejection. These "negative falsifications" of combat hypotheses, while not the rigorously controlled experiments of the physical sciences, may nevertheless be considered to approach validation and allow the incorporation of the hypotheses into the theory [Ref.7: p.25].

Since all of the hypotheses about combat will be tested for statistical significance using the actual data about combat, those that are statistically significant will be considered validated for the purposes of this theory of combat. These hypotheses will also need to be in agreement with military judgment so that the theory and modeling results are transparent to the intended user, the military planner.

## B. OVERVIEW OF MODELS USED AND RESULTS

The number of models tried in the modeling effort was large. The following table displays some of the models developed and the wide range of significance levels observed. The statistical significance level given, $\alpha$, is the maximum of the individual p-values for the model's explanatory variables. The models are arranged roughly in order of relatively best fit to worst.

## Table 4. SUMMARY OF MODELING RESULTS

| Response Variable: Attack Success | | |
|---|---|---|
| Explanatory Variables | P value of likelihood statistic | Overall α level |
| Attacker, Posture, Surprise | 0.89 | 0.04 |
| Tank ratio, Posture, Surprise | 0.62 | 0.14 |
| Tank ratio, Posture | 0.50 | 0.15 |
| Tank ratio, Surprise | 0.47 | 0.25 |
| Attacker, Posture | 0.40 | 0.06 |
| Artillery ratio, Posture | 0.35 | 0.83 |
| Attacker, Defender | 0.30 | 0.01 |
| Tank ratio, Terrain | 0.14 | 0.42 |
| Troop ratio, Posture | 0.09 | 0.87 |
| Tank, Artillery, and Troop ratios | 0.001 | 0.86 |

Again, the higher the p-value for the likelihood statistic, the more consistent the model is with the data. While the α level for most models is relatively high, it must be remembered that the data being modeled does not come from a rigorously controlled experiment, but from actual battles distributed over a period of forty-five years. Because combat is as much a social phenomenon as a physical one, there are many uncontrolled factors such as leadership, morale, training and doctrine. An effort was made to see if the differences in fighting capabilities between different national forces could be quantified. This effort was unsuccessful in finding a measure of the fighting capabilities of differing national forces, but the models that include the attacking and or defending forces are highly significant, probably due to the fact that the identification of the national forces captures some of the uncontrolled factors. The tabled probabilities of success by national force and posture in Appendix A may provide some insights into the fighting capabilities of the forces of specific nations.

A considerable amount of time was spent attempting to use firepower indices to quantify combat power and predict battle outcomes using categorical modeling. While highly significant scalings of firepower scores were developed, these scalings produced unsatisfactory results when combined with other explanatory variables (defender posture, surprise) to model battle outcomes. It is suggested that the subjective scaling used

in firepower score methods does not capture the synergistic effects of combined arms forces. Additionally, it is not clear whether or not the relative firepower score of a system would remain constant during the time period of the data, 1937 through 1982.

A modified version of the Quantified Judgment Model suggested by Dupuy in his analysis of the 1982 Bekka Valley campaign [Ref.7: pp.237-250] was tried on the data set. This approach used essentially a firepower score approach with multiplicative factors for terrain, posture and surprise included in the firepower index of each side. This model did not produce statistically significant results in the modeling of battle outcomes.

## C. RESULTS SPECIFIC TO THE THEORY OF COMBAT

### 1. Superior Combat Power Wins

One of the principal findings of the modeling was that the force ratios of attacking to defending troops and attacking to defending artillery pieces were not statistically significant in predicting battle outcomes. The more interesting result, however, was that the ratio of attacking to defending tanks was significant at the 0.05 level in predicting successful attacks. This may not be surprising considering that:

> In mounted warfare, the tank is the primary offensive weapon. Its firepower, protection from enemy fire, and speed create the shock effect necessary to disrupt the enemy's operations and to defeat him. [Ref.8: p.42]

This is not to say, however, that tanks are the only weapons required to conduct a successful attack. The principle of combined arms, that is an appropriate mix of infantry, armor, and artillery, supported by engineers, aviation and air defense is necessary for success. The tank ratio, however, seems to be the barometer of whether or not an appropriately balanced force has enough combat power to successfully conduct an attack. As seen in Figure 4 on page 17 the probability of a successful attack increases by fifty percent as the tank ratio increases from less than 1:1 to 5:1. An effect attributed to several Arab-Israeli war campaigns and further discussed in the analysis of posture as a combat multiplier may explain why the slight peak exists in the area of the 1:1 tank ratio. As a result of these findings, the measure of combat power to be used in subsequent models will be the ratio of attacking to defending tanks.

An attempt was made to distinguish a historical trend in the tank ratio's ability to predict battle outcomes. The data points were divided into four periods of approximately equal numbers, including 1937 through 1943, 1944 Europe, 1944 through 1953 Asia and the Pacific, and 1954 through 1982. No trends in the tank ratio's ability to

predict battle outcomes were evident between the four periods, as none of the models produced significant results when tested against a subset of the data.

## 2. The Law of Diminishing Returns/Economy of Force

The law of diminishing returns would imply that marginal increases in combat power would have a diminishing effect on the marginal increase in probability of success as the tank ratio increases. This effect can be seen in the plot of the tank ratio in Figure 4 on page 17 as well as all of the figures in this chapter. The slope of the probability curve begins to decrease at about the 3:1 tank ratio, implying that the point where marginal cost equals marginal returns is in the vicinity of that point. While the effect of the law of diminishing returns is not statistically proven by itself, the effects are evident in the plots of statistically significant models. The land area over which forces are concentrated may influence this effect, and further research on this hypothesis is suggested in Chapter VI.

## 3. Combat Multiplier: Terrain

The modeling of terrain by itself and combined with other factors did not have a statistically significant effect on battle outcomes. The model results are shown in Table 5 and plotted in Figure 5 on page 23.

Table 5.  MODEL RESULT FOR LOGLINEAR MODEL SUCCESS - TANK RATIO TERRAIN

| Response variable | Explanatory variables | P value of explanatory variables | P value of likelihood statistic |
|---|---|---|---|
| Attack success | Tank ratio | 0.08 | 0.14 |
| | Terrain | 0.42 | |

**TERRAIN AND TANK RATIO v SUCCESS**

**MAXIMUM LIKELIHOOD ESTIMATES**
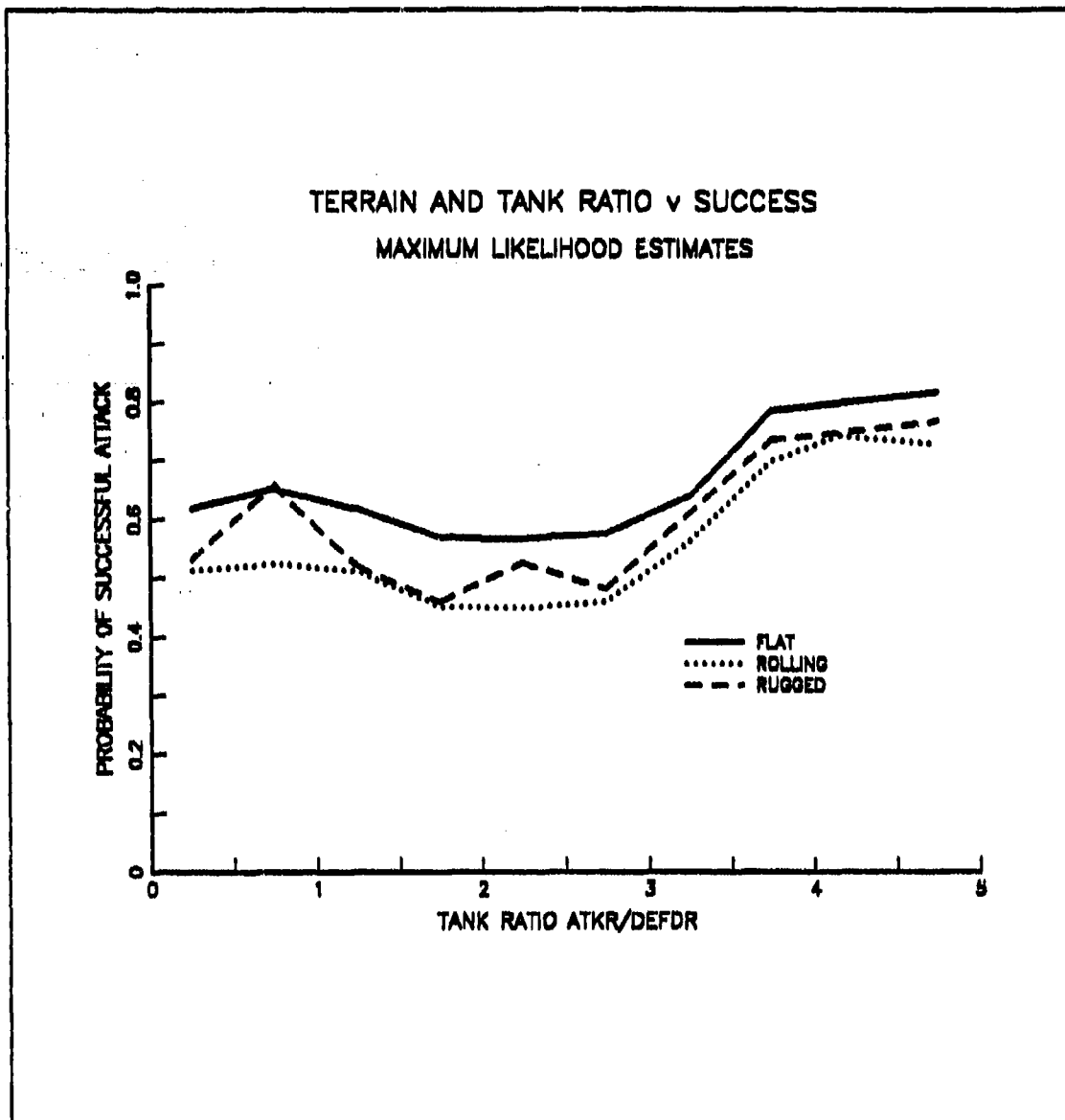
**Figure 5.** Terrain and Tank Ratio versus Success

The plot does show, however, that there is some effect due to terrain. While terrain is certainly significant from the perspective of military judgment, there may be a reason for its lack of statistical significance in a model. The models are based on data from battles that actually occurred. In most of these instances the attacker probably had the option not to attack if he felt that the terrain was to his disadvantage and he did not have other means of gaining an advantage. It is interesting to note that the combination of terrain

and posture did not produce a statistically significant model. As a result of these findings, the hypothesis that terrain is a combat multiplier is not included in the theory of combat.

### 4. Combat Multiplier: Posture

The defender's posture was found to be highly significant in predicting battle outcomes, both by itself and in combination with certain other explanatory variables, particularly the tank ratio and surprise. The model results are shown for the combination of the tank ratio and posture in Table 6 and plotted in Figure 6 on page 25. A highly useful three factor model combining posture, the tank ratio and surprise will be used in the application example in Chapter V.

**Table 6. MODEL RESULT FOR LOGLINEAR MODEL SUCCESS – TANK RATIO POSTURE**

| Response variable | Explanatory variables | P value of explanatory variables | P value of likelihood statistic |
|---|---|---|---|
| Attack success | Tank ratio | 0.09 | 0.50 |
| | Defender posture | 0.15 | |

The observed data about posture, summarized in Table 7 on page 26 lends additional support to the plotted model. The one surprising result from a military perspective is that the probability of success against a hasty defense is lower than the probability of success against a prepared defense at any force ratio. Hasty defenses are characterized by a lower level of preparation (less than 24 hours) than prepared defenses. The key to understanding this phenomenon may lie in realizing that deliberate attacks are normally conducted against prepared and fortified postions because of their strength and time is made available for pre-attack preparations. Hasty attacks are usually conducted against hasty defenses due to the need to exploit a situation or when a decision is sought before reinforcements can arrive. In these situations it is possible that the defender can use the strength of the defense as a form of combat to reduce the attacker's chances of success.
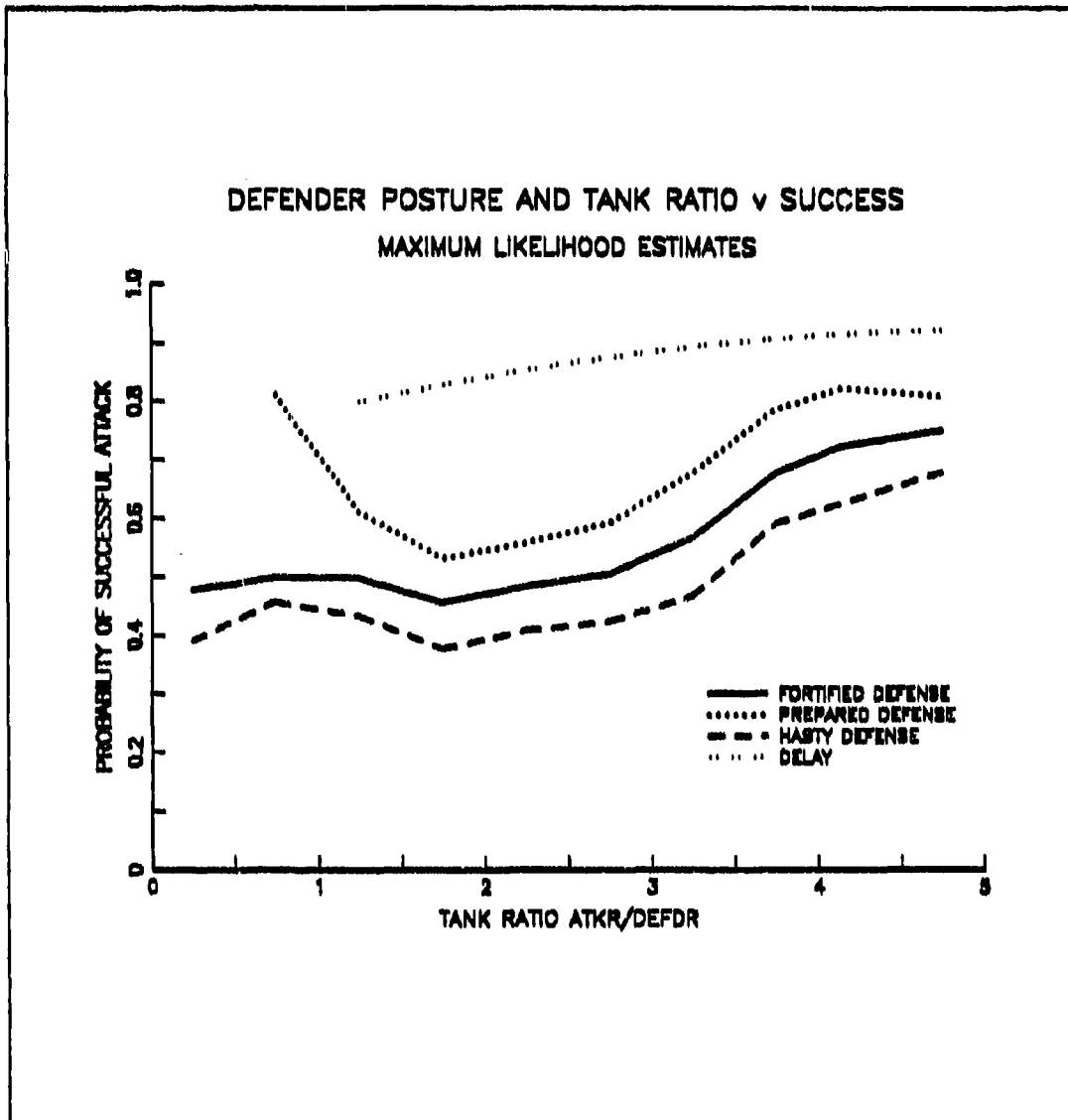
**Figure 6.** Defender Posture and Tank Ratio versus Success

