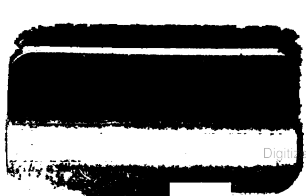

The American Kriegsspiel,

BY

CAPT. W. R. LIVERMORE,
CORPS OF ENGINEERS,
U. S. ARMY.

THE

American Kriegsspiel.

A GAME

FOR PRACTICING THE

ART OF WAR

UPON A TOPOGRAPHICAL MAP.

BY

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PREFACE.

THE American Kriegsspiel, or War Game, has been developed from that of the Germans, its purpose being to represent military operations upon a geographical or topographical map, by small colored blocks, and auxiliary apparatus to which a conventional meaning is assigned.

All the information which in the minor Kriegsspiel is kept in the Record of Losses and Record of the Progress of the Game is in the American Kriegsspiel expressed upon the plan itself by the position of the apparatus. Many new devices have been introduced to enable the exercise to be conducted without delay, and thus serve to diminish the labor and enhance the profit to be derived from it by professional students, as well as to make it more attractive to those not familiar with military operations.

Although the form of the game which is about to be explained has been much modified in this country during the past thirteen years, yet similar changes appear to have been going on in Germany; and some of the methods which distinguish the present

from the earlier forms were undoubtedly first applied to the game in its own fatherland, but it is believed that the mechanism has been much improved, and the labor-saving process more nearly perfected in America than in Germany.

Wherever the same difficulties have suggested like methods of overcoming them it has been the aim of the present work, rather to assimilate the details to the German form, than to preserve that in which they were first applied in America.

The " Regiments Kriegsspiel " of Lieutenant Naumann approaches more nearly than any other to the American method, and to that able work the author desires to express his indebtedness for much valuable information.

The works of Verdy du Vernois, the distinguished Chief of Staff of the First Army Corps, of Meckel, Trotha and Tchischwitz of the German army, of V. Sterneck, Zipser and Mayer of the Austrian, and of Captain Baring of the Royal Artillery, have been freely consulted, and much of the statistical information has been taken from these sources. The remainder has been derived from the standard military text books and from reports of recent experiments and military operations, especially from that of the General Staff, on the War of 1870–1871, etc. The report of Lieutenant Greene on the campaigns of 1877 and 1878 has thrown much light upon several of the new problems.

To Mr. William Popp, Civil Engineer, and formerly an officer of the Bavarian Army, the author is indebted for his first acquaintance with the game, in 1865, as well as for much valuable information in regard to the method of conducting it. To Captain V. Sterneck of the Austrian General Staff, himself the author of an estimable epitome on the subject, and to the officers of all branches of the United States Service, who have aided him in developing it, the author desires to express his gratitude for their kind suggestions.

Since the following pages have been written, two other American works on the War Game have made their appearance; one by Capt. Charles W. Raymond, of the Corps of Engineers, entitled "Kriegsspiel," printed at the Artillery School at Fortress Monroe; and the other by Lieutenant C. A. L. Totten, of the Artillery, entitled "Strategos, the American Game of War."

Captain Raymond has been one of the most prominent among American officers in introducing and developing the exercise: his book describes more clearly than any other the requirements of a proper system, and the course that has been taken in Germany and America to fulfill them. It is not, however, intended for a text-book.

"Strategos," although it is styled the "American Game of War," resembles in many respects the earlier forms of the Kriegsspiel. The distinctive

feature of this system consists in a series of games or "object lessons," calculated to amuse and encourage young military students, rather than to present a faithful counterpart of a battle or a campaign; it includes, also, an "Advanced Game," whose methods are very similar to those of the English translation made by Captain Baring in 1872.

Neither of these works, then, cover the same ground as the present manual.

THE AMERICAN KRIEGSSPIEL MANUAL.

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ABBREVIATIONS.

Or. — Order of considering.
An. — Analysis.
Ex. — Expression.
Cl. — Method of calculating.
Dir. — Direction.
Pos. — Possibility.
Ef. — Effect.
Cq. — Consequence.
Rs. — Result.
Op. — Operations.
Fr. — Fire.
Ft. — Hand-fight.
Mv. — Movement.
Wk. — Work.
Tr. — Troops.
In. — Infantry.
Cav. — Cavalry.
Art. — Artillery.
Eng. — Engineers.
N. C. — Non Combatants.

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THE AMERICAN KRIEGSSPIEL.

CHAPTER I.

CONDUCT OF THE GAME. (TABLE I.)

THE APPARATUS.

§ 1. THE apparatus comprises a large number of small blocks to represent battalions, batteries, squadrons, companies, patrols, officers, etc.; pointers called indices or arrows to indicate the direction of marching and firing; counters, checks, etc., to place upon the map to record the condition of the troops, etc.; dials or dummy clocks, to mark the progress of the game; a firing board to calculate and note the effect of fire, and dice to supply the element of chance.

THE DIFFERENT VARIETIES OF THE GAME.

§ 2. Any of the operations of warfare may be represented upon a map by the Kriegsspiel apparatus, from the tactics of a squad to the strategic combinations of a large army; and the resulting games may be classified accordingly under the following heads:—

(1.) The Tactical Game, representing an engagement in all its details.

(2.) The Grand Tactical Game, representing an extensive battle in a more general manner.

(3.) The Strategical Game, involving the movements of armies over an extended area and for a period of several days or months.

(4.) The Fortification Game, representing siege operations; and—

(5.) The Naval Game.

The pieces are also very convenient for tracing the movements of historical battles and campaigns. They are often used for this purpose, and sometimes for illustrating tactics of instruction; but such applications are too obvious to require explanation.

The most entertaining exercise, as well as the most useful for the army and the militia, is that known as the Tactical Kriegsspiel, and that alone will be described in detail in the present volume.

THE TACTICAL GAME: PREPARATIONS.

§ 3. This game is applicable to any military problem which can be represented upon a map drawn to a large scale, say from $\frac{1}{20000}$ to $\frac{1}{2000}$, or, from three to thirty inches to a mile; and involving any number of troops on either side, from a detachment of a handful of men to an army of 100,000. Although usually conducted under the direction of an umpire this is by no means essential, for the rules are specific enough in their present form to enable the players to agree very well about their application.

§ 4. Where a number of players can be assembled it is better to divide them into three classes, one comprising the umpire and his assistants, and the others the commander-in-chief and subordinate commanders of the Red and Blue sides respectively. If the latter are familiar with military movements the game can

be conducted without previous knowledge of the rules on the part of any but the umpire.

§ 5. The umpire assigns the problem for each side, and if possible communicates it to the commanders a day or two before the time assigned for the exercise to begin. The following are examples of problems suitable for five or six players.

The Red party with three regiments of infantry, each comprising 1,000 men, two batteries of light artillery, each of four guns and 64 cannoneers, and six companies of cavalry of 64 men each, in all 3,640, constitute the advanced guard of an army corps of 20,000 approaching upon the road from A. to B.

The Blue party with four battalions of infantry of 250 men each, one battery of artillery, and two squadrons of cavalry, in all 1,192, constitutes the rear guard of a defeated army now at B.

The problem for the Red party consists in dislodging the forces of the Blue from the hills around C. before the expiration of a certain time, so as to clear the way for the advance of the main body as soon as it shall arrive, and if possible to cut off the rear guard of the enemy, or so force it upon its own army as to delay the retreat of the latter.

Or, the troops might be made to represent the right and left flanks of the opposing armies, with any supposition as to the position of the main body.