### Table 7. OBSERVED PROBABILITY OF SUCCESS BY POSTURE

| Posture | P[success] | Number of observa- tions |
|---|---|---|
| Delay | 0.88 | 16 |
| Fortified | 0.63 | 98 |
| Hasty Defense | 0.52 | 60 |
| Prepared | 0.75 | 75 |

A careful observer will note that in Figure 6 on page 25 the probability of success against prepared defenses at about a 1:1 tank ratio does not follow the slope of the other curves. This may be attributed to about twelve data points in that region representing attacks in various campaigns of the Arab-Israeli conflicts. The recognized professionalism of the Israeli armored corps probably contributed to their success in attacking prepared positions at that force ratio; however, two of the battles were Egyptian successes during the initial crossing of the Suez Canal at the start of the 1973 war.

### 5. Combat Multiplier: Surprise

Surprise by itself was not found to be significant in determining battle outcomes, but contributed to models that included the tank ratio and posture.

### Table 8. MODEL RESULT FOR LOGLINEAR MODEL SUCCESS = TANK RATIO SURPRISE

| Response variable | Explanatory vari- ables | P value of ex- planatory vari- ables | P value of likeli- hood statistic |
|---|---|---|---|
| Attack success | Tank ratio | 0.02 | 0.47 |
| | Surprise | 0.25 | |

Table 9 on page 28 indicates that historically a five to twelve percent increase in the probability of a successful attack can be gained by attaining some form of surprise, and reinforces the modeling result depicted in Figure 7 on page 27.
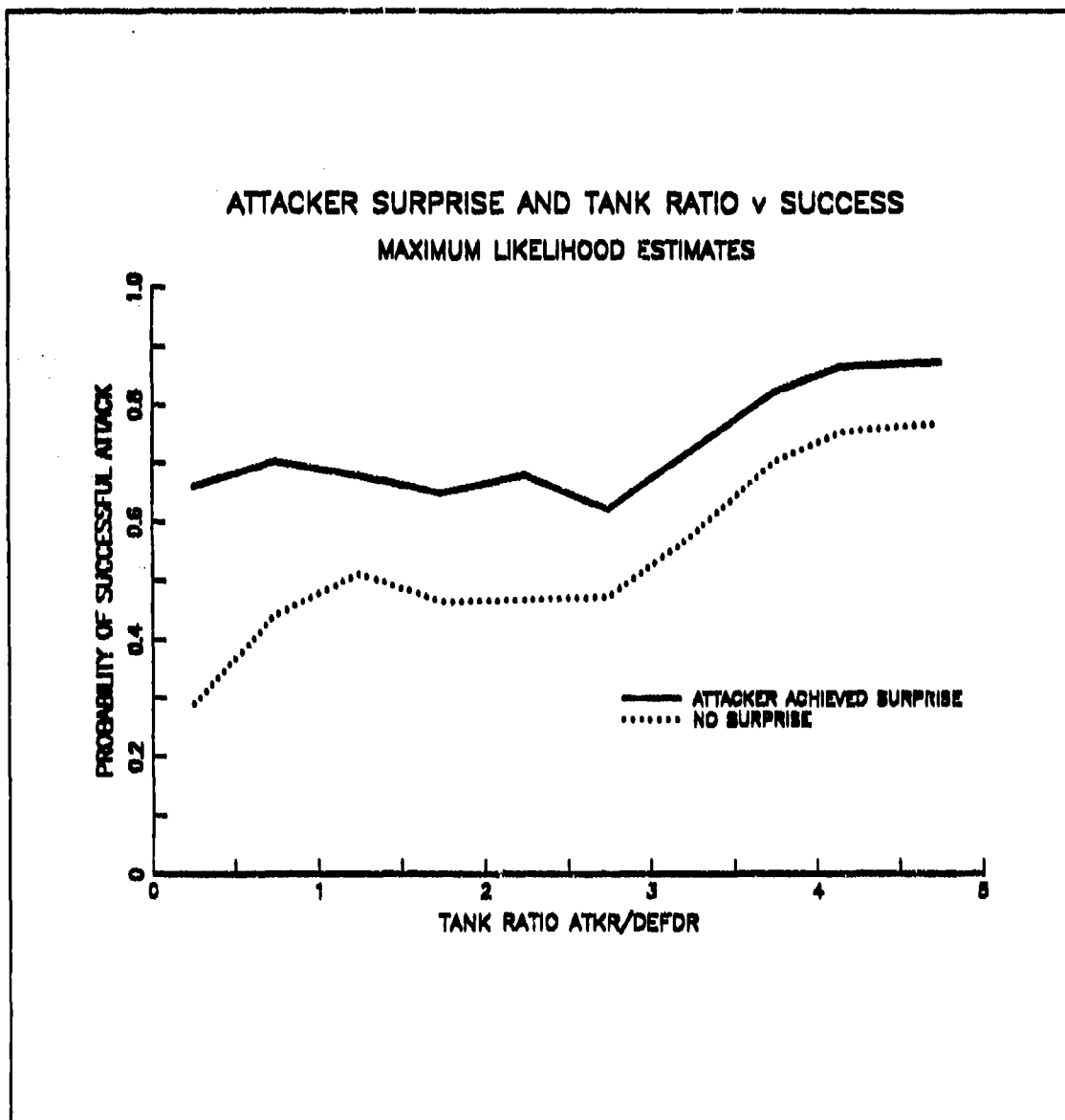
Figure 7. Attacker Surprise and Tank Ratio versus Success

**Table 9.    OBSERVED PROBABILITY OF SUCCESS BY POSTURE AND SURPRISE**

| Posture | Surprise | P[success] | Number of observations |
|---|---|---|---|
| Fortified Defense | Atkr | 0.77 | 13 |
| Fortified Defense | No | 0.72 | 84 |
| Hasty Defense | Atkr | 0.58 | 12 |
| Hasty Defense | No | 0.52 | 46 |
| Prepared Defense | Atkr | 0.78 | 9 |
| Prepared Defense | No | 0.74 | 66 |

The manner in which surprise was achieved was not specified in the database, but the possibilities include surprise in the time of the attack, its location, the forces and tactics used, or the employment of a new technology.

## D.  SUMMARY

The method of falsification developed by Huber was explained as the means for the validation of the theory of combat.  In short, deductively derived hypotheses about combat may be considered usable as long as historical research does not provide statistically significant evidence for their rejection.  Each of the hypotheses was then modeled using the loglinear modeling of categorical data and the results were analyzed.

The traditional force ratios of attacking to defending troops and attacking to defending artillery pieces were not statistically significant in predicting battle outcomes, while the ratio of attacking to defending tanks was significant at the 0.05 level in predicting successful attacks.  This suggests that the tank ratio is a statistically significant measure of combat power.  The effect of the law of diminishing returns was seen in models that included the tank ratio as one of the explanatory variables.  Terrain is not considered a combat multiplier for purposes of this theory of combat as it was shown to be not statistically significant.  Surprise is a combat multiplier when considered with the tank ratio, while the defender's posture is the most significant of the combat multipliers.  In Chapter V, a practical application of these results will be discussed.

# V. APPLICATION TO THE PLANNING OF LAND COMBAT

## A. INTRODUCTION

This chapter will illustrate an application of the theory of combat developed up to this point to the planning of a land combat operation in a contingency theater of operations. This application will use a three factor model which integrates the tank ratio, defender posture, and surprise as the variables predicting attack success.

**Table 10.  MODEL RESULT FOR LOGLINEAR MODEL SUCCESS - TANK RATIO POSTURE SURPRISE**

| Response variable | Explanatory variables | P value of explanatory variables | P value of likelihood statistic |
|---|---|---|---|
| Attack success | Tank ratio | 0.03 | 0.62 |
| | Defender posture | 0.14 | |
| | Surprise | 0.13 | |

This model is highly significant relative to all of the models developed by this analysis and is the best of the three factor models. The model results are plotted in Figure 11 on page 35 and Figure 12 on page 36. The standard errors of the probability estimates range from 0.05 to 0.20. The regions defined by a one standard error distance from the plotted lines overlap adjacent regions through the range of the tank ratio. The regions overlap the estimated probabilities for adjacent levels of posture most notably in the areas of the 1.0 to 1.5 and the 4.0 to 4.5 tank ratios, which are also the regions where the slopes of the probability estimates change most rapidly.

## B. A SCENARIO FOR DEMONSTRATION

The following scenario is used to demonstrate the potential of the theory of combat in examining two courses of action.

Situation.  Sirocco, a country allied with the United States in promoting regional interests has been invaded by a neighboring country, Ekron, intent on seizing disputed territory.  U.S. forces have been deployed to assist in repelling the attack of the belligerent neighbor. The neighboring country is well-armed with modern main battle tanks, armored personnel carriers, self-propelled artillery and aviation support.  Siroccan forces are no longer capable of offensive action due to

the surprise nature of the attack and an extraordinary effort to contain the enemy advance. Forces available to the U.S. III Corps commander are limited due to naval and air actions off the coast of Sirocco by another unfriendly power. The enemy forces that have crossed the international boundary are preparing defensive positions in the hope that a cease fire agreement will be negotiated, allowing them to annex the territory gained. The enemy forces in Sirocco are listed in Table 11, and do not include the sizeable reserve force located in Ekron. The U.S. ground forces available are listed in Table 12 on page 31, and the current dispositions of all forces are shown in Figure 8 on page 32.

Mission. The U.S. III Corps commander has been given the mission to attack and terminate the conflict on terms favorable to the U.S. and our Siroccan allies. The mission must be accomplished within the next 48 hours and with the forces currently on hand.

Courses of Action. The III Corps plans officer has developed two courses of action for analysis. The first, designated as Course of Action A, is represented in Figure 9 on page 33, and is an attack on two axes by armored brigades to destroy the enemy forces in sector. The western axis, designated as the main attack, is reinforced by the Corp's mechanized infantry brigade. One armored cavalry squadron will block movement by the 211 Infantry Regiment along the Portola-Webster highway, while the other cavalry squadron will follow the attack and block the other highway crossing the Ekron-Sirocco international boundary. Course of Action B, depicted in Figure 10 on page 34, is an attack on one axis with two armored brigades abreast to penetrate the enemy's defenses and secure positions cutting off his lines of communication. One of the cavalry squadrons secures the Webster-Portola highway, while the other blocks any advances toward Portola by the cut off enemy forces.

Table 11. ENEMY FORCES DEPLOYED IN SIROCCO

| Unit | Symbol | Number of tanks |
|---|---|---|
| 111 and 121 Armored Regiments, 2 TD | | 70 each |
| 131 and 211 Mechanized Regiments, 2 TD | | 30 each |
| 2 Tank Division Artillery Regiment | | None |

Table 12.   U.S. FORCES AVAILABLE FOR EMPLOYMENT

| Unit | Symbol | Number of tanks |
|---|---|---|
| 1st and 3d Brigades, 2d Armored Division | | 100 each |
| 2d Brigade (Mech), 2d Armored Division | | 50 |
| Division Artillery, 2d Armored Division | | None |
| 1st and 2d Squadrons, 3d Armored Cavalry Regiment | | 40 each |

## C.  APPLICATION OF THE THEORY

In order to analyze each course of action the plans officer must first establish what information is available and what assumptions will be made.  He will use available intelligence information to estimate the enemy strength, the level of preparation of the enemy's defensive positions, and whether or not it is likely that some form of surprise will be achieved.  This information is combined with the size of the attacking force on each axis of attack to estimate the force ratio.  This is done for each course of action in succession.  We can then use the modeling results in Figure 11 and Figure 12 to estimate the attack's probability of success based on the tank ratio, the defender's posture, and whether surprise is likely to be achieved.