The convoy and capture of a train, the capture of a village, a reconnaissance in force, or a foraging expedition, would furnish a good argument.

The forces upon one side might be required to reach a place of safety before being intercepted by their opponents, or to throw themselves upon his line

of communications so as to force him to fight at a disadvantage.

If a large number can be assembled, or if it is not desirable to finish the game at one sitting, a pitched battle can be fought under any circumstances which would be likely to occur in actual warfare.

But unless the umpire and players are somewhat familiar with the technicalities, it is preferable to begin with a small number of troops, not exceeding one or two thousand on either side, and those not acquainted with military operations would do well to commence with a few companies.

§ 6. It is customary to state the problem in writing, and to designate as "GENERAL IDEA" those points which are well known to both sides, such as the general object of the campaign, the result of previous engagements, etc. The instructions to each commander-in-chief contain in addition a "SPECIAL IDEA," which embraces a statement of facts only known to his side, as well as the object he is to accomplish with his troops, which will generally be expressed in the form of orders from his superior.

The commander-in-chief of each side is informed of the exact number of his own forces and the probable number of those of his enemy; but with regard to the latter his information may be entirely erroneous. It may be that the problems assigned to the two parties will be entirely different; for example, one side may be required to attack a village supposed to contain provisions, while the other is directed to advance to a position which will throw him directly across his opponent's path or in his rear, quite contrary to the expectations of both parties.

§ 7. The game differs greatly in its nature from those in which two players contend under equal chances for a certain definite object, as in ordinary games, and it often happens, after the exercise is concluded, that neither side can properly be said to have been defeated.

The commanders should strive rather to make the best use of the means at their disposal than to obtain victory at all hazards, and should aid the umpire in making the exercise approach as nearly as possible to the reality represented.

They should also endeavor to avoid all useless delays and complications which do not materially affect the problem.

§ 8. Each party is furnished with a copy of the "GENERAL IDEA," and one of his own "SPECIAL IDEA," of the time of year, the climate, and state of the weather, etc., and of any details of the topography not fully expressed upon the map.

The commanders are informed of the general positions of their own forces at the hour when the movements are to begin, and are requested to assign each of their subordinates to the command of a portion of their troops. In so doing they should rather keep in view the probable dispositions, than the dignity of the office assigned; for it is highly important that every detachment which is too far from the main body to communicate directly with it should be conducted by a separate player.

§ 9. When the troop-leaders have been notified of their orders and received the necessary instructions from their chief, they are to draw up a plan of their dispositions at the hour of starting, or be prepared to

place their pieces in position before the game commences. The umpire usually indicates the line or points beyond which no outposts are to be placed, and the positions of the head of each column of march, or of each encampment.

It is desirable that the chief of each side should write out a general plan of operations, and give a copy of it to the umpire, together with copies of all his orders and instructions to the subordinate commanders or troop-leaders.

EXERCISE AT THE MAP.

§ 10. At least two copies of the map should be employed when several players can be assembled; and if these maps measure about five feet in length and three in width, they are laid side by side upon two tables, or one large table, with a partition or a screen between them. One is assigned to each of the opposing armies. If a double room is available, it is convenient to place the tables in different rooms against one of the folding doors, so that the troops of each side are hidden from the players upon the other, while the umpire and his assistants, by standing in the door-way, can view the two maps simultaneously.

If two or more commanders upon the same side are, from the position of their forces, out of each other's sight, they are not allowed to converse except by messenger; nor to approach the plan, until all that portion which from the nature of the ground would be invisible to them has been concealed. For this purpose, pieces of paper or cardboard are laid upon the plan, and held in position by weights; or a

pasteboard or wooden screen, with hinges like a fire screen, is set up vertically along the ridge which separates their troops.

If a great many players are engaged in the exercise, more than two copies of the map may be employed to advantage, and when the fight extends over a long line it is sometimes more convenient to place the adjacent wings of the opposing armies upon the same map.

The Tabular Synopses of "Rate of Marching," "Infantry Fire," "Results of Loss," etc., are pasted upon a card and hung across the edge of the folding door or screen, so as to be directly in front of the umpire when he stands in the doorway, but not to interfere with his view of the two maps. The umpire also carries in his hand a card with these tables printed upon it, and other copies should be so distributed that any player can refer to them if necessary. A clock is placed against the screen, on each side, or laid upon a convenient part of the map.

The blocks are placed upon the plan to represent the position of the forces, before the party assembles, whenever time will permit. The position of the commander-in-chief and of the troop-leaders must each be indicated by one of the little gilded blocks representing officers. Whenever any doubt could arise as to the dispositions or orders, everything should be clearly explained to the umpire and his assistants.

§ 11. The following order of proceeding is suggested for complicated situations: —

(1.) The umpire directs the commanders to express their dispositions and indicate the movements and fire of their troops.

(2.) He and his assistants consider the possibility of executing them, without reference to the effect of hostile fire, and cause them to correct their indications if necessary.

(3.) They ascertain how far the orders of the troop-leaders are modified after observing the conduct of the enemy, and cause the indications to be changed if necessary.

(4.) They compute the effect of fire and note the consequences.

(5.) They cause the movements to be performed, decide hand-to-hand fights, and note the consequences.

(6.) They make all other computations necessary to complete the move.

(1.) INDICATIONS BY TROOP LEADERS.

§ 12. It was formerly customary to divide the game into MOVES of two minutes each, both sides moving simultaneously. The effect of fire was computed and recorded for each move before proceeding to the next, and the tables of marching and firing were prepared upon this basis. Sometimes several moves were made at once by both parties, and in critical moments a move was divided into halves or even quarters.

Some recent writers have advocated the move of two and a half instead of two minutes, because this is a simpler factor of five, ten, and fifteen minutes, etc.; and others, objecting to the term "move," have made their computations for one minute, so that they can be more readily converted into any time that the situation demands. In the American Kriegsspiel this unit of one minute has been adopted in prepar-

ing the factors, after a fair trial of the others. The length of the move in every case should be determined by the time that would elapse before the conduct of one side would be so modified by that of the other that a truthful representation of warfare would make it necessary for the troop-leaders to know what had transpired before making further indications. The umpire should carefully consider, in every case, how soon it would be possible for a change in dispositions to be effected. With new players more time is allowed for consideration than they would have in the field, but after a little practice this should not be permitted.

In proportion as the commanders are more familiar with the game the more rapidly will it progress. If the umpire thoroughly understands how each one is accustomed to handle his forces under different circumstances he can often, upon the basis of previous instructions, conduct an extensive movement or a long engagement to the entire satisfaction of both parties.

The game thus approaches the nature of the third form described in the introduction, in which the umpire dispenses with all rules and bases his decision upon the dictates of his own judgment.

The method of conducting a game is admirably illustrated in a pamphlet entitled "Beitrag, zum Kriegsspiel" by Verdy du Vernois.

§ 13. When the length of the move has been determined, the troop-leaders express their movements and fire for as many minutes as the umpire directs by laying the blocks, indices, and arrows upon the plan, as explained hereafter.

§ 14. Silence is absolutely essential to the proper conduct of the game. Under no circumstances can conversation be permitted at the table. The commanders will confine themselves to answering questions put to them by the umpire and his assistants, and for this purpose should retire far enough to prevent their answers from being overheard.

(2.) CORRECTION OF INDICATIONS.

§ 15. The umpire consults Table II. if necessary to aid his judgment in deciding whether it would be possible under the circumstances for the troops to march, to fire, or to fight, in the manner indicated by their leaders, who should themselves be careful to conduct their game so as to require as little exercise of this intervention as possible.

The umpire causes any indications that appear impracticable to be corrected.

(3.) MODIFICATIONS OF INDICATIONS.

§ 16. As soon as the piece representing one of the commanders arrives at a position from which the enemy would be visible, the assistant informs him of the fact, and either duplicates the corresponding pieces upon the plan, or gives him a vague and general idea of the number and character of the troops, according to the circumstances. If this commander wishes to notify the others upon his side of what he has seen, he must send a message, either by courier or signal, handing it to the assistant, who delivers it at a proper time to the player to whom it is directed. The message should be directed to the commander at a specific point.

§ 17. When it appears that important discoveries would be made by other troops than those impersonated by the players, the umpire must use his judgment as to how and when the information should be communicated to the commanders, basing his opinion upon the duty assigned to the troops and the instructions they have received. In every case he should be careful to prohibit any movement based upon circumstances which would not be likely to occur in action, or upon a knowledge of facts which should have been concealed.

§ 18. Instead of duplicating the necessary blocks, indices, and arrows, upon his own plan, the umpire may allow the player to examine as much of that of his opponent as may be necessary for this purpose. In this event, the remainder of the hostile troops should of course be screened or temporarily removed, and dummies should occasionally be placed in other parts of the field, or false indications made there, so that the observer need not be tempted to draw any inference from an accidental exposure of ground that would not properly be visible to him.[1]

§ 19. Then the umpire directs the troop-leaders to communicate any of their present intentions that are not clearly shown upon the plan, and questions them as to how they would probably act in certain cases; but carefully avoids any leading questions, in order that the operations may be properly directed up to the time that information is received or messages are delivered.

[1] After the players are familiar with the exercise it is preferable to have a curtain between the two plans, placing them in parallel positions, and after holding up the curtain for a short time require the players to make their own representations of the hostile forces.

§ 20. If either side expresses an intention to make a charge the umpire asks the troop-leader upon the other side whether and how he will receive it.

If he is not fully satisfied upon all these points, he may conduct an imaginary fight upon one of the plans by placing blocks upon it to represent hostile troops, and while moving them slowly himself, cause the troop-leader to represent the corresponding positions of his own forces. This will enable him to form a clear idea of the commander's instructions and of the efforts that he would make to meet the dispositions of his enemy, even though he should not see fit to allow all the modifications to be made.

If troops are under heavy fire, their leader should be prepared to state definitely to the umpire how heavy a loss he would suffer before taking measures to withdraw them from exposure; for example, what fraction of the entire force.

§ 21. Any MESSAGES that arrive during the course of the move are then delivered to the commanders, and the umpire satisfies himself of their subsequent measures in the same manner.

§ 22. When he has decided how to permit the dispositions to be modified, before the completion of the move, he places the arrows and indices accordingly, or directs the players to do so. It cannot be too frequently repeated that he should be careful to permit no changes to be made more quickly than in his judgment would be possible in reality.

§ 23. When the troops in any part of the field are entirely or generally visible to each other, it is better to place these blocks upon the same map and to let the players represent their hidden movements to the

umpire while the other is absent, by making a diagram, by temporarily using the other map, or by employing blocks to which a purely conventional meaning is assigned for the purpose, known to the umpire and to the players to whom they belong, but not to the others.

§ 24. If it is desirable to preserve a RECORD of the POSITION of the troops and fire, it is now made upon one of the miniature maps.

(4.) COMPUTATION OF FIRE.

§ 25. The commanders now retire from the table and the umpire considers in what part of the field a crisis will first be developed that will have a controlling influence upon the other parts, examining first those places where the fire is most concentrated or where a charge is indicated. He determines for how long a time to compute the fire in this quarter and how much of the line can be treated as one engagement.

§ 26. In estimating the fire in this quarter it is best to CONSIDER FIRST that which is unreciprocated or that which appears to be least affected by hostile fire, so that it will require the least subsequent modification.

It is well to compute a heavy fire directed upon artillery before the fire of the artillery, and finally the general mass of infantry and cavalry fire in this region.

§ 27. The umpire and his assistants COMPUTE the fire as explained hereafter, making use of the firing board and of tables of infantry and artillery fire, Tables III., IV., and X. in connection with the dice.

The number of killed and wounded is recorded with the colored pegs. If it appears after the computation that any of the firing troops have been suffering great losses at the same time, the proper reduction is made in the estimate of their own fire. If the umpire now deems it necessary to modify any of the dispositions of either party in view of their previous instructions, he makes the proper changes and calculates any new fire that may result.

The losses are RECORDED by turning over the pieces so as to bring up a side with one or more spots or stripes upon it.

§ 28. When the loss of any portion of the line becomes sufficiently severe, the umpire refers to Table V. to determine the probability of its taking flight or dispersing; he throws the die, and if the result is unfavorable he causes the block to be removed or conducted to the rear; and if any new fire results from the altered situation he computes it in the same manner as before.

When the effect of fire has been determined and expressed upon the plan, and after any hand-to-hand fight of troops suffering from it has been determined, the arrows are removed and the expenditure of small arm ammunition noted by ammunition blocks.

§ 29. If ARTILLERY FIRE in this region is directed upon artificial structures for the purpose of BURNING or DESTROYING them, reference is made to Table X. to determine the result, which is indicated by means of the black blocks and arrows as hereafter explained, and the labor of working parties is then noted by means of the fortification blocks if necessary.

(5.) MOVEMENT OF TROOPS.

§ 30. The movements of troops in this portion of the field are now performed, according to the indications, in the following order: —

If a hand-to-hand fight is indicated for any of the troops subjected to this fire who have not been dispersed by it, this issue should be immediately decided while the circumstances of the fire are fresh in the memory of the umpire and his assistants.

The movements of other troops are then performed, and lastly of those not subjected to fire.

The distances gained by the troops in marching is computed by the aid of Table VI.

§ 31. In deciding a HAND-TO-HAND FIGHT, all that portion of the line should be regarded as forming a separate combat in which the defenders are fighting under like conditions.

When the umpire has decided how much of the line to treat as a unit, he moves the blocks of both parties up to the time of collision, and refers to the table of infantry or cavalry charge (Tables VII., VIII., and X.) to decide the issue. He then places markers and indices upon the map to note the length of the melée, the direction of the retreat, and the time required for the defeated troops to rally. The indices placed by the troop-leaders are now removed, and if rapid gaits have been employed the corresponding fatigue of the troops is expressed by the counters.

The umpire now considers whether any fresh troops will enter the fight before the expiration of the melée, or in case the fight is composed of several

combats which have not all resulted in a victory for the same side, whether a subsequent encounter would result between the two successful bodies, being guided in his judgment partly by the orders given before the charge and partly by the condition of the troops and their relative positions. He then calculates the result of the new combats if necessary, and records the losses in the melée, determined from Table IX., by turning over the troop blocks so as to expose one or more scores or spots as in the case of losses from fire.

§ 32. Whenever in a cavalry fight it becomes time to consider the PURSUIT (which will not necessarily begin during the move in which the collision occurs) if Table IX. shows that it will be possible, the umpire directs it without further consultation with the troop-leaders, referring to Table IX. for this purpose, and expresses the losses and consequences in the same manner as before.

§ 33. After the operations in the portion of the field first under consideration have been executed and the results indicated, the umpire proceeds in the same manner with the adjacent portions of the line.

He then causes the troops remote from the engagement to move as indicated, removes the indices and blocks for old formations, and places or turns the counters, if necessary, to indicate the fatigue from rapid rates of marching.