In Course of Action A, the main attack, designated by the double arrow in Figure 9, has a ratio of attacking to defending tanks of approximately 1.5:1.  If we identify the enemy's posture as prepared, and assess that surprise is unlikely, the attack's probability of success from Figure 12 is about $0.5 \pm 0.1$.  The supporting attack by the 3d Brigade and a cavalry squadron has a 2:1 tank ratio, and under the same posture and surprise assumptions also has a probability of success of about $0.5 \pm 0.1$.  If a means of achieving surprise were available, such as a night movement and a deception operation in the northern sector, Figure 11 would show the probabilities of success of the main and supporting attacks to be about $0.77 \pm 0.1$ and $0.82 \pm 0.1$ respectively.  Differing assumptions about the defender posture  would be handled in the same manner by referencing the appropriate line in Figures 11 and 12.

31
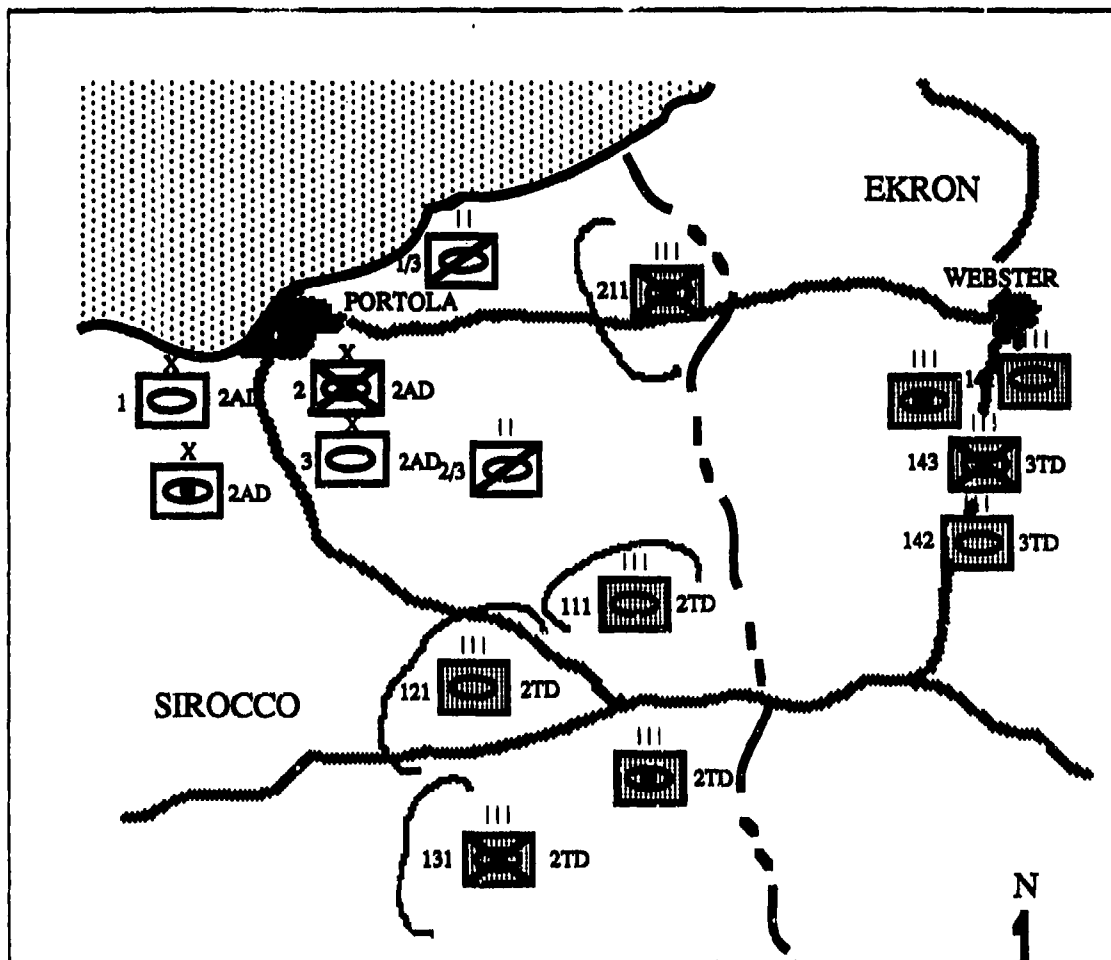
**Figure 8.   Operational Situation**

Course of Action B, illustrated in Figure 10, concentrates the available forces against one enemy regiment, achieving a tank ratio of 3.5:1. If surprise is possible and if the enemy's posture is prepared, the probability of success from Figure 11 is $0.9 \pm 0.05$. The probability of success from Figure 12 is $0.7 \pm 0.15$ if surprise is unlikely to be attained. We also note from the plot that the point of diminishing marginal returns is reached at about the 3.5:1 ratio for this level of defender posture. To the planner this would imply that if additional forces were available they would be more effectively used in efforts that were not at the point of diminishing returns. The planner would now have the estimated probabilities of success based on historical experience to consider along with other factors in evaluating which course of action will best accomplish the mission. If all other
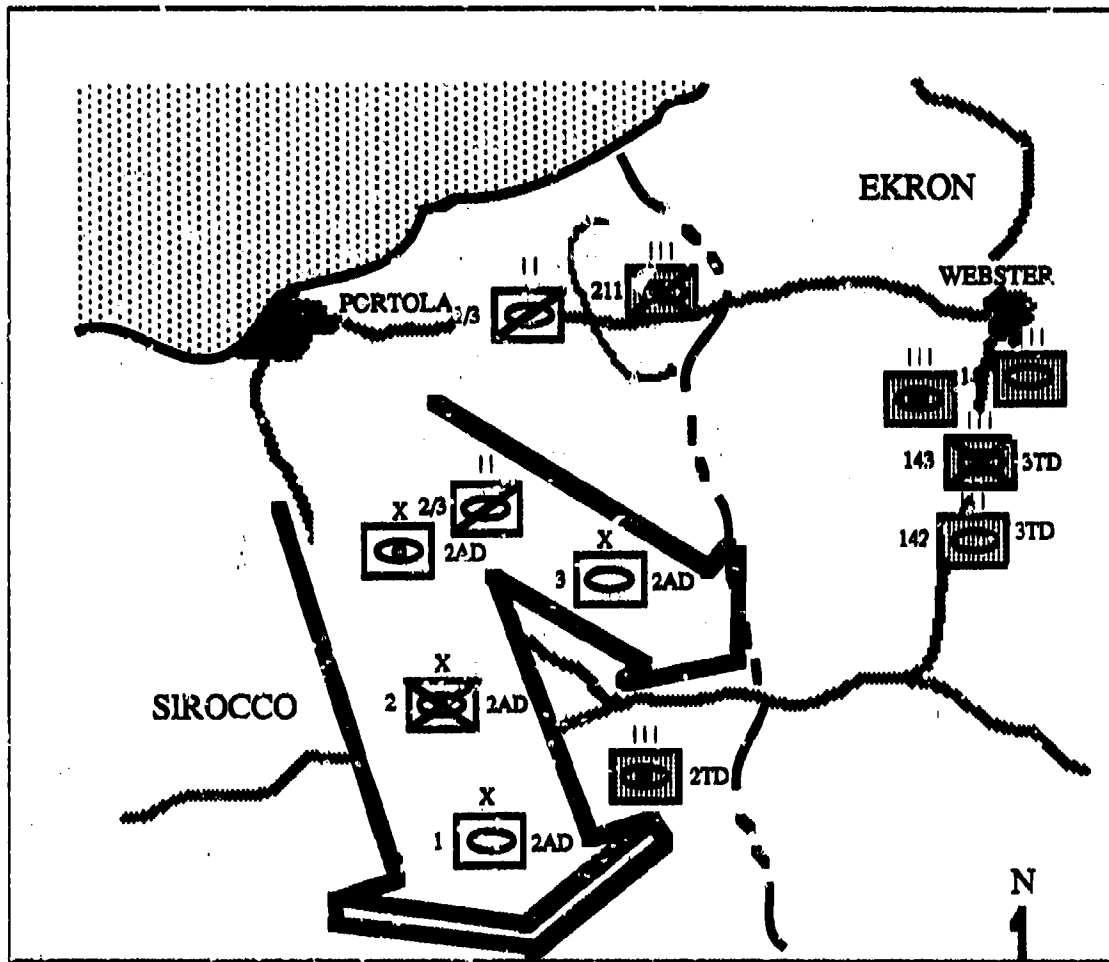
**Figure 9.** Course of Action A

considerations we.e equal, the planner should choose course of action B, the plan with the greatest probabililty of success.

The laws of probability can be used to extend the usefulness of the model used in this chapter. For instance, the joint probability of success of two simultaneous attacks is the product of the two probabilities, if the operations are independent of each other. The probability of a successful defense is one minus the probability of a successful attack. If defensive operations are being planned, the tank ratio used in the model is still the ratio of attacking to defending tanks. In this case the defensive planner must estimate the number of enemy tanks in the formation that will oppose him and whether the attacker can achieve surprise as to the time and place of the attack. A conservative
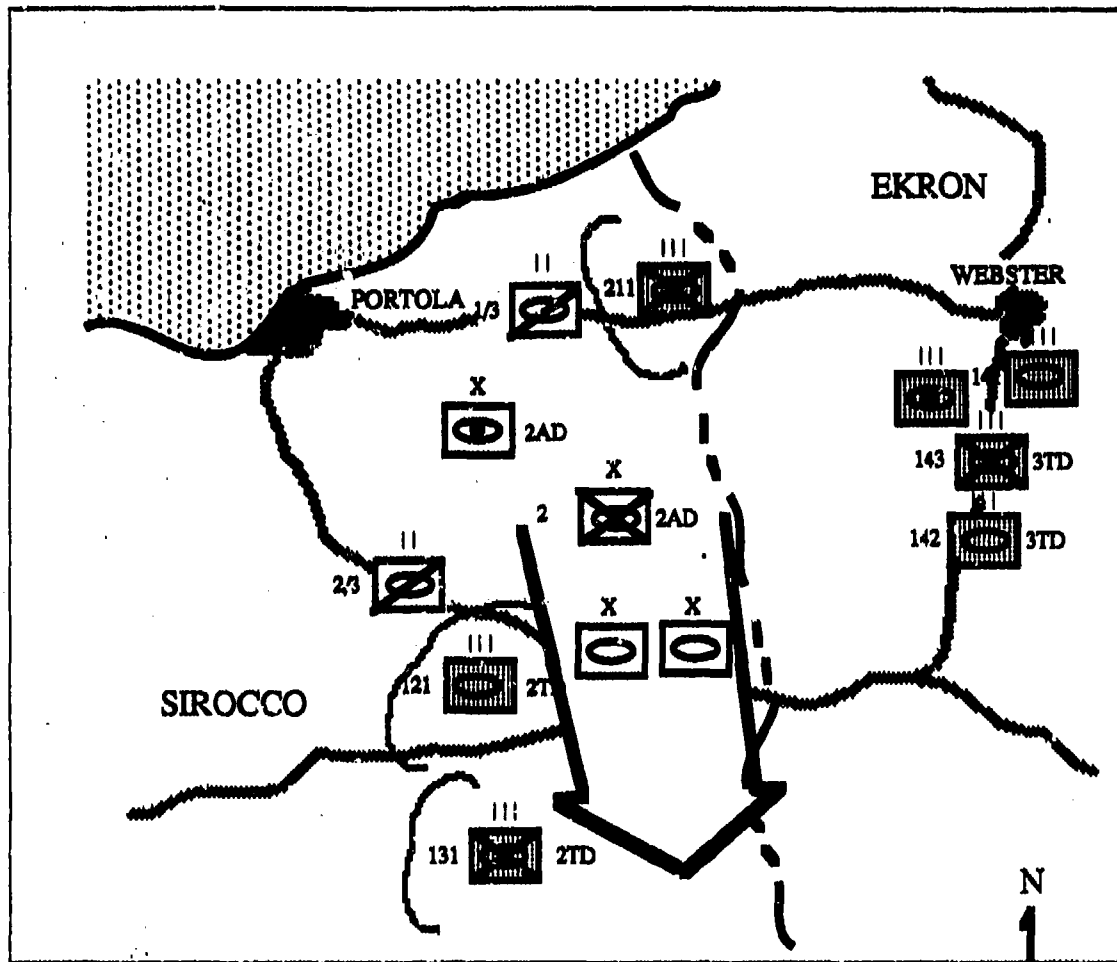
**Figure 10.    Course of Action B**

planner may start with the assumption that the attacker will intially achieve surprise, then evaluate his alternatives from that assumption. The planner will know his own level of preparation and can then make an estimate of the probability of the attacker's success, or the estimate of his defense's success by subtracting the attack probability from one. It should be reemphasized at this point that this model was developed from data about combat at the brigade/regiment level and higher, and as such the validity of the model in estimating probabilities for combat at lower levels is not established.