(6.) COMPLETION OF THE MOVE.

§ 34. The assistants then examine the MESSAGES that may have been written out by the players, and consider from the situation whether any will soon

reach their destination, and if sent by courier, place a block upon the plan to represent his position at the end of the movement. If a signal station has been established or a telegraph line put up, they calculate how much time would be required for the information to be transmitted, and mark upon these messages the probable time and place of delivery.

§ 35. When the movement has been completed, the umpire sometimes asks the players if they have any SUGGESTIONS to make, or any reason to suppose that their orders were misinterpreted, or that the umpire has overlooked some important point.

If, after they have expressed their opinion, the umpire's decision should be at variance with the views of one of the players, the latter should make a note of the fact, and at the end of the game offer the situation for a general discussion.

After the completion of the movements he causes the clocks to be advanced.

§ 36. Once in every TEN MINUTES, namely, at each even hour of the progress of the game, and at every ten, twenty, etc., minutes after the hour, the umpire examines the counters, checks, and fortification blocks, and turns them over so as to express how much the troops are recovering from their fatigue, or how the work of fortification or destruction is progressing, or the time to rally troops diminishing. (Plate II. — INDICATIONS.)

§ 37. When the umpire considers that the problem has been so far determined as to leave no doubt of the final result or involve any further points of interest, he announces that the game is completed, and expresses his opinion of the causes of success or failure

upon purely military principles; and requests each player in turn to do the same. This DISCUSSION after the game is the proper time for expressing a dissent from the umpire's decisions, and for military men must be regarded as one of its most useful features.

§ 38. Although the methods about to be described will enable the umpire to determine with the utmost rapidity any doubtful point that may arise in the course of the game, it cannot be too strongly stated that all these computations not only need not, but must not, be made in every case, after the players and umpire have had a little practice, especially if they are at all familiar with military operations. They are intended to facilitate and hasten the game and should not be so perverted as to retard it.

The reduction in the rate of march can almost always be estimated; only the important factors should be considered in modifying the effect of fire; unimportant fires should be neglected; the fatigue may be neglected until the players show a disposition to force the troops; the minute marks need only occasionally be employed; and the loss of ammunition need only be expressed when there appears to be difficulty about replenishing it.

§ 39. It must be clearly understood that the decisions of the umpire are final during the progress of the game. The players are to make suggestions only when called upon to do so, and must under no circumstances attempt to urge their own opinions.

CHAPTER II.

INDICATION OF MILITARY OPERATIONS UPON THE MAP BY MEANS OF THE KRIEGSSPIEL APPARATUS. (PLATES I., II., III.)

TOPOGRAPHY. THE MAPS. (PLATE I.)

§ 40. The maps for the Tactical Game, two of which are used with each apparatus, depict the contour of the country by means of horizontal curves differing 10 feet in vertical distance.

The important features are represented by the ordinary topographical signs; the rate of march for troops of the different arms over each portion is sometimes expressed, as well as the time required for crossing fords, etc., and other definite information of like nature.

§ 41. They are divided into squares, and every fifth line is somewhat heavier than the others, so that each side of the small squares represents 200 yards on a scale of $\frac{1}{5000}$, and each diagonal a little less than 300 yards; and of the larger ones the sides correspond to 1,000 yards each, and the diagonals to 1,500 yards.

The squares aid in the measurement of distances and in locating the blocks in corresponding positions on the two maps. They serve also to enable two parties provided with copies of the same map to communicate the positions and movements of the troops upon them by a notation similar to that employed in describing a game of chess.

For example.

VI. 42. — 2 Companies of infantry 32.3 — 16.1 to 33.1 — 15.2 facing N. W.
1 Company of infantry 39.1 — 10.2 to 38.3 — 14.6 facing W. by S.
1 Company of infantry 30.2 — 21.3 rapid fire on artillery at 25.1 — 22.3.

Either noting every block or only the extremities of the line.

§ 42. SMALL COPIES of the map drawn to one fourth of the scale of the larger one are very convenient in assigning the problem, and for recording the successive positions of the troops. The horizontal curves are taken at 20 feet.

INDICATION OF PROGRESS OF TIME.

§ 43. The clocks are used to mark the progress of the game in hours and minutes.

One is placed upon each map, and the hands are advanced when the movements are completed. In the Strategic Game, the hour hand marks the month and the minute hand the day.

The X.'s placed outside the circle of the dial above the numbers II., IV., VI., VIII., X., and XII., serve to remind the umpire that at intervals of ten minutes of Kriegsspiel time certain circumstances are to be noted. The points of time in the progress of the game when the hands pass these numbers are described as X. minute points, the IV., VIII., and XII., are also called XX. minute points.

§ 44. As the progress of WORK is indicated by exposing one score every ten minutes, the fortification

blocks are turned over at each X. minute point, and the checks and the counters, excepting those applied to artillery, are turned back so as to show one less score. If a minute mark is upon a piece it is taken down at the first X. minute point. If a check is upon it and not a minute mark, it is sometimes taken down. At each XX. minute point the counters for artillery are turned back.

REPRESENTATION OF TROOPS. (PLATE II.)

§ 45. The troops are represented by the small blocks of metal, wood, or porcelain. Those of one side are colored red and green, and those of the other side blue and orange.

§ 46. Upon a map drawn to the scale of $\frac{1}{5000}$, or about one foot to a mile, the largest blocks colored light red (Plate II.) may be taken for a company of SKIRMISHERS, deployed at intervals of two and a half yards (three paces), or 64 men in 160 yards (200 paces); such a line as would be formed after deployment by numbers from a battalion of four companies, in single rank, or after doubling a line at intervals of five yards. The shorter ones each represent half a company. A continuous line at intervals of five yards is shown by leaving a space between the pieces equal to their own length; and a denser one, by placing as many blocks as may be required behind or on top of the first.

Any of the blocks may be used for the latter purpose; and if one representing troops in line is placed immediately behind the skirmishers, it is assumed that all are deployed, unless otherwise specified.

Where a single company is deployed at greater in-

tervals than two and one half yards, the extremities of the line may be indicated by two of the smaller blocks of light tint placed at the proper distance apart.

The deeper red and blue blocks may be taken for INFANTRY IN CLOSE ORDER in line of battle, or column at full distance; the longest for a regiment of 16 companies, comprising 1,000 men in two ranks, drawn up in column or line of masses.

The next size, for a battalion of four companies in line of battle, in two ranks, or column at full distance, etc. Those colored on but one side are used for patrols and small detachments, or individual messengers, etc.

The smallest blocks of light tint represent half companies.

Two pieces placed side by side serve to represent a double column of fours, etc.

If it is proposed to adopt the SINGLE RANK as the habitual formation, each block may be taken to represent one half the number above mentioned; and in exceptional cases, one block placed upon or behind another would indicate a doubling of the ranks.

§ 47. It is always assumed that infantry at a halt will lie down whenever exposed to fire, unless otherwise expressly stated, provided the conformation of the ground, or the height of the underbrush or other obstacle does not compel them to take a different attitude in order to deliver their own fire.

§ 48. The darkest red and blue blocks represent ARTILLERY. A stripe of gold serves to distinguish the line of pieces from that of the caissons, the latter being striped with a light tint of their own color.

The larger blocks on this scale may be taken for batteries of four guns, 64 cannoniers and the proper complement of horses and drivers, and the smaller ones for platoons.

Horse artillery is represented by substituting a block for cavalry in place of that denoting the line of caissons (or by a stripe of color complementary to that of the block).