## D.  SUMMARY

This chapter has illustrated the use of a model that was highly significant in explaining the outcome of historical battles. This model was used to estimate the
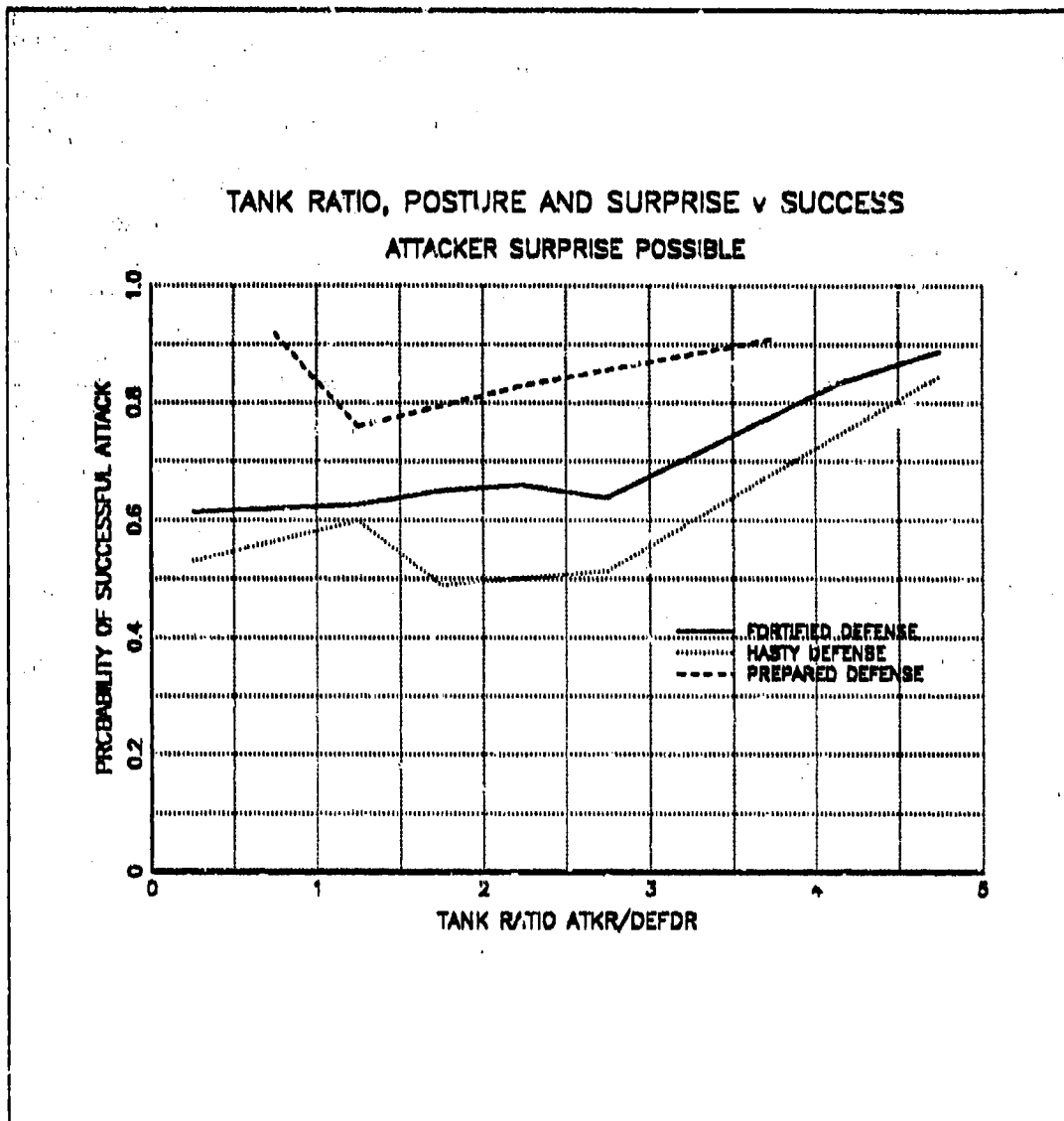
**Figure 11.  Tank Ratio and Posture versus Success (Surprise Possible)**

probability of success of offensive operations, and its use for evaluating defensive courses of action was also explained. While this model cannot be used alone to evaluate operational plans, it provides a quantitative means to supplement military judgment. The next chapter concludes with a summary of the research findings and recommendations for further study.

35
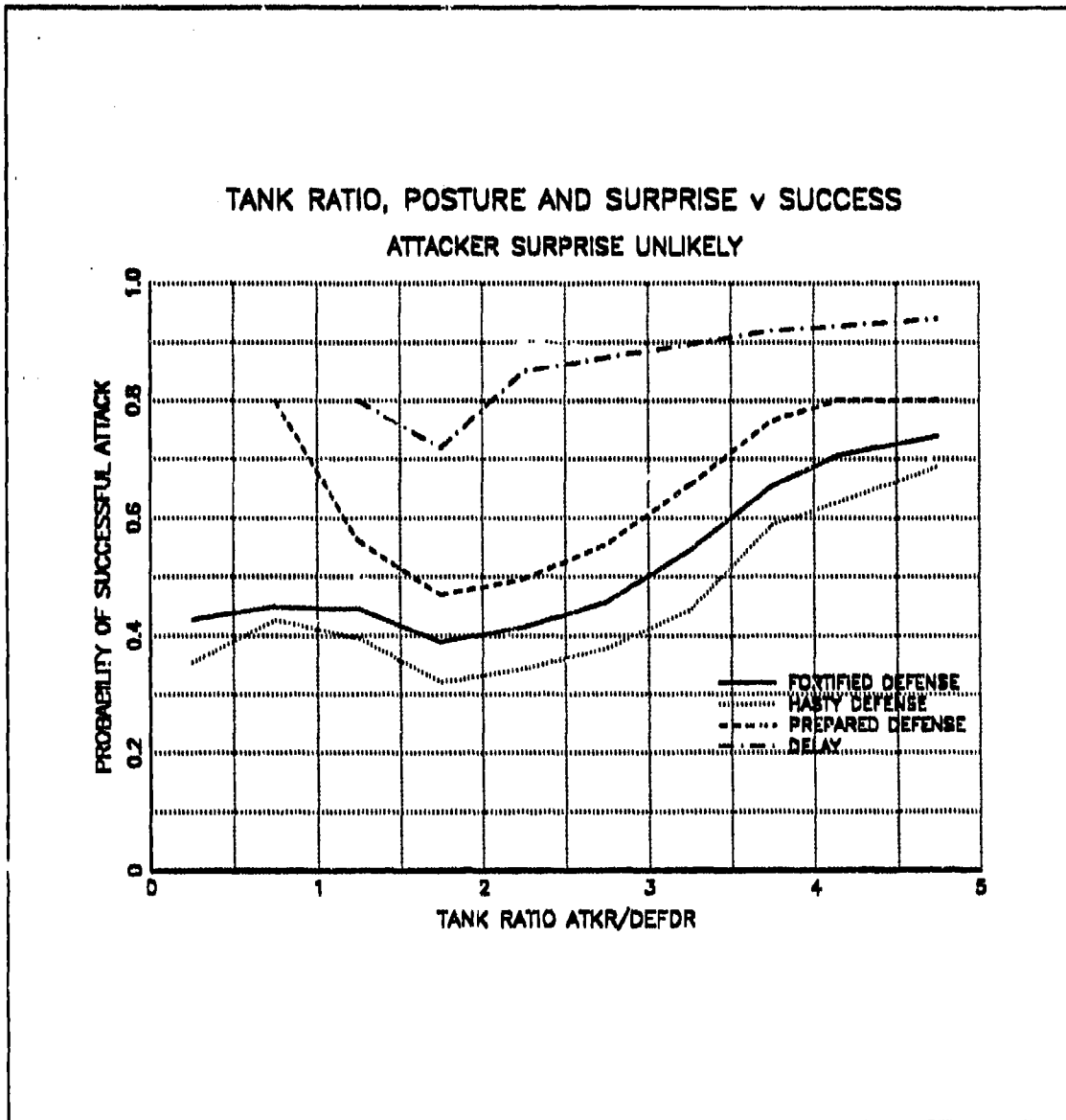
Figure 12. Tank Ratio and Posture versus Success (Surprise Unlikely)

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# VI. CONCLUSIONS

## A. THE THEORY AND MODEL FOR THE PLANNING OF LAND COMBAT

The focus of this thesis was a method of comparing alternative courses of action based on a quantitative evaluation of the estimated probability of success of each. The scope was the planning of land combat at the brigade through corps levels. A theory of combat was used to organize fundamental laws about combat and explain the interaction of combat forces and processes. These laws of combat were hypotheses confirmed by historical data, military judgment and formal models.

The method of falsification developed by Huber was explained as the means for the validation of the theory of combat. In short, deductively derived hypotheses about combat may be considered usable as long as historical research does not provide statistically significant evidence for their rejection. Each of the hypotheses was then modeled using the loglinear modeling of categorical data and the results were analyzed. The data characterized 260 combined arms battles that occurred during the period 1937 through 1982.

The traditional force ratios of attacking to defending troops and attacking to defending artillery pieces were not statistically significant in predicting battle outcomes, while the ratio of attacking to defending tanks was significant at the 0.05 level in predicting successful attacks. This suggests that the tank ratio is a statistically significant measure of combat power. The effect of the law of diminishing returns was seen in graphs of attack success probabilities that included the tank ratio as one of the explanatory variables. Terrain is not considered a combat multiplier for purposes of this theory of combat as it was not shown to be statistically significant. Surprise is a combat multiplier when considered with the tank ratio, while the defender's posture is the most significant of the combat multipliers. In Chapter V, a practical application of these laws of combat was illustrated.

## B. IMMEDIATE APPLICATIONS TO MILITARY PLANNING

The theory and models addressed in this research could be incorporated into current doctrinal and instructional manuals as a means of modeling combat power and assessing courses of action. These manuals and courses of instruction could include the Command and General Staff College's *ST 100-9 The Command Estimate* and *ST 100-3 Battle Book*, as well as instruction in brigade level operations conducted at the Army's combat

arms schools. Additionally, the tables containing observed data and probabilities of success in Chapter IV and Appendix A give some insights into the effects of posture, surprise, and attacker-defender combinations cn combat outcomes. These tables and the plots of modeling results can also be used as a "benchmark" to compare highly aggregated combat models with historical combat.

## C. RECOMMENDATIONS FOR FURTHER STUDY

The methodology developed in Chapter III could be used to further analyze the Benchmark database. The categorical modeling of battle outcomes (e.g. penetration, withdrawl, breakthru) using explanatory variables including tactics and posture could validate additional hypotheses to be included in the theory of combat developed in this thesis. The data may also be analyzed to validate current tables of advance rates, casualty rates, and equipment loss rates or to develop new tables. In addition, some testing could be done to determine if these types of loss and advance rates can be reliably modeled. One further area of interest would be the examination of the effect of attacker and defender frontage and defensive position depth on battle outcome. This study might reveal more about the effects of economy of force and diminishing returns on combat power and battle outcomes.

# APPENDIX A.   PROBABILITIES OF SUCCESS BY NATIONAL FORCE AND POSTURE

These tables display the observed probabilities of successful attacks by various combinations of attacking and defending forces and defender posture. Posture was found to be highly significant in predicting battle outcome when combined with data about the national force attacking or defending. Cells that contain dashed entries had fewer than five observations in them and are not displayed to avoid misinterpretation.

Table 13.   OBSERVED PROBABILITY OF SUCCESS BY ATTACKING FORCE AND POSTURE

| Attacker | Defender Posture | | | |
|---|---|---|---|---|
| | Fortified Defense | Prepared Defense | Hasty Defense | Delay |
| British | 0.58 | 0.75 | 0.80 | - |
| Egyptian | - | - | 0.33 | - |
| German | - | 0.54 | 0.17 | - |
| Israeli | 0.77 | 0.83 | 0.81 | - |
| U.S. | 0.59 | 0.89 | 0.78 | 0.86 |
| U.S.S.R. | 0.78 | 0.90 | - | - |

Table 14. OBSERVED PROBABILITY OF SUCCESS BY DEFENDING FORCE AND POSTURE

| Defender | Defender Posture | | | |
|---|---|---|---|---|
| | Fortified Defense | Prepared Defense | Hasty Defense | Delay |
| British | - | 0.14 | 0.20 | - |
| Egyptian | 0.80 | 0.89 | 0.70 | - |
| German | 0.58 | 0.84 | 0.75 | 0.80 |
| Israeli | - | 0.43 | 0.20 | - |
| Japanese | 0.64 | - | - | - |
| Syrian | 0.74 | 0.99 | - | - |
| U.S. | - | - | 0.09 | - |
| U.S.S.R. | - | 0.60 | - | - |

Table 15. OBSERVED PROBABILITY OF SUCCESS BY ATTACKING AND DEFENDING FORCE

| Attacker | Defender | P[success] |
|---|---|---|
| German | British | 0.36 |
| British | German | 0.62 |
| Egyptian | Israeli | 0.50 |
| German | U.S. | 0.11 |
| German | U.S.S.R. | 0.67 |
| Israeli | Egyptian | 0.81 |
| Israeli | Jordanian | 0.71 |
| Israeli | Syrian | 0.86 |
| Syrian | Israeli | 0.22 |
| U.S. | German | 0.67 |
| U.S. | Chinese | 0.99 |
| U.S. | Japanese | 0.70 |
| U.S.S.R. | German | 0.87 |