Heavy artillery (three and a half inch), by employing two blocks for line of caissons.

Revolving cannon by another block denoting line of pieces in the same manner.

A mitrailleur battery, of eight guns and 64 cannoneers, by substituting an infantry skirmisher block for the line of caissons.

§ 49. The CAVALRY is painted with a color complementary to that characteristic of the side to which it belongs; namely, green and red for the Red side, and orange and blue for the Blue side; the deeper shade denoting troops in line of battle, and the light tint those deployed as skirmishers.

The long ones, on scale of $\frac{1}{2000}$, may be taken for a company of 64 men at intervals of two and a half yards, like the infantry; and the smaller ones, of light tint, for half a company.

Of the deep green and orange blocks, the smallest represent patrols, videttes, etc.; the next in size can be used for companies of 64 men in double ranks, or half companies in single rank, etc.

The position of the horses of dismounted cavalry is indicated by the original block with an ammunition block placed upon it.

§ 50. The engineer troops are colored purple, with

a stripe of red or blue to denote the side of the battle to which they belong.

§ 51. Four of the longest black and purple blocks represent a division of a reserve PONTON train in single file; and one of these blocks would correspond with the length of the bridge when laid. Four of the next in size represent an advance guard division, and one of them the length of the canvas pontoon bridge.

§ 52. Telegraph, baggage, supply TRAINS, etc., are indicated by the black pieces with red and blue ends respectively, the long ones for ten wagons, and the short ones five wagons each, in single file.

The black pieces with yellow ends may each be used for eight ambulances.

§ 53. The long black pieces either represent five wagons each loaded with 20,000 rounds of small arm AMMUNITION, and the short ones five mules, each carrying 2,000 rounds, or these blocks are used conventionally in a manner hereafter described.

§ 54. At the beginning of the exercise each troop-leader receives from the umpire the necessary blocks to represent all the troops of his command and a sufficient number of others for the different formations that he may subsequently require, such as skirmishers, detached companies, etc. The surplus blocks are kept in a small box by themselves.

The umpire and his assistants carefully note their number so as to correct any error that may arise in the progress of the exercise.

When a deployment or other TACTICAL CHANGE is to be represented, the troop-leaders place the blocks representing the new formation in their position at

the end of the move, noting also, with the indices, the line of march for each flank.

After the completion of the move, the umpire removes the blocks that indicated the old formation and puts them in the box from which the others were taken.

Another box is kept to receive those troops that have been dispersed, so that the number upon the plan may at any time be verified.

§ 55. The pincers are used to handle the blocks and indices. It is important that the former should not receive rough treatment on account of the danger of defacing them.

They may be kept in the pasteboard boxes during the progress of the game, but should be replaced in the trays if they are to be subjected to rough travel.

INDICATIONS OF MOVEMENTS, FIRE, ETC., OF THE TROOPS. (PLATE III.)

§ 56. The metallic pointers, although similar to those of Meckel, Zipser, and others, receive in the American game a more extended application. Those resembling swords are called indices, and are laid in front of the troop blocks to point out the direction and represent the gait at which the troops are moving. The short ones would correspond to a distance of 200 yards (250 paces), or that passed over at a walk in two minutes and a half.

The scores serve to divide the length of each into tenths, for convenience in measuring the distance gained in one minute or quarter minute, etc.

§ 57. Thus, if a MARCH of five minutes (often a convenient unit) is to be considered, two small indices

placed in front of an infantry block represent a walk, two long ones double time, and one or two small ones partly withdrawn a walk and halt, or a walk over difficult ground. Placed in front of a cavalry block, two small indices represent a walk, two long ones a slow trot, three long ones a fast trot, and four long ones a gallop. A march of ten minutes is represented by doubling the number of indices; and a shorter one by withdrawing the index, so that the point marks the spot reached at expiration of the time represented.

When troops prepare to SWIM across a stream a minute mark shows the time that preparations begin.

§ 58. The other pointers are called arrows, and are placed in front of the troop blocks to show the direction of their projectiles and the amount and nature of their FIRE. A short arrow placed in front of an infantry block represents common fire for five minutes, two short arrows (one before the other) rapid fire. One short one advanced four scores represents slow fire for four minutes or common fire for two minutes. A short arrow before an artillery block represents canister fire, a long one case shot, and a long and short one shell fire for five minutes. A short arrow laid across the end of the others, shows that the fire is maintained for five more minutes.

§ 59. To show that the troops walk for 200 yards, and then fire for five minutes, a short index is applied to the block and an arrow to the point of the index.

An advance by alternately springing forward and

lying down to fire is shown by an arrow and index placed side by side and withdrawn as far as necessary.

EXPRESSION OF THE CONDITION OF TROOPS.

§ 60. As the colored blocks represent the nature and number of the troops, and the pointers indicate what they are doing, so the marks upon the different sides of the blocks serve to express their condition. The stripes and dots which mark the different sides of the blocks are called scores.

EXPRESSION OF THE LOSS OF POWER.

§ 61. When the troops are first brought into action, the blank side of the troop blocks should be up, and the end on which the other sides are scored should be to the right (facing the enemy).

The gradual reduction in the power of troops who have been in action, is represented as follows. One score turned up shows a loss of two tenths of their fighting power; two scores show that they retain but six tenths; three scores, four tenths. A further loss is shown by removing the blocks in succession. When a few men are killed and wounded by hostile fire, but not enough to reduce the strength of the organization by two tenths, the number is sometimes indicated by placing one of the little blocks called minute marks behind the troops, with a figure turned up to show the loss of men. A minute mark in front of the troop-block notes the minute when the score was turned up on the block.

The reduction in the firing power of artillery is expressed in the same manner, by the scores turned up on the line of pieces; each score denotes a reduction of two tenths as in case of the other arms.

TO EXPRESS FATIGUE.

§ 62. The white blocks with stripes are called counters. They are placed in front of troops who have been marching rapidly, a counter with one score turned up indicating that the troops to whom it is applied are fatigued from two and a half minutes' excessive use of these gaits.

TO EXPRESS THE DISORGANIZATION OF TROOPS WHO HAVE BEEN IN ACTION.

§ 63. The white blocks with dots resembling dies are called checks, and are placed in front of the troops to show that they require as many minutes to rally as ten times the number of dots exposed.

These checks placed on the top of the troop blocks show that they are not in condition to resist an attack.

TO EXPRESS THE ISSUE OF A HAND-TO-HAND COMBAT.

§ 64. An index is applied to the defeated troops, to point out the direction of retreat. A check placed upon the troop-block shows, by the number of spots exposed, the number of minutes in the melée. A small block with figures, called a minute mark, is laid on the troops by the side of the check, to indicate the minute of the progress of the game at which the melée terminates. At the next X. minute point, the minute mark is placed in front of the troop-block.

TO EXPRESS EXPENDITURE OF AMMUNITION.

§ 65. The black pieces representing ammunition may be used conventionally to represent by their scores the amount of ammunition that has been expended. In that case the large blocks with one score turned up indicate that 20,000 rounds have been expended along the line in front of them without regard to the original supply, etc.

The small blocks represent 10,000 rounds each, or the load of five pack mules, and one score corresponds to that of one mule.

A long ammunition block with one score up behind the line of caissons of a battery shows that it has been firing for 20 minutes, etc.

§ 66. TO EXPRESS THE WORK OF FORTIFICATION or of construction or destruction, the black and white pieces are laid along the line occupied by the working parties, each extremity of the line being marked by one of the white ends. The total number of scores expressed on the blocks will then represent the number of X. minute points since the work was begun, and a minute mark will show the exact minute after the X. minute point, at which it will be completed.

§ 67. Thus, fortification blocks are placed in front of troops in the open ground, to show that they are digging a shelter trench or battery, etc.; along the edge of a forest or village, that it is preparing for defense; across a stream, that the troops are building a bridge; along the bank of a stream, and across a bridge, that they are destroying it. A bridge is covered with a piece of paper to show that it is destroyed.

§ 68. When a ponton train is drawn up along the banks of a stream, the scores and minute marks note the time of loading or unloading. To indicate progress of the bridge, lay a block across the stream, and the number of scores will show the progress of the work. Minute marks are always removed when the work is completed.

§ 69. The ammunition blocks are used in connection with the arrows to show that a building is burning. The arrow points in the direction that the wind is blowing, and the ammunition block placed at the point shows the number of minutes that a wooden building has been burning or half the number that a stone building has been burning.

An ammunition block placed behind the arrow notes the amount of artillery fire that has been directed upon it with a view to setting it on fire.

CHAPTER III.

THE COMPUTATIONS. (PLATE IV.)

GENERAL PRINCIPLES ON WHICH THE COMPUTATIONS ARE BASED.

§ 70. THE factors upon which the game is based have been determined from a comparison of military statistics, made with the utmost care, and subjected to long and severe tests by constant practice of the game in the German army; they have been modified to conform to the improvements in fire-arms since the war of 1871, and completed by reference to other military authorities, and by original investigation in case the ground has not been covered by previous works on the subject.

The propriety of some of the changes has been clearly demonstrated by the results of the war of 1878 between the Russians and the Turks.

It is by no means assumed that these factors are invariable, or that causes apparently identical will always produce the same results; but it is of great advantage to be able at once to ascertain the average experience with regard to any point that may arise in the course of the game, or in actual warfare.

§ 71. The action of troops in the field is much modified by the circumstances under which they are placed.

Their fire is sometimes much more effective than at others. They sometimes take flight at the appearance of dangers which at other times would not disturb them. When favorably situated, they fight to advantage at close quarters against far superior numbers, and their rate of march varies greatly over different kinds of ground.

§ 72. Simple cases have therefore been taken as STANDARDS of the FIRING, FIGHTING, and MARCHING capacity of ordinary troops, and expressed in terms of distance, strength, number, etc., upon the scales of the Firing Board, and by the scores of the indices, etc.

The circumstances that modify their action are then classified and weighed, and the effect of each is expressed in a RATIO between the modified case and the standard.

It generally appears that when a great many mod ifying circumstances co-exist, the influence of each is essentially the same as that expressed by this ratio; and that the combined influence of all produces the same modification as that which would be expressed by applying each of the ratios in succession, or by multiplying the standard case by the product of all.

Thus the values expressed in Table III. of the influences that modify the effect of the fire of one company of infantry upon another at a given distance, enable the scale of fire to be applied to an indefinite number of distinct suppositions, by making the necessary combinations of the different factors.

§ 73. After all known circumstances have been considered, the computation shows only the probable

result, and the unknown influences are generally accounted for by throwing the die before applying it to the case under consideration. The range assigned to the effect of CHANCE depends upon the discrepancy in the results of experience under similar circumstances. Thus the distance that troops march over certain ground for a short time can be determined with great accuracy; the effect of fire can be predicted to within one half, and the victory in a hand-to-hand fight may always be decided in favor of that side which appears to possess four times the strength of its opponents.

The conduct of troops under fire cannot be determined with as much accuracy as the number of killed and wounded, and in expressing the probability of dispersing, it becomes necessary to assign a wider range to the element of chance. Although a company is sometimes dispersed and passes out of the control of its officers after the loss of one twelfth of its numbers, it sometimes happens that good troops retain their organization after the loss of one half.

The unknown influences are expressed in the game by determining with the die whether the troops are fortunate or otherwise, and making a slight modification for chance, in the result of the computation, in the same manner as for circumstances which can be estimated.

METHOD OF APPLYING THE RESULTS OF EXPERIENCE TO THE IMAGINARY WARFARE OF THE GAME. — THE FIRING BOARD. (PLATE IV.)

§ 74. The umpire's measurements and calculations are made by means of the Firing Board, which he uses in connection with the tables and with the dice, to determine and record the losses from fire, the result of a hand-to-hand fight, etc., etc.

§ 75. On the left upper corner of the board is printed a SCALE of DECLIVITY which is applied to the horizontal contour lines of the map.

§ 76. Immediately below is the table for TALLY OF TIME. As an illustration of its use: one white peg in the hole marked VII. another in the 20, and another in the 11, would in the Tactical Game indicate that it had progressed as far as 31 minutes past VII.; in the Strategical Game, as far as the evening of the 31st of July.

§ 77. Along the right edge of the Firing Board the figures denote the number of hundred yards; the next column is the SCALE OF INFANTRY FIRE and shows the rate of loss in men per minute, that would be sustained by troops under certain circumstances, from the fire of one company of infantry at corresponding distances.

The SCALE at the top applies to ARTILLERY FIRE up to 1,500 yards and the two at the bottom to greater distances up to 4,500 yards.

§ 78. On the left side of the Firing Board is printed the COMPUTING TABLE, which is used to facilitate the calculations of loss from fire, relative strength of opposing forces in a hand-to-hand fight, etc., etc.

The numbers in this table follow each other in geometrical progression, so that each is about one tenth greater than that which precedes it in the series.

The Roman numbers refer to the relative chances of success in a hand-to-hand fight, and of dispersing when troops are subjected to heavy fire.

On the left is a TABLE of MULTIPLIERS, or a list showing the number of points or holes that the pegs must be advanced in the Computing Table to multiply by the numbers in the left-hand column, or set back to divide by these numbers. It will appear by examining the series of the Computing Table that each number is twice as great as that 6 places before it, within the necessary limits of accuracy, it is ten times as great as that 20 places before it, and one hundred times as great as that 40 places before it, etc. Thus the Computing Table is used as a handy multiplier, and the columns referred to correspond to a rough table of logarithms.

The black pegs are generally used for these computations.

A sliding scale is sometimes used instead of the Computing Table.

§ 79. The table on the right is used to keep a TALLY OF LOSSES.

The pegs corresponding in color to the troops are inserted in their respective holes to show the number of killed and wounded, expressed in battalions, regiments, etc., according to the organization that may be adopted. The tally board may be also used as an addition table in making computations, or for any kind of memorandum.

THE DICE.

§ 80. The dice, besides their use in connection with the scales for fire, are employed to aid the umpire in deciding many points that arise in the course of the play, and that are explained under the proper headings.

One die is made larger than the others, so that a special value may be assigned to its faces whenever it becomes necessary to discriminate chances with the utmost detail, and to save the time that would sometimes be consumed in making two throws.

THE RATIOS.

§ 81. The ratios can either be expressed in the form of vulgar or decimal fractions, or they may be compared with the terms of the geometrical progression upon the Computing Table. Each term of the latter differs from the following one by only one tenth of its value, and a greater degree of accuracy is not attempted in these calculations.

§ 82. To find a number bearing to another a given ratio expressed in the form of a vulgar fraction, it is only necessary to advance the number as many places in the series as shown by the number in the column headed Pts. in the Table of Multipliers, opposite to that expressing the numerator, and to set it back as many as that opposite the denominator ; if expressed in the form of a percentage, to set it back 40 places and advance it as far as necessary. The number of places may also be determined by counting the spaces from 1.0 in the series.