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# APPENDIX B.   EXTRACT FROM BENCHMARK DATABASE

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***********************************************************************
* Row Theater        Name                 Atkr  Defdr Atkr   Defdr   Terrain  Cover *
*                                                      echelon echelon            *
***********************************************************************
```

| Row | Theater | Name | Atkr | Defdr | Atkr echelon | Defdr echelon | Terrain | Cover |
|-----|---------|------|------|-------|--------------|---------------|---------|-------|
| 1 | | | | | | | | |
| 2 | Spain | Guadalajara | Ital | SRpb | Army | Army | Flat | Bare |
| 3 | | | | | | | | |
| 4 | France | Ardennes | Ger | Fr | ArGp | Army | Rolling | Mixed |
| 5 | France | Sedan | Ger | Fr | Corp | Army | Rolling | Mixed |
| 6 | France | Cambrai | Ger | Fr | Div | Div | Rolling | Mixed |
| 7 | France | Arras | Brit | Ger | Rgt | Rgt | Rolling | Mixed |
| 8 | France | Boos | Fr | Ger | Co | Co | Rolling | Mixed |
| 9 | | | | | | | | |
| 10 | Manchuria | Changkufeng 1 | Jap | USSR | Rgt | Rgt | Rugged | Bare |
| 11 | Manchuria | Changkufeng 2 | USSR | Jap | Div | Div | Rugged | Bare |
| 12 | Manchuria | Changkufeng 3 | USSR | Jap | Army | Div | Rugged | Bare |
| 13 | Manchuria | Nomonhan 1 | Jap | USSR | Rgt | Rgt | Rolling | Bare |
| 14 | Manchuria | Nomonhan 2 | USSR | Jap | Army | Army | Rolling | Bare |
| 15 | Manchuria | Mutankiang | USSR | Jap | Army | Corp | Rugged | Mixed |
| 16 | | | | | | | | |
| 17 | Malaysia | Jitra | Brit | Jap | Div | Div | Rolling | Wooded |
| 18 | | | | | | | | |
| 19 | Finland | Suomussalmi | Finn | USSR | Div | Corp | Rolling | Wooded |
| 20 | Russia | Rovno | Ger | USSR | Army | ArGp | Rolling | Mixed |
| 21 | Russia | Moscow Defense | Ger | USSR | ArGp | ArGp | Rolling | Mixed |
| 22 | Russia | Moscow Counterattack | USSR | Ger | ArGp | ArGp | Rolling | Mixed |
| 23 | Russia | Pogoreloye | USSR | Ger | Army | Army | Flat | Swamp |
| 24 | | | | | | | | |
| 25 | N.Africa | Alam Halfa | Ger+ | Brit | Army | Army | Flat | Bare |
| 26 | N.Africa | Alamein 2 | Brit | Ger+ | Army | Army | Flat | Bare |
| 27 | N.Africa | Alamein-Lightfoot | Brit | Ger+ | Army | Army | Flat | Bare |
| 28 | N.Africa | Alamein-Bridgehead | Brit | Ger+ | Army | Army | Flat | Bare |
| 29 | N.Africa | Alamein-Supercharge | Brit | Ger+ | Army | Army | Flat | Bare |
| 30 | N.Africa | Chouigui Pass | Ger | US | Bn | Co | Rolling | Bare |
| 31 | N.Africa | El Guettar 3 | Ger | US | Div | Div | Rolling | Bare |
| 32 | N.Africa | Sedjanne-Bizerte | US | Ger | Div | Div | Rugged | Mixed |
| 33 | | | | | | | | |
| 34 | Italy | Amphitheater | Brit | Ger | Div | Rgt | Rolling | Mixed |
| 35 | Italy | Port of Salerno | Brit | Ger | Div | Rgt | Rolling | Mixed |
| 36 | Italy | Sele-Calore Corridor | US | Ger | Div | Div | Rolling | Mixed |
| 37 | Italy | Battipaglia 1 | Ger | Brit | Div | Div | Rolling | Mixed |
| 38 | Italy | Vietri 1 | Ger | Brit | Div | Div | Rolling | Mixed |
| 39 | Italy | Tobacco Factory | Ger | Brit | Div | Div | Rolling | Mixed |
| 40 | Italy | Battipaglia 2 | Brit | Ger | Div | Rgt | Rolling | Mixed |
| 41 | Italy | Eboli | US | Ger | Div | Div | Rolling | Mixed |
| 42 | Italy | Vietri 2 | Ger | Brit | Div | Div | Rolling | Mixed |
| 43 | Italy | Grazzanise | Brit | Ger | Div | Div | Flat | Mixed |
| 44 | Italy | Caiazzo | US | Ger | Div | Div | Rolling | Mixed |
| 45 | Italy | Capua | Brit | Ger | Div | Div | Flat | Mixed |
| 46 | Italy | Castel Volturno | Brit | Ger | Div | Div | Flat | Mixed |
| 47 | Italy | Monte Acero | US | Ger | Div | Div | Rugged | Mixed |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 48 | Italy | Triflisco | US | Ger | Div | Div | Rolling | Mixed |
| 49 | Italy | Dragoni | US | Ger | Div | Div | Rolling | Mixed |
| 50 | Italy | Canal 1 | Brit | Ger | Div | Div | Flat | Mixed |
| 51 | Italy | Monte Grande (V) | Brit | Ger | Rgt | Rgt | Rolling | Mixed |
| 52 | Italy | Canal 2 | Brit | Ger | Div | Rgt | Rolling | Mixed |
| 53 | Italy | Francolise | Brit | Ger | Div | Rgt | Rolling | Mixed |
| 54 | Italy | S. Maria Oliveto | US | Ger | Div | Div | Rolling | Mixed |
| 55 | Italy | Monte Camino 1 | Brit | Ger | Div | Rgt | Rugged | Mixed |
| 56 | Italy | Monte Lungo | US | Ger | Div | Rgt | Rugged | Mixed |
| 57 | Italy | Pozzilli | US | Ger | Div | Div | Rugged | Mixed |
| 58 | Italy | Monte Camino 2 | Ger | Brit | Rgt | Rgt | Rugged | Mixed |
| 59 | Italy | Monte Rotondo | US | Ger | Div | Rgt | Rugged | Mixed |
| 60 | Italy | Calabritto | Brit | Ger | Div | Div | Rugged | Mixed |
| 61 | Italy | Monte Camino 3 | Brit | Ger | Div | Rgt | Rugged | Mixed |
| 62 | Italy | Monte Maggiore | US | Ger | Div | Rgt | Flat | Mixed |
| 63 | Italy | Aprilia 1 | Brit | Ger | Div | Div | Flat | Mixed |
| 64 | Italy | Factory 1 | Ger | Brit | Div | Div | Rolling | Mixed |
| 65 | Italy | Campoleone 2 | Ger | Brit | Div | Rgt | Flat | Mixed |
| 66 | Italy | Campoleone 1 | Brit | Ger | Div | Div | Flat | Mixed |
| 67 | Italy | Carroceto | Ger | Brit | Div | Div | Flat | Mixed |
| 68 | Italy | Moletta River 1 | Ger | Brit | Div | Div | Flat | Mixed |
| 69 | Italy | Aprilia 2 | Ger | Brit | Div | Div | Flat | Mixed |
| 70 | Italy | Factory 2 | US | Ger | Div | Div | Flat | Mixed |
| 71 | Italy | "Bowling Alley" 1 | Ger | US | Corp | Div | Flat | Mixed |
| 72 | Italy | Moletta River 2 | Ger | Brit | Div | Div | Flat | Mixed |
| 73 | Italy | Ficocia | Ger | US | Div | Div | Flat | Mixed |
| 74 | Italy | S. Maria Infante | US | Ger | Div | Div | Rugged | Bare |
| 75 | Italy | San Martino | US | Ger | Div | Div | Rugged | Bare |
| 76 | Italy | Castellonorato | US | Ger | Div | Div | Rugged | Bare |
| 77 | Italy | Spigno | US | Ger | Div | Div | Rugged | Bare |
| 78 | Italy | Formia | US | Ger | Div | Div | Rugged | Bare |
| 79 | Italy | Monte Grande (R) | US | Ger | Div | Div | Rolling | Mixed |
| 80 | Italy | Itri-Fondi | US | Ger | Div | Div | Rugged | Mixed |
| 81 | Italy | Terracina | US | Ger | Div | Div | Rugged | Mixed |
| 82 | Italy | Moletta River 3 | Brit | Ger | Div | Div | Flat | Mixed |
| 83 | Italy | Anzio-Albano Road 2 | Brit | Ger | Div | Div | Flat | Mixed |
| 84 | Italy | Anzio Breakout | US | Ger | Div | Div | Flat | Mixed |
| 85 | Italy | Cisterna | US | Ger | Div | Div | Flat | Mixed |
| 86 | Italy | Sezze | US | Ger | Div | Rgt | Rolling | Mixed |
| 87 | Italy | Velletri | US | Ger | Div | Div | Rolling | Mixed |
| 88 | Italy | Campoleone [Station] | US | Ger | Div | Div | Rolling | Mixed |
| 89 | Italy | Villa Crocetta | US | Ger | Div | Div | Rolling | Mixed |
| 90 | Italy | Ardea | Brit | Ger | Div | Div | Rolling | Mixed |
| 91 | Italy | Fosso di Campoleone | US | Ger | Corp | Div | Rolling | Mixed |
| 92 | Italy | Lanuvio | US | Ger | Div | Div | Rolling | Mixed |
| 93 | Italy | Lariano | US | Ger | Div | Div | Rolling | Mixed |
| 94 | Italy | Via Anziate | US | Ger | Div | Div | Rolling | Bare |
| 95 | Italy | Valmontone | US | Ger | Div | Div | Rolling | Mixed |
| 96 | Italy | Tarto-Tiber | Brit | Ger | Corp | Div | Flat | Mixed |
| 97 | Italy | Il Giogio Pass | US | Ger | Div | Rgt | Rugged | Mixed |
| 98 | | | | | | | | |
| 99 | W.Europe | Saint Lo | US | Ger | Div | Div | Rolling | Mixed |
| 100 | W.Europe | "Goodwood" | Brit | Ger | Army | Corp | Rolling | Mixed |
| 101 | W.Europe | "Cobra" | US | Ger | Corp | Corp | Rolling | Mixed |
| 102 | W.Europe | Mortain | Ger | US | Corp | Div | Rolling | Mixed |
| 103 | W.Europe | Chartres | US | Ger | Div | Army | Rolling | Mixed |
| 104 | W.Europe | Melun | US | Ger | Div | Div | Rolling | Mixed |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 105 | W.Europe | Seine River | US | Ger | Corp | Div | Rolling | Mixed |
| 106 | W.Europe | Moselle-Metz | US | Ger | Corp | Army | Rolling | Mixed |
| 107 | W.Europe | Metz | US | Ger | Corp | Army | Rolling | Mixed |
| 108 | W.Europe | Arracourt | Ger | US | Div | Rgt | Rolling | Mixed |
| 109 | W.Europe | Nastwell | US | Ger | Corp | Corp | Rolling | Mixed |
| 110 | W.Europe | Schmidt | US | Ger | Div | Corp | Rolling | Mixed |
| 111 | W.Europe | Seille-Nied | US | Ger | Corp | Corp | Rolling | Mixed |
| 112 | W.Europe | Chateau Salins | US | Ger | Corp | Div | Rolling | Mixed |
| 113 | W.Europe | Morhange | US | Ger | Div | Div | Rolling | Mixed |
| 114 | W.Europe | Morhange-Faulquemont | US | Ger | Corp | Corp | Rolling | Mixed |
| 115 | W.Europe | Bourgaltroff | US | Ger | Div | Div | Rolling | Mixed |
| 116 | W.Europe | Sarre-St. Avold | US | Ger | Corp | Corp | Rolling | Mixed |
| 117 | W.Europe | Baerendorf 1 | US | Ger | Div | Div | Rolling | Mixed |
| 118 | W.Europe | Baerendorf 2 | US | Ger | Div | Div | Rolling | Mixed |
| 119 | W.Europe | Burbach-Durstel | US | Ger | Div | Div | Rolling | Mixed |
| 120 | W.Europe | Durstel-Faerbersville | US | Ger | Corp | Corp | Rolling | Mixed |
| 121 | W.Europe | Sarre-Union | US | Ger | Div | Div | Rolling | Mixed |
| 122 | W.Europe | Sarre-Singling | US | Ger | Corp | Corp | Rolling | Mixed |
| 123 | W.Europe | Singling-Bining | US | Ger | Div | Div | Rolling | Mixed |
| 124 | W.Europe | Sauer River | Ger | US | Div | Rgt | Rugged | Mixed |
| 125 | W.Europe | Saint Vith | Ger | US | Corp | Div | Rolling | Mixed |
| 126 | W.Europe | Bastogne | Ger | US | Corp | Rgt | Rolling | Mixed |
| 127 | | | | | | | | |
| 128 | E.Europe | Leningrad-"Spark" | USSR | Ger | Army | Army | Flat | Mixed |