Thus to find $\frac{18}{20}$ of 2.2, put a peg in the hole corre-

sponding to 2.2, find in the Table of Multipliers the number of points opposite 18, namely, 25 points, advance the peg 25 places in the series, to the hole marked 40, find the number opposite 20, namely, 26, and set the peg back 26 points to 2.0, which gives a result near enough to 1.98 for all purposes of this game; or instead of advancing it 25, and setting it back 26, simply set it back one point at once. To obtain .9 of 2.2, advance the counter 19 and set it back 20 places,

To find $\frac{1}{4}\frac{3}{7}$ of $6.2 \times 1.2 \times \frac{2}{3}$ of 23 per cent. of 139, set the peg in the hole 140, and move it $23-25+16+2+6-10+27-40=-1$ place to the hole 120, a much shorter operation than the ordinary method of multiplying, which would require a great deal of figuring even if all but the two left-hand figures were rejected.

THE CHANCES OF SUCCESS.

§ 83. Both dice are used to decide the result of a fire fight as well as that of a hand fight. Thirty-six different chances could be discriminated if necessary, but by taking the sum of the two readings, the computation is simplified. and sufficient accuracy is attained for all purposes of the game. The 25 terms of the series in the Computing Table on each side of unity, namely from .24 to 4.0, are found to indicate very nearly the probability that a company of 64 men will be dispersed after the loss of ten times as many men as the number corresponding to the term.

A combat at close quarters can safely be decided without the element of chance, when the attack is more than four times, or less than one quarter as

strong as the defense, etc., and it will appear that the 25 points of the series form a convenient scale for determining the result of a hand-to-hand fight. The companies are therefore taken at 64 men in ranks, which is a suitable number from several other considerations.

When the Computing Table is used for discriminating chances of success, a peg placed in the sixth hole of the 25 above mentioned (.45) denotes six chances in 25, that the troops fired upon or charged will be driven back; in the 13th hole, namely, 1.0, it indicates 13 chances in 25, etc., and the Roman numbers corresponding, namely V. to the sixth hole and VII. to the 13th, indicate that they are to be dispersed or saved according as the sum of the pips that turn up on two dice amounts to more or less than V. or VII. respectively.

THE TABLES.

§ 84. In drawing up the tables of fire, etc., the modifying circumstances are classified and arranged in horizontal lines for convenience of reference. The numbers at the head of the columns show the modifying effect of each upon the standard on the scale, expressed both in the form of a percentage and in the number of holes or points in the Computing Table that the peg must be advanced or set back in making the calculations. The letters in parentheses serve to remind the umpire of the order in which the different tables or parts of tables should be consulted, and another with a bracket is added for reference wherever the natural order is not to be followed. The manner of expressing the result in the language of the game, is indicated at the foot of each table.

CHAPTER IV.

MUSKETRY FIRE. (TABLE III.)

§ 85. In analyzing a combat with fire-arms, *the first point* to be considered is the number of men who would be put *hors du combat* by the projectiles; *the second*, the change produced in the effective strength of the forces, arising from the diminution of numbers, the exhaustion of the combatants, and the dangers to which they are exposed; and *the third*, the probability of their passing out of the control of their leaders and dispersing.

§ 86. If one company of infantry, comprising 64 men armed with breech-loading rifled muskets, such as the Springfield, the Remington, or the Peabody, is deployed as skirmishers, lying down and firing at the rate of about six rounds in a minute, at another line directly in front of it and distant about 500 yards, lying down in an open plain, at intervals of two and a half yards or three paces, in a line at right angles to the line of fire, and firing upon the first with about equal effect, and if the company first mentioned is composed of soldiers of average ability belonging to the offensive party, perfectly fresh in the fight, but long enough upon the ground to have formed a fair conception of the distance, it may be inferred that it will inflict a loss

in killed and wounded, at the average rate of not less than .45 men in a minute, as shown by the scale for infantry fire on the Firing Board.

§ 87. If the DISTANCE were 100 yards instead of 500, this rate would not be less than that of 1.5 men in a minute; at 1,000 yards, .11; at 1,200 yards, .06. Beyond this distance and up to nearly 3,000 yards the rate would diminish by one half for every 250 yards.

§ 88. The average number of killed and wounded, under different circumstances, may be conveniently expressed by referring to the case above stated, as a STANDARD, and showing what proportion of this loss should be estimated if each of the conditions were modified in succession, while the others remained unchanged.

These conditions will now be considered as they refer to: —

(1.) The troops who are delivering the fire.

(2.) The relations between the troops on the opposite sides.

(3.) The troops subjected to the fire; and

(4.) The troops who chance to suffer from the fire which is not directed upon them; generally those behind the line fired upon.

(1.) THE TROOPS FIRING.

§ 89. If these 64 men are not skirmishers, but in single rank FORMATION, the number of killed and wounded from their fire may be estimated at 80 per cent. of that above-mentioned; in double rank formation 70 per cent.; or respectively 20 and 30 per cent. less than from the standard fire.[1]

[1] It has been maintained that at target practice the percentage of hits of

If their POSITION is not lying down in the open plain, but mounted on horseback, 12 per cent.; if standing, 80 per cent.; if kneeling, 90 per cent.; if they are firing from behind a log, an embankment, or a window sill, which not only shelters them from hostile fire, but affords a suitable rest for the pieces, their fire may be taken at 120 per cent. of the standard.

§ 90. If they are in MOVEMENT springing forward a short distance, and then lying down to fire, 40 per cent. (They would have time to fire about twenty rounds in five minutes.) If firing as skirmishers in advance or retreat, 60 per cent. (They would not be able in this case to fire more than three rounds in a minute.)

Their PREVIOUS MOVEMENT would also affect their fire; which, for a minute or two after they have been moving in double time, may be estimated at 60 per cent.; and if they have been exhausted by too frequent running, or fatigued by labor of any kind, a proportionate reduction should be made. Immediately after marching at a walk, 90 per cent.

§ 91. If they are firing at the rate of 3 rounds in a minute, 60, 12 rounds in a minute, 160 per cent., etc.; these rates are known as slow and RAPID FIRE respectively. While discharging the magazine of a repeating rifle at the rate of 48 cartridges per minute, four times the effect of common fire.

If the troops are firing at a new object whose distance is not known, their fire is not likely to be more than half as effective as in the general case during

a large body firing simultaneously, is much less than that of a small body; but this is probably because the former produces an excitement akin to that of a battle-field.

the first minute; but CONTINUED FIRING exhausts the soldier, as well as continued marching; and after about 60 rounds, or ten minutes of common fire, the effect is generally about 90 per cent.; after twenty minutes, 80 per cent.; after twenty-five minutes, 70 per cent., etc.

(2.) RELATIONS.

§ 92. The relations between the troops firing and those under fire, may be considered under the same general headings, — namely: their position, movement, and fire.

If there is a marked difference in ELEVATION, so that troops in LINE are compelled to fire upwards at an angle of 10° with the horizon, their fire may be regarded as 60 per cent., if at an angle of 5°, 80 per cent., as effective as in the general case.

With SKIRMISHERS, if firing up 15°, 60 per cent.; if up 10°, 80 per cent.; if up 5°, 90 per cent., etc.

If the LINE subjected to fire is not at right angles to the path of the projectile, but makes with it an ANGLE of 60°, the fire is about 120 per cent. as effective; if 45°, 160 per cent.; if 30°, twice as effective.