| 129 | E.Europe | Kursk-Oboyan 1 | Ger | USSR | Corp | Army | Rolling | Mixed |
| 130 | E.Europe | Kursk-South (???) | Ger | USSR | Army | ArGp | Rolling | Mixed |
| 131 | E.Europe | Kursk-Oboyan 2 | Ger | USSR | Corp | Army | Rolling | Mixed |
| 132 | E.Europe | Kursk-Oboyan 3 | Ger | USSR | Corp | Army | Rolling | Mixed |
| 133 | E.Europe | Kursk-Prokhorovka | USSR | Ger | ArGp | Corp | Rolling | Mixed |
| 134 | E.Europe | Kursk Counterattack | USSR | Ger | ArGp | Army | Rolling | Mixed |
| 135 | E.Europe | Kursk-Belgorod | USSR | Ger | Army | Div | Rolling | Mixed |
| 136 | E.Europe | Melitopol | USSR | Ger | ArGp | Army | Rolling | Mixed |
| 137 | E.Europe | Korsun-Schevkovskiy | USSR | Ger | ArGp | Army | Flat | Mixed |
| 138 | E.Europe | Nikopol Bridgehead | USSR | Ger | Div | Div | Flat | Mixed |
| 139 | E.Europe | Sevastopol | USSR | Ger | ArGp | Army | Rolling | Urban |
| 140 | E.Europe | Berezina River | USSR | Ger | Corp | Div | Flat | Swamp |
| 141 | E.Europe | Lvov-Sandomierz | USSR | Ger | ArGp | ArGp | Flat | Mixed |
| 142 | E.Europe | Brody 1 | USSR | Ger | Corp | Rgt | Flat | Swamp |
| 143 | E.Europe | Brody 2 | USSR | Ger | Corp | Div | Flat | Swamp |
| 144 | E.Europe | Vistula Crossing 1 | USSR | Ger | Corp | Div | Flat | Mixed |
| 145 | E.Europe | Vistula Crossing 2 | USSR | Ger | Corp | Corp | Flat | Mixed |
| 146 | E.Europe | Targul Frumos | USSR | Ger | Army | Div | Flat | Bare |
| 147 | E.Europe | Yassy-Kishinev | USSR | Ger | ArGp | ArGp | Flat | Mixed |
| 148 | E.Europe | Vistula-Oder | USSR | Ger | ArGp | ArGp | Flat | Mixed |
| 149 | E.Europe | East Prussia | USSR | Ger | ArGp | ArGp | Rolling | Mixed |
| 150 | E.Europe | Ciechanow 1 | USSR | Ger | Div | Div | Rolling | Bare |
| 151 | E.Europe | Ciechanow 2 | USSR | Ger | Div | Div | Rolling | Bare |
| 152 | E.Europe | Seelow Heights | USSR | Ger | Div | Rgt | Rugged | Mixed |
| 153 | | | | | | | | |
| 154 | Pacific | Tarawa-Betto | US | Jap | Div | Rgt | Rolling | Mixed |
| 155 | Pacific | Iwo Jima 1 | US | Jap | Corp | Div | Rolling | Bare |
| 156 | Pacific | Iwo Jima-Mt Suribachi | US | Jap | Rgt | Rgt | Rugged | Bare |
| 157 | Pacific | Iwo Jima 3 | US | Jap | Corp | Rgt | Rolling | Bare |
| 158 | Pacific | Okinawa Beach 1 | US | Jap | Div | Rgt | Flat | Mixed |
| 159 | Pacific | Okinawa Outposts | US | Jap | Div | Rgt | Rugged | Mixed |
| 160 | Pacific | Tomb Hill-Ouki | US | Jap | Div | Rgt | Rugged | Mixed |
| 161 | Pacific | Skyline Ridge | US | Jap | Div | Rgt | Rugged | Mixed |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 162 Pacific | Koohi Ridge-Onaga 1 | US | Jap | Div | Rgt | Rugged | Mixed |
| 163 Pacific | Koohi Ridge-Onaga 2 | US | Jap | Div | Rgt | Rugged | Mixed |
| 164 Pacific | Koohi Ridge-Onaga 3 | US | Jap | Div | Rgt | Rugged | Mixed |
| 165 Pacific | Kochi Counterattack | Jap | US | Div | Rgt | Rugged | Mixed |
| 166 Pacific | Koohi Ridge 4 | US | Jap | Div | Div | Rugged | Mixed |
| 167 Pacific | Shuri West 1 | US | Jap | Div | Rgt | Rugged | Mixed |
| 168 Pacific | Shuri Counterattack | Jap | US | Div | Div | Rolling | Mixed |
| 169 Pacific | Shuri West 2 | US | Jap | Div | Div | Rugged | Mixed |
| 170 Pacific | Shuri West 3 | US | Jap | Div | Div | Rugged | Mixed |
| 171 Pacific | Hill-95 1 | US | Jap | Div | Rgt | Rugged | Mixed |
| 172 Pacific | Hill-95 2 | US | Jap | Div | Rgt | Rugged | Mixed |
| 173 Pacific | Yaeju Dake | US | Jap | Div | Rgt | Rugged | Mixed |
| 174 Pacific | Hills 153 & 115 | US | Jap | Div | Rgt | Rugged | Mixed |
| 175 Pacific | Okinawa Beach 2 | US | Jap | Div | Rgt | Rolling | Mixed |
| 176 Pacific | Shuri Advance | US | Jap | Div | Rgt | Rolling | Mixed |
| 177 Pacific | Kakazu & Tombstone | US | Jap | Div | Rgt | Rolling | Mixed |
| 178 Pacific | Nishibaru Ridge | US | Jap | Div | Rgt | Rolling | Mixed |
| 179 Pacific | Maeda Escarpment | US | Jap | Div | Div | Rolling | Mixed |
| 180 Pacific | Shuri East 1 | US | Jap | Div | Div | Rolling | Mixed |
| 181 Pacific | Shuri East 2 | US | Jap | Div | Div | Rolling | Mixed |
| 182 Pacific | Shuri East 3 | US | Jap | Div | Div | Rolling | Mixed |
| 183 Pacific | Yuza Dake Approach | US | Jap | Div | Div | Rolling | Mixed |
| 184 Pacific | Yuza Dake Attack | US | Jap | Div | Div | Rolling | Mixed |
| 185 Pacific | Yuza Dake Capture | US | Jap | Div | Rgt | Rolling | Mixed |
| 186 | | | | | | | |
| 187 Viet Nam | Quang Tri | NVN | SVN | Corp | Div | Flat | Mixed |
| 188 | | | | | | | |
| 189 Korea | Pusan Perimeter | NKor | US | Corp | Div | | |
| 190 Korea | Pusan Breakout | US | NKor | Div | Corp | | |
| 191 Korea | Nam River | US | China | Div | Army | | |
| 192 Korea | Kunson | US | China | Div | Army | | |
| 193 Korea | Han River | US | China | Div | Army | | |
| 194 Korea | Butte Line | US | China | Div | Army | | |
| 195 Korea | Chen River | US | China | Div | Army | | |
| 196 Korea | Kansas Line | China | US | Army | Div | | |
| 197 Korea | Pierce Line | US | China | Div | Army | | |
| 198 Korea | Iron Triangle | China | US | Army | Div | | |
| 199 Korea | Bayonette Line | US | China | Div | Army | Rugged | |
| 200 | | | | | | | |
| 201 W.Bank | Jerusalem "Jebussi" | Is | Jor | Rgt | Rgt | Rugged | Mixed |
| 202 W.Bank | Jerusalem Corridor | Is | Jor | Div | Rgt | Rolling | Bare |
| 203 Golan | Mishmar Hayarden 1 | Syr | Is | Rgt | Rgt | Flat | Mixed |
| 204 Golan | Mishmar Hayarden 2 | Syr | Is | Rgt | Rgt | Flat | Mixed |
| 205 Golan | Hiram | Is | Syr | Div | Rgt | Rolling | Bare |
| 206 Sinai | Acre | Is | Egy | Rgt | Rgt | Flat | Mixed |
| 207 Sinai | "Death to Invader" | Is | Egy | Rgt | Rgt | Rolling | Bare |
| 208 Sinai | El Auje "Ayin" | Is | Egy | Div | Div | Flat | Bare |
| 209 Sinai | Ageila-Rafah "Ayin" | Is | Egy | Div | Div | Flat | Bare |
| 210 | | | | | | | |
| 211 Sinai | Abu Ageila-Um Katef | Is | Egy | Div | Rgt | Flat | Bare |
| 212 Sinai | Bir Rud Salim | Is | Egy | Rgt | Rgt | Flat | Bare |
| 213 Sinai | Rafah-El Arish | Is | Egy | Div | Div | Flat | Bare |
| 214 Sinai | Gaza-Khan Yunis | Is | Egy | Rgt | Rgt | Flat | Urban |
| 215 | | | | | | | |
| 216 W.Bank | Jenin | Is | Jor | Div | Rgt | Rugged | Mixed |
| 217 W.Bank | Jerusalem | Is | Jor | Corp | Rgt | Rugged | Mixed |
| 218 W.Bank | Katibiya | Is | Jor | Rgt | Rgt | Rugged | Mixed |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 219 W.Bank | Tiflit-Zababiya | Is | Jor | Rgt | Rgt | Rugged | Mixed |
| 220 W.Bank | Nablus | Is | Jor | Div | Div | Rugged | Mixed |
| 221 | | | | | | | |
| 222 Jordan | Karama | Is | Jor | Div | Div | Flat | Mixed |
| 223 | | | | | | | |
| 224 Sinai | Rafah | Is | Egy | Div | Div | Flat | Desert |
| 225 Sinai | Bir Lahfan | Is | Egy | Div | Div | Flat | Desert |
| 226 Sinai | Abu Ageila-Um Kataf | Is | Egy | Div | Div | Flat | Mixed |
| 227 Sinai | El Arish | Is | Egy | Div | Div | Flat | Desert |
| 228 Sinai | Jebel Libni | Is | Egy | Div | Div | Flat | Desert |
| 229 Sinai | Gaza Strip | Is | PLO | Div | Div | Flat | Mixed |
| 230 Sinai | Bir Hasana-Thamada | Is | Egy | Div | Div | Flat | Desert |
| 231 Sinai | Mitla Pass | Egy | Is | Div | Div | Flat | Desert |
| 232 Sinai | Bir Hama-Bir Gifgafa | Is | Egy | Div | Div | Flat | Desert |
| 233 Sinai | Nakhl | Is | Egy | Div | Div | Flat | Desert |
| 234 Sinai | Bir Gifgafa | Egy | Is | Rgt | Rgt | Flat | Desert |
| 235 | | | | | | | |
| 236 Golan | Tel Fahar-Banias | Is | Syr | Rgt | Rgt | Rugged | Mixed |
| 237 Golan | Rawiyeh | Is | Syr | Rgt | Rgt | Rugged | Mixed |
| 238 Golan | Zaoura-Kala | Is | Syr | Rgt | Rgt | Rugged | Mixed |
| 239 Golan | Banias-Masaada | Is | Syr | Rgt | Rgt | Rugged | Mixed |
| 240 Golan | Kuneitra | Is | Syr | Div | Div | Rugged | Mixed |
| 241 Golan | Boutmiya | Is | Syr | Div | Div | Rugged | Mixed |
| 242 | | | | | | | |
| 243 Sinai | Suez Canal-North | Egy | Is | Corp | Div | Rolling | Desert |
| 244 Sinai | Suez Buildup-North | Egy | Is | Corp | Div | Rolling | Desert |
| 245 Sinai | Suez Canal-South | Egy | Is | Corp | Rgt | Rolling | Desert |
| 246 Sinai | Suez Buildup-South | Egy | Is | Corp | Div | Rolling | Desert |
| 247 Sinai | Kantara Firdan | Is | Egy | Div | Corp | Rolling | Desert |
| 248 Sinai | Suez Attack-North | Egy | Is | Corp | Corp | Rolling | Desert |
| 249 Sinai | Suez Attack-South | Egy | Is | Corp | Corp | Rolling | Desert |
| 250 Sinai | Chinese Farm 1 | Is | Egy | Div | Corp | Rolling | Desert |
| 251 Sinai | Chinese Farm 2 | Is | Egy | Div | Corp | Rolling | Desert |
| 252 Sinai | Chinese Farm-West | Is | Egy | Div | Div | Rolling | Desert |
| 253 Sinai | Ismailia | Is | Egy | Div | Div | Rolling | Desert |
| 254 Sinai | Jebel Geneifa | Is | Egy | Div | Corp | Rolling | Desert |
| 255 Sinai | Shallufa 1 | Is | Egy | Div | Corp | Rolling | Desert |
| 256 Sinai | Shallufa 2 | Is | Egy | Div | Corp | Rolling | Desert |
| 257 Sinai | Suez [City] | Is | Egy | Div | Corp | Rolling | Desert |
| 258 Sinai | Adabiya | Is | Egy | Div | Corp | Rolling | Desert |
| 259 | | | | | | | |
| 260 Golan | Kuneitra 2 | Syr | Is | Div | Rgt | Rugged | Bare |
| 261 Golan | Ahmediyeh | Syr | Is | Div | Rgt | Rugged | Bare |
| 262 Golan | Rafid | Syr | Is | Div | Rgt | Rugged | Bare |
| 263 Golan | Yehuda el Al | Syr | Is | Div | Div | Rugged | Bare |
| 264 Golan | Nafekh | Syr | Is | Div | Rgt | Rugged | Bare |
| 265 Golan | Tel Faris | Is | Syr | Div | Div | Rugged | Bare |
| 266 Golan | Hushniyah | Is | Syr | Div | Div | Rugged | Bare |
| 267 Golan | Mount Hermonit | Syr | Is | Div | Rgt | Rugged | Bare |
| 268 Golan | Mount Hermon 1 | Is | Syr | Rgt | Rgt | Rugged | Bare |
| 269 Golan | Tel Shams | Is | Syr | Div | Div | Rugged | Bare |
| 270 Golan | Tel Shaar | Is | Syr | Div | Div | Rugged | Bare |
| 271 Golan | Tel el Hara | Irq | Is | Div | Div | Rugged | Bare |
| 272 Golan | Kfar Shams-Tel Antar | Is | Irq | Div | Div | Rugged | Bare |
| 273 Golan | Naba | Jor | Is | Div | Rgt | Rugged | Bare |
| 274 Golan | Golan Counterattack | Syr | Is | Div | Div | Rugged | Bare |
| 275 Golan | Mount Hermon 2 | Is | Syr | Rgt | Rgt | Rugged | Mixed |

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| 276 Golan | Mount Herman 3 | Is | Syr | Rgt | Rgt | Rugged | Mixed |
|---|---|---|---|---|---|---|---|
| 277 | | | | | | | |
| 278 Lebanon | Bekka Valley | Is | Syr | Corp | Div | Rolling | Desert |
| 279 | | | | | | | |

| * Row | Surprise | Defender posture | Success | Atkr troops | Atkr tanks | Atkr arty | Defdr troops | Defdr tanks | Defdr arty | * |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | Atkr | Prepared | Dfdr | 52000 | 50 | 230 | 100000 | 70 | | |
| 3 | | | | | | | | | | |
| 4 | | | Atkr | | 2439 | | | 2160 | | |
| 5 | Atkr | Prepared | Atkr | 48000 | 756 | 202 | 60000 | 200 | 192 | |
| 6 | | | Atkr | 17000 | 218 | | 12143 | 238 | | |
| 7 | No | Hasty | Dfdr | 11821 | 88 | 6 | 18000 | 218 | | |
| 8 | No | Prepared | Tie | 189 | 14 | 0 | 189 | 10 | | |
| 9 | | | | | | | | | | |
| 10 | No | Fortified | Atkr | 1410 | | 14 | 1460 | 20 | 20 | |
| 11 | No | Fortified | Dfdr | 4000 | 30 | 40 | 3010 | 0 | 22 | |
| 12 | No | Fortified | Dfdr | 20000 | 200 | 100 | 8000 | 0 | 37 | |
| 13 | No | Hasty | Both | 1300 | 10 | 4 | 1228 | 0 | 14 | |
| 14 | Atkr | Fortified | Atkr | 57000 | 498 | 216 | 30000 | 120 | 135 | |
| 15 | Atkr | Fortified | Atkr | 147000 | 770 | 1786 | 75000 | 105 | 584 | |
| 16 | | | | | | | | | | |
| 17 | Atkr | Hasty | Atkr | 7000 | 40 | 52 | 12000 | 0 | 56 | |
| 18 | | | | | | | | | | |
| 19 | Atkr | Hasty | Atkr | 9000 | | 8 | 29954 | 55 | 96 | |
| 20 | Atkr | Prepared | Atkr | 132000 | 765 | 370 | 150000 | 852 | 320 | |
| 21 | No | Prepared | Dfdr | 1100000 | 1800 | 5746 | 1372200 | 950 | 6678 | |
| 22 | No | Fortified | Atkr | 1060300 | 667 | 3440 | 880000 | 850 | 2050 | |
| 23 | No | Prepared | Atkr | 54180 | 539 | 880 | 45897 | 258 | 370 | |
| 24 | | | | | | | | | | |
| 25 | No | Fortified | Dfdr | 124000 | 515 | 558 | 120000 | 450 | 576 | |
| 26 | Atkr | Fortified | Atkr | 220476 | 1037 | 908 | 105223 | 593 | 592 | |
| 27 | Atkr | Fortified | Atkr | 220476 | 1037 | 908 | 105223 | 593 | 592 | |
| 28 | No | Fortified | Atkr | 214336 | 745 | 906 | 101528 | 470 | | |
| 29 | No | Fortified | Atkr | 211000 | 700 | 906 | 97000 | 310 | | |
| 30 | Dfdr | Hasty | Dfdr | 465 | 13 | 0 | 188 | 25 | 3 | |
| 31 | Atkr | Hasty | Dfdr | 10300 | 103 | 62 | 22000 | 75 | 124 | |
| 32 | No | Fortified | Atkr | 24100 | 94 | 100 | 5000 | 5 | 34 | |
| 33 | | | | | | | | | | |
| 34 | No | Hasty | Atkr | 12917 | 0 | 138 | 4250 | 128 | 56 | |
| 35 | No | Hasty | Atkr | 12917 | 0 | 138 | 4250 | 38 | 46 | |
| 36 | No | Hasty | Dfdr | 12447 | 106 | 82 | 8390 | 78 | 90 | |
| 37 | No | Hasty | Dfdr | 14730 | 89 | 106 | 11230 | 30 | 146 | |
| 38 | No | Hasty | Dfdr | 15000 | 108 | 164 | 12917 | 30 | 146 | |
| 39 | No | Hasty | Dfdr | 14733 | 98 | 106 | 12691 | 106 | 112 | |
| 40 | No | Delay | Atkr | 14730 | 97 | 152 | 6995 | 58 | 80 | |
| 41 | No | Delay | Atkr | 15576 | 106 | 106 | 6702 | 59 | 80 | |
| 42 | No | Prepared | Dfdr | 13300 | 108 | 164 | 18912 | 96 | 152 | |
| 43 | No | Prepared | Atkr | 14557 | 158 | 68 | 8068 | 39 | 45 | |
| 44 | No | Delay | Atkr | 18210 | 106 | 104 | 6435 | 42 | 51 | |
| 45 | No | Prepared | Dfdr | 16857 | 73 | 160 | 8000 | 22 | 59 | |
| 46 | No | Prepared | Atkr | 21265 | 51 | 199 | 8160 | 39 | 45 | |
| 47 | No | Delay | Atkr | 21265 | 106 | 89 | 6435 | 44 | 43 | |
| 48 | No | Prepared | Atkr | 18480 | 95 | 113 | 7250 | 22 | 59 | |
| 49 | No | Delay | Dfdr | 17034 | 106 | 101 | 5152 | 55 | 51 | |
| 50 | No | Prepared | Atkr | 14600 | 158 | 68 | 8138 | 40 | 45 | |
| 51 | No | Prepared | Atkr | 16400 | 73 | 112 | 7239 | 22 | 49 | |
| 52 | No | Prepared | Atkr | 17500 | 51 | 168 | 8128 | 39 | 45 | |
| 53 | No | Prepared | Dfdr | 14000 | 158 | 68 | 8088 | 39 | 45 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 54 | No | Prepared | Atkr | 16870 | 106 | 92 | 6321 | 30 | 41 |
| 55 | No | Fortified | Dfdr | 19513 | 45 | 160 | 6750 | 38 | 41 |
| 56 | No | Fortified | Dfdr | 16600 | 106 | 110 | 6566 | 54 | 50 |
| 57 | No | Fortified | Dfdr | 17404 | 106 | 110 | 6566 | 54 | 50 |
| 58 | No | Hasty | Atkr | 7942 | 40 | 41 | 5200 | 0 | 112 |
| 59 | No | Fortified | Tie | 16350 | 106 | 106 | 7942 | 42 | 53 |
| 60 | No | Fortified | Dfdr | 17765 | 51 | 130 | 7585 | 12 | 37 |
| 61 | No | Fortified | Atkr | 20744 | 0 | 140 | 3268 | 12 | 34 |
| 62 | No | Fortified | Atkr | 5551 | 0 | 152 | 3283 | 12 | 34 |
| 63 | Atkr | Hasty | Atkr | 19350 | 71 | 130 | 6750 | 46 | 66 |
| 64 | No | Hasty | Dfdr | 15317 | 92 | 130 | 17976 | 71 | 242 |
| 65 | No | Prepared | Atkr | 26029 | 107 | 222 | 9834 | 35 | 122 |
| 66 | No | Prepared | Atkr | 17746 | 71 | 230 | 15098 | 92 | 123 |
| 67 | No | Prepared | Dfdr | 26490 | 107 | 221 | 4515 | 139 | 82 |
| 68 | No | Prepared | Tie | 7418 | 27 | 58 | 5000 | 0 | 76 |
| 69 | No | Prepared | Atkr | 27518 | 113 | 223 | 17730 | 100 | 226 |
| 70 | No | Fortified | Dfdr | 13400 | 70 | 155 | 7077 | 28 | 102 |
| 71 | Atkr | Fortified | Dfdr | 41974 | 201 | 317 | 20496 | 75 | 210 |
| 72 | Atkr | Fortified | Atkr | 21478 | 24 | 167 | 9761 | 59 | 185 |
| 73 | No | Fortified | Dfdr | 15367 | 45 | 164 | 19613 | 106 | 187 |
| 74 | No | Fortified | Atkr | 18702 | 249 | 160 | 9250 | 34 | 123 |
| 75 | No | Fortified | Atkr | 17970 | 107 | 160 | 8141 | 21 | 76 |
| 76 | No | Fortified | Atkr | 16458 | 124 | 154 | 7500 | 21 | 73 |
| 77 | No | Delay | Atkr | 18306 | 249 | 166 | 8215 | 40 | 128 |
| 78 | No | Delay | Atkr | 23190 | 225 | 139 | 7627 | 30 | 58 |
| 79 | No | Hasty | Atkr | 13095 | 130 | 132 | 4563 | 23 | 40 |
| 80 | No | Delay | Atkr | 17912 | 104 | 126 | 6650 | 26 | 40 |
| 81 | No | Hasty | Atkr | 18030 | 131 | 148 | 6653 | 26 | 40 |
| 82 | No | Fortified | Tie | 17345 | 35 | 100 | 12569 | 0 | 92 |
| 83 | No | Fortified | Tie | 17343 | 36 | 100 | 11343 | 19 | 94 |
| 84 | Atkr | Fortified | Atkr | 22374 | 424 | 152 | 12815 | 89 | 107 |
| 85 | Atkr | Fortified | Atkr | 19971 | 106 | 201 | 11928 | 49 | 88 |
| 86 | No | Withdraw | Atkr | 17925 | 110 | 138 | 6957 | 32 | 88 |
| 87 | Dfdr | Fortified | Dfdr | 20683 | 462 | 92 | 12327 | 65 | 64 |
| 88 | No | Fortified | Tie | 19047 | 102 | 97 | 10593 | 19 | 106 |
| 89 | No | Fortified | Dfdr | 18000 | 102 | 93 | 13715 | 71 | 117 |
| 90 | No | Fortified | Atkr | 15557 | 55 | 104 | 7659 | 0 | 64 |
| 91 | No | Fortified | Dfdr | 29711 | 281 | 146 | 15001 | 100 | 117 |
| 92 | No | Fortified | Dfdr | 17300 | 0 | 94 | 6108 | 46 | 61 |
| 93 | No | Prepared | Atkr | 22641 | 106 | 115 | 13012 | 30 | 112 |
| 94 | No | Fortified | Tie | 23604 | 156 | 121 | 19255 | 35 | 202 |
| 95 | No | Hasty | Atkr | 26607 | 126 | 144 | 10311 | 31 | 110 |
| 96 | No | Fortified | Atkr | 38011 | 71 | 200 | 10855 | 0 | 123 |
| 97 | No | Fortified | Atkr | 15721 | 70 | 145 | 5700 | 0 | 29 |
| 98 | | | | | | | | | |
| 99 | No | Fortified | Atkr | 18228 | 107 | 120 | 7500 | 23 | 84 |
| 100 | Atkr | Fortified | Dfdr | 76213 | 1369 | 720 | 57500 | 528 | 292 |
| 101 | No | Fortified | Atkr | 126000 | 650 | 792 | 30700 | 62 | 318 |
| 102 | Atkr | Hasty | Dfdr | 25500 | 120 | 218 | 27673 | 340 | 192 |
| 103 | No | Hasty | Tie | 15646 | 317 | 146 | 8325 | 15 | 76 |
| 104 | No | Prepared | Atkr | 17232 | 318 | 146 | 6000 | 16 | 32 |
| 105 | No | Prepared | Atkr | 40619 | 472 | 296 | 15000 | 38 | 80 |
| 106 | No | Delay | Tie | 59631 | 585 | 520 | 41500 | 160 | 248 |
| 107 | No | Fortified | Dfdr | 60794 | 472 | 296 | 39580 | 88 | 248 |
| 108 | No | Hasty | Dfdr | 7500 | 126 | 12 | 4800 | 122 | 40 |
| 109 | No | Fortified | Atkr | 32283 | 312 | 234 | 19632 | 63 | 116 |
| 110 | No | Fortified | Dfdr | 20493 | 91 | 177 | 20250 | 66 | 114 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 111 | No | Fortified | Atkr | 99583 | 764 | 543 | 23588 | 71 | 99 |
| 112 | No | Fortified | Atkr | 43587 | 326 | 239 | 11185 | 20 | 152 |
| 113 | No | Prepared | Atkr | 25881 | 202 | 142 | 7555 | 16 | 106 |
| 114 | No | Fortified | Atkr | 92393 | 524 | 515 | 28582 | 63 | 169 |
| 115 | No | Prepared | Atkr | 10348 | 115 | 158 | 6519 | 16 | 81 |
| 116 | No | Prepared | Atkr | 88941 | 642 | 519 | 32396 | 66 | 207 |
| 117 | No | Hasty | Atkr | 7935 | 106 | 51 | 8366 | 30 | 64 |
| 118 | No | Prepared | Atkr | 15871 | 211 | 36 | 6299 | 36 | 87 |
| 119 | No | Prepared | Atkr | 16232 | 211 | 104 | 6713 | 43 | 81 |
| 120 | No | Prepared | Tie | 90078 | 624 | 543 | 30712 | 75 | 456 |
| 121 | No | Prepared | Atkr | 19773 | 237 | 156 | 6044 | 23 | 150 |
| 122 | No | Delay | Atkr | 89977 | 624 | 565 | 31501 | 42 | 193 |
| 123 | No | Fortified | Tie | 15224 | 211 | 104 | 5044 | 18 | 99 |
| 124 | Atkr | Hasty | Atkr | 10000 | 4 | 68 | 8634 | 40 | 60 |
| 125 | No | Hasty | Tie | 87000 | 251 | 94 | 19996 | 152 | 108 |
| 126 | No | Hasty | Dfdr | 36678 | 359 | 313 | 4849 | 152 | 18 |
| 127 | | | | | | | | | |
| 128 | No | Fortified | Atkr | 120000 | 316 | 1173 | 30000 | 20 | 182 |
| 129 | No | Fortified | Atkr | 62000 | 320 | 410 | 45000 | 55 | 1180 |
| 130 | No | Prepared | Atkr | 140000 | 868 | 470 | 75000 | 155 | 2115 |
| 131 | No | Prepared | Atkr | 60000 | 280 | 375 | 149000 | 450 | 1600 |
| 132 | No | Prepared | Dfdr | 56000 | 205 | 323 | 129000 | 310 | 1490 |
| 133 | No | Hasty | Atkr | 78000 | 650 | 1380 | 82300 | 505 | 419 |
| 134 | No | Prepared | Atkr | 980600 | 2293 | 6220 | 280000 | 600 | 1600 |
| 135 | No | Fortified | Atkr | 70000 | 291 | 2088 | 15000 | 50 | 171 |
| 136 | No | Fortified | Atkr | 524724 | 778 | 3450 | 210000 | 300 | 1300 |
| 137 | No | Prepared | Atkr | 254950 | 451 | 2650 | 84500 | 229 | 828 |
| 138 | No | Fortified | Atkr | 25100 | 6 | 201 | 8230 | 0 | 44 |
| 139 | No | Fortified | Atkr | 397600 | 490 | 3890 | 72000 | 50 | 1050 |
| 140 | No | Hasty | Atkr | 16100 | 196 | 215 | 8500 | 15 | 82 |
| 141 | No | Prepared | Atkr | 1200000 | 1979 | 11255 | 900000 | 900 | 4800 |
| 142 | No | Prepared | Atkr | 39000 | 34 | 730 | 3300 | 0 | 44 |
| 143 | No | Prepared | Atkr | 38500 | 55 | 718 | 12900 | 103 | 103 |
| 144 | No | Prepared | Atkr | 12700 | 0 | 205 | 5100 | 12 | 78 |
| 145 | No | Prepared | Dfdr | 17550 | 34 | 308 | 6400 | 24 | 156 |
| 146 | No | Mobile | D+dr | 35170 | 410 | | 13725 | 160 | |
| 147 | No | Prepared | Atkr | 1250000 | 1428 | 10469 | 800000 | 400 | 5320 |
| 148 | No | Prepared | Atkr | 2200000 | 4230 | 17990 | 560000 | 1200 | 3050 |
| 149 | No | Fortified | Atkr | 1220000 | 2035 | 15540 | 780000 | 700 | 5740 |
| 150 | No | Fortified | Both | 10800 | 73 | 420 | 3100 | 12 | 78 |
| 151 | No | Fortified | Atkr | 12115 | 190 | 414 | 3900 | 32 | 84 |
| 152 | No | Fortified | Atkr | 13600 | 78 | 233 | 3710 | 5 | 26 |
| 153 | | | | | | | | | |
| 154 | No | Fortified | Atkr | 9000 | 66 | 278 | 4836 | 14 | 53 |
| 155 | No | Fortified | Atkr | 33935 | 144 | 474 | 18300 | 40 | 59 |
| 156 | No | Fortified | Atkr | 3200 | 23 | 330 | 1600 | 0 | 30 |
| 157 | No | Fortified | Atkr | 32000 | 144 | 800 | 2685 | 40 | 120 |
| 158 | No | Delay | Atkr | 22888 | 134 | 95 | 1400 | 0 | |
| 159 | No | Fortified | Atkr | 18398 | 134 | 173 | 2900 | 0 | 32 |
| 160 | No | Fortified | Atkr | 18111 | 151 | 221 | 4731 | 0 | 32 |
| 161 | No | Fortified | Atkr | 16291 | 125 | 221 | 2600 | 0 | 38 |
| 162 | No | Fortified | Dfdr | 14594 | 126 | 203 | 5000 | 0 | 40 |
| 163 | No | Fortified | Dfdr | 15986 | 123 | 226 | 4500 | 0 | 40 |
| 164 | No | Fortified | Dfdr | 15764 | 126 | 329 | 4050 | 0 | 40 |
| 165 | No | Hasty | Dfdr | 6850 | 0 | 60 | 15350 | 140 | 198 |
| 166 | No | Fortified | Atkr | 15109 | 140 | 209 | 5140 | 0 | 30 |
| 167 | Atkr | Prepared | Atkr | 16043 | 0 | 50 | 3338 | 0 | 2 |

| 168 | Atkr | Hasty | Dfdr | 4000 | 0 | 8 | 15777 | 0 | 157 |
|-----|------|-------|------|------|---|---|-------|---|-----|
| 169 | No | Fortified | Dfdr | 15640 | 0 | 171 | 3000 | 0 | 24 |
| 170 | No | Fortified | Atkr | 15205 | 79 | 150 | 2600 | 0 | 3 |
| 171 | No | Fortified | Tie | 16091 | 122 | 129 | 3500 | 0 | 12 |
| 172 | No | Fortified | Atkr | 16002 | 122 | 180 | 2500 | 0 | 12 |
| 173 | No | Fortified | Atkr | 8237 | 40 | 53 | 2500 | 0 | 6 |
| 174 | No | Fortified | Atkr | 15808 | 109 | 141 | 2000 | 0 | 6 |
| 175 | No | Delay | Atkr | 19082 | 138 | 95 | 2000 | 0 | 0 |
| 176 | No | Fortified | Atkr | 16388 | 74 | 174 | 2900 | 0 | 32 |
| 177 | No | Fortified | Dfdr | 21247 | 0 | 246 | 3000 | 0 | 32 |
| 178 | No | Fortified | Atkr | 17163 | 100 | 228 | 3000 | 0 | 34 |
| 179 | No | Fortified | Atkr | 18095 | 97 | 200 | 3900 | 0 | 36 |
| 180 | No | Fortified | Tie | 19714 | 121 | 157 | 3284 | 0 | 34 |
| 181 | No | Fortified | Tie | 20973 | 189 | 210 | 4737 | 0 | 34 |
| 182 | No | Fortified | Atkr | 19658 | 140 | 183 | 4217 | 0 | 34 |
| 183 | No | Prepared | Atkr | 18777 | 113 | 177 | 4000 | 0 | 21 |
| 184 | No | Prepared | Tie | 18660 | 117 | 172 | 4250 | 0 | 11 |
| 185 | No | Prepared | Atkr | 19047 | 115 | 206 | 3250 | 0 | 5 |
| 186 | | | | | | | | | |
| 187 | No | Prepared | Atkr | 30000 | | 100 | 17000 | | 78 |
| 188 | | | | | | | | | |
| 189 | No | Hasty | Dfdr | 11000 | 0 | 72 | 15200 | 215 | 72 |
| 190 | No | Delay | Atkr | 16600 | 200 | 70 | 10300 | 0 | 72 |
| 191 | No | Delay | Atkr | 16400 | 200 | 70 | 9000 | 0 | 28 |
| 192 | No | Delay | Atkr | 16200 | 215 | 72 | 7100 | 0 | 23 |
| 193 | No | Prepared | Atkr | 25500 | 215 | 162 | 27000 | 0 | 748 |
| 194 | No | Hasty | Atkr | 29000 | 215 | 72 | 30200 | 0 | 648 |
| 195 | No | Hasty | Atkr | 26000 | 215 | 72 | 12500 | 0 | 288 |
| 196 | No | Delay | | 30700 | 0 | 240 | 26900 | 215 | 72 |
| 197 | No | Hasty | Atkr | 27900 | 215 | 72 | 35100 | 0 | 203 |
| 198 | No | Hasty | Dfdr | 37000 | 0 | 192 | 13800 | 118 | 85 |
| 199 | No | Prepared | Atkr | 13700 | 118 | 72 | 35500 | 0 | 72 |
| 200 | | | | | | | | | |
| 201 | No | Prepared | Tie | 3000 | 15 | 2 | 3600 | 8 | 4 |
| 202 | No | Prepared | | 4500 | 37 | 14 | 2500 | 40 | 8 |
| 203 | No | Prepared | Atkr | 4000 | 100 | 2 | 2500 | 0 | 16 |
| 204 | No | Hasty | Dfdr | 3000 | 60 | 4 | 2700 | 25 | 16 |
| 205 | No | Prepared | | 6000 | 60 | 32 | 6000 | 60 | 24 |
| 206 | No | Prepared | Atkr | 2500 | 0 | 2 | 3000 | 0 | 8 |
| 207 | No | Prepared | Atkr | 2500 | 25 | 8 | 3000 | 40 | 24 |
| 208 | No | Prepared | Atkr | 6000 | 75 | 24 | 4000 | 90 | 16 |
| 209 | No | Prepared | Atkr | 4000 | 50 | 16 | 3000 | 67 | 12 |
| 210 | | | | | | | | | |
| 211 | No | Fortified | Dfdr | 4700 | 72 | 27 | 4300 | 38 | 32 |
| 212 | No | Fortified | Atkr | 2608 | 40 | 5 | 3300 | 68 | 24 |
| 213 | No | Fortified | Atkr | 10000 | 108 | 32 | 10050 | 108 | 130 |
| 214 | No | Prepared | Atkr | 4000 | 25 | 12 | 6400 | 8 | 44 |
| 215 | | | | | | | | | |
| 216 | Atkr | Prepared | Atkr | 10900 | 100 | 36 | 6160 | 40 | 20 |
| 217 | Atkr | Fortified | Atkr | 27682 | 91 | 72 | 13600 | 40 | 36 |
| 218 | No | Hasty | Atkr | 12800 | 140 | 48 | 9900 | 120 | 24 |
| 219 | No | Hasty | Atkr | 5350 | 90 | 24 | 5450 | 60 | 24 |
| 220 | No | Hasty | Atkr | 10700 | 180 | 48 | 8640 | 84 | 24 |
| 221 | | | | | | | | | |
| 222 | No | Prepared | Tie | 11940 | 128 | 67 | 16168 | 60 | 91 |
| 223 | | | | | | | | | |
| 224 | Atkr | Prepared | Atkr | 19520 | 240 | 84 | 19520 | 197 | 68 |

| 225 | No | Hasty | Atkr | 10450 | 180 | 48 | 10050 | 180 | 48 |
| 226 | Atkr | Fortified | Atkr | 19280 | 120 | 72 | 18450 | 114 | 126 |
| 227 | No | Prepared | Atkr | 6350 | 90 | 48 | 12750 | 78 | 36 |
| 228 | No | Prepared | Tie | 10800 | 184 | 48 | 3000 | 60 | 48 |
| 229 | No | Prepared | Atkr | 12150 | 100 | 72 | 17450 | 134 | 114 |
| 230 | No | Prepared | Atkr | 8700 | 146 | 48 | 3000 | 40 | 24 |
| 231 | No | Hasty | Dfdr | 22000 | 224 | 114 | 7250 | 90 | 48 |
| 232 | No | Delay | Atkr | 10200 | 220 | 72 | 13500 | 172 | 48 |
| 333 | Atkr | Hasty | Atkr | 18780 | 120 | 72 | 18450 | 114 | 72 |
| 234 | No | Hasty | Dfdr | 3500 | 60 | | 3600 | 70 | 0 |
| 235 | | | | | | | | | |
| 236 | No | Fortified | Atkr | 5375 | 10 | 24 | 8160 | 75 | 70 |
| 237 | No | Fortified | Atkr | 5350 | 90 | 24 | 4350 | 50 | 76 |
| 238 | No | Fortified | Atkr | 5850 | 90 | 24 | 8560 | 75 | 82 |
| 239 | No | Prepared | Atkr | 11400 | 184 | 48 | 9080 | 175 | 72 |
| 240 | No | Prepared | Atkr | 16500 | 409 | 72 | 19300 | 505 | 132 |
| 241 | No | Prepared | Atkr | 17550 | 224 | 72 | 16767 | 366 | 108 |
| 242 | | | | | | | | | |
| 243 | Atkr | Prepared | Atkr | 29490 | 67 | 1223 | 4455 | 67 | 40 |
| 244 | No | Hasty | Atkr | 63910 | 464 | 639 | 14000 | 192 | 40 |
| 245 | Atkr | Prepared | Atkr | 22850 | 71 | 971 | 3020 | 52 | 28 |
| 246 | No | Hasty | Atkr | 45160 | 310 | 555 | 10980 | 148 | 24 |
| 247 | No | Hasty | Dfdr | 25850 | 530 | 44 | 67440 | 516 | 639 |
| 248 | No | Hasty | Dfdr | 81160 | 1002 | 585 | 43400 | 714 | 144 |
| 249 | No | Hasty | Dfdr | 37960 | 709 | 447 | 28600 | 348 | 96 |
| 250 | Atkr | Hasty | Atkr | 52790 | 344 | 96 | 30970 | 389 | 322 |
| 251 | No | Hasty | Atkr | 28900 | 444 | 72 | 36840 | 419 | 347 |
| 252 | No | Hasty | Atkr | 19600 | 232 | 72 | 18180 | 293 | 119 |
| 253 | No | Hasty | Dfdr | 17000 | 232 | 72 | 23860 | 246 | 72 |
| 254 | No | Hasty | Atkr | 16200 | 318 | 48 | 35623 | 454 | 150 |
| 255 | No | Hasty | Atkr | 16200 | 318 | 72 | 25600 | 445 | 160 |
| 256 | No | Withdraw | Atkr | 11700 | 126 | 48 | 22570 | 259 | 139 |
| 257 | No | Hasty | Dfdr | 14681 | 225 | 60 | 22570 | 259 | 139 |
| 258 | No | Fortified | Atkr | 10900 | 164 | 36 | 14620 | 199 | 37 |
| 259 | | | | | | | | | |
| 260 | Atkr | Prepared | Tie | 17750 | 75 | 115 | 3630 | 50 | 12 |
| 261 | Atkr | Fortified | Dfdr | 22750 | 147 | 131 | 5745 | 78 | 16 |
| 262 | Atkr | Fortified | Atkr | 19525 | 147 | 129 | 4958 | 75 | 24 |
| 263 | Atkr | Hasty | Dfdr | 21984 | 189 | 129 | 6300 | 106 | 136 |
| 264 | Atkr | Hasty | Dfdr | 12500 | 318 | 71 | 6946 | 110 | 36 |
| 265 | No | Hasty | Atkr | 17833 | 249 | 60 | 23750 | 253 | 150 |
| 266 | No | Hasty | Atkr | 12733 | 219 | 60 | 14683 | 170 | 90 |
| 267 | No | Prepared | Dfdr | 31650 | 182 | 155 | 5395 | 38 | 24 |
| 268 | No | Fortified | Dfdr | 2692 | 9 | 12 | 1583 | 5 | 24 |
| 269 | No | Fortified | Atkr | 16100 | 270 | 60 | 19400 | 329 | 110 |
| 270 | No | Prepared | Atkr | 14700 | 318 | 60 | 21500 | 387 | 130 |
| 271 | Dfdr | Hasty | Dfdr | 12500 | 318 | 71 | 14300 | 318 | 60 |
| 272 | Atkr | Hasty | Atkr | 11000 | 212 | 40 | 12000 | 269 | 70 |
| 273 | No | Prepared | Dfdr | 11500 | 269 | 48 | 11000 | 212 | 48 |
| 274 | No | Prepared | Dfdr | 35750 | 566 | 198 | 16100 | 270 | 60 |
| 275 | No | Fortified | Dfdr | 5700 | 0 | 12 | 4750 | 0 | 27 |
| 276 | No | Fortified | Atkr | 11400 | 0 | 24 | 4750 | 0 | 27 |
| 277 | | | | | | | | | |
| 278 | No | Prepared | Atkr | 34500 | 775 | | 25000 | 362 | |
| 279 | | | | | | | | | |

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