If the INDIVIDUAL soldiers in this line are not facing the troops who are firing upon them, but are firing in another direction and lying at an angle of 90° with the path of the projectiles and thus exposing twice as much surface to the shower, the fire upon them is twice as effective. At an angle of 40° with the line of fire, 160 per cent.; and at 10°, 120 per cent. The same principle applies to the exposure of mounted troops marching across the line of fire.

If the line to which the fire is directed is shorter than one tenth of the distance from the troops who are firing, the balls which pass to the right and left are sufficiently numerous to be considered; and where the line measures only one hundredth of this distance, its APPARENT SIZE is so small that musketry fire directed against it is only about one fourth as effective as against a long line of equal density; for example, in firing against a line of three skirmishers at intervals of two and a half yards and at a distance of 500 yards (600 paces) the rate of loss would be .11 per minute instead of .45 as in the standard case. If the width of the target is .02 of the distance, 40 per cent.; if .03, 50 per cent.; .04, 60 per cent.; .05, 70 per cent., etc.

§ 93. If the TROOPS fired upon, whose apparent size is less than one tenth, are MOVING directly across the line of fire at a walk, they only suffer about 80 per cent. of the loss of those standing still; if at double time or a trot, .50; if at a gallop 25 per cent. If their apparent size is very small, a still further reduction may be estimated. If moving in the line of fire, the diminution of effect would be about one half as great at distances beyond 400 yards (500 paces).

§ 94. Troops subjected to a heavy fire generally suffer a proportionate diminution in their own efficiency for firing. If under these circumstances no shelter is at hand, their fire becomes rapid and wild; but the effect of heavy fire upon troops behind shelter is such as to discourage them from making any attempt to reply.

This effect is very different upon troops who have been generally *successful* in previous engagements,

and are now fighting upon the *offensive*, from that upon those who belong to the side which has generally been *defeated*, or who are now acting upon the *defensive*.

In the case of SUCCESSFUL troops, if instead of sustaining a loss about equal to that which they are inflicting, they were suffering twice as much, it is estimated that their fire would be 90 per cent. of the general case; if suffering four times as much, 80 per cent. If attacked by surprise, *i. e.*, if cavalry suddenly appear within a distance of 400 yards, and make a charge upon them, or if infantry unexpectedly fire, or rush upon them from a distance of 200 yards or one minute's march, their fire is reduced to about 70 per cent.

The fire of DEFEATED troops is generally reduced to 80 per cent., when subjected to a fire twice as strong as their own; if four times as great to 70, and if attacked by surprise, to 50 per cent.

(3.) TROOPS FIRED UPON.

§ 95. When troops in the field fire upon each other at any considerable distance, the accuracy of their aim is not sufficient to enable them to single out an individual in a skirmish line; but the shower of projectiles is about equally distributed over the area occupied by the *target*, a term universally employed in this exercise to denote the troops or object subjected to fire.

If the company above described were spreading out their fire over a wider target, *i. e.*, one composed of a longer line of skirmishers at intervals of two and one half yards, the total number of killed and wounded

would be the same; but if the same extent of line were occupied by twice the number of men, namely, by 128 men at intervals of one and one fourth yards, it is probable that twice as many would be killed as in the case assumed as a unit.

It is true that at very short ranges a good marksman would be able to pick off a single man from a line of skirmishers, yet this kind of fire rarely finds its application except where both parties are well covered, as in siege operations, etc. To attack in the open field, it becomes necessary to reënforce the line in proportion to the advance, and before reaching close quarters, it presents a continuous wall of skirmishers so that but few exceptions need be made to the general rule, which assumes that along the front of a line of battle subjected to hostile fire the loss sustained upon any length of this front will be proportional to the number of men occupying the front; and that the loss inflicted by a given amount of fire will be proportional to the thickness or density of the target, and the following proportions of the numbers above given represent the losses sustained by troops in different FORMATIONS from that taken as a unit.

A skirmish line at five yards, 50 per cent.; a line at one and a quarter yards, such as would be formed by deploying two from each set of fours, would lose twice as many as in the standard case.

A line of battle in one rank 4 times, in two ranks 8, in a column comprising four subdivisions in double rank 16, and one of eight such subdivisions 24 times as many.

If the troops fired upon are not lying down in open plain, but firing through *loopholes*, the loss would be

6 per cent.; if behind *abattis*, 12; behind a trench, 25; firing over the *crest* of a hill, 40; from the edge of a forest, 50 per cent.; behind a hedge which screens them from observation, but affords no barrier to the passage of the projectiles, 90 per cent.

If instead of lying down continually, they are advancing alternately by *springing* forward and firing, 1.20; if kneeling, 2; standing, 4; and if *mounted* on horseback, 8 times as many. (This estimate takes account not only of the difference of surface exposed, but also of the difficulty of aiming at a small object.)

(4.) TROOPS BEHIND THE LINE.

§ 96. But beside those shots which fall somewhere upon the front line of the enemy's forces, many that pass over their heads will strike the troops behind them. The trajectory of a rifle ball is more than twice as flat at 500 as at 1,000 yards, but the projectiles are more widely dispersed at the longer ranges and many circumstances tend to equalize the *relative* loss of the first and second lines at the different distances. It will be sufficiently accurate for ordinary purposes to assume that on level ground the shower is one half as dense 200 yards behind the line, as on its front, one fourth as dense 250 yards behind, etc., but the *formation* of the troops behind the line can have no influence upon their losses, unless, indeed, they are so densely massed that the front ranks form a wall of human flesh thick enough to intercept the projectiles and thus shield their comrades behind them.

Thus, behind a line, a company of infantry in column of platoons would suffer no more than the same

number of men deployed as in the standard case assumed; — two companies, however, would lose twice as many men as one company, and a company standing up nearly four times as many as one lying down.[1]

The ratio of the loss sustained by troops behind the line, if sufficient in number to cover the extent of front when deployed at intervals of two and one half yards, to that sustained by those in the first line deployed in this manner, may be estimated as follows: —

In the HORIZONTAL PLANE OF FIRE, that is, in the plane passing through the troops firing and those fired upon, if 200 yards behind the line, .50; if 350 yards, .25; if 450 yards, .12; if 600 yards, 6 per cent.

If they are 5° BELOW the plane of fire, and not sheltered from it, and 400 yards behind the line, .50; if 500 yards, .25; if 600 yards, .12; if 700 yards, 6 per cent.

If 10° below and 500 yards behind, .50; if 700 yards, .25; if 1,000 yards, .12; if 1,200 yards, 6 per cent.

CHANCE.

§ 97. In no case can the effect of fire be predicted with absolute certainty. Even the best marksmen are liable to errors, which cannot be estimated nor accounted for. When the various causes which influence the effect of musketry fire in the field are taken into consideration it will appear that military calculations in which this fire enters as a factor should not

[1] This statement is made upon the supposition that circumstances preclude the possibility of directing the aim at the troops in the rear, who otherwise are to be regarded as "Troops fired upon."

be based upon the assumption that the result in any particular case will conform to the average experience under like circumstances, but the possibility of a very different result should be considered. Reserves should be in readiness to replace troops who are unaccountably slaughtered and dispersed, and successive attacks will often produce results altogether incommensurate with the strength of the forces which are engaged at the critical moment.

It is believed that by considering all the elements enumerated, the effect of the fire of infantry can be calculated so nearly, that by taking the greatest value at less than twice the smallest, the majority of cases will be covered by the estimate. The scales are prepared for the minimum effect.

KIND OF TROOPS FIRING.

§ 98. But if, instead of ordinary troops of the line, a corps of selected marksmen are to be considered, such, for example, as would be found by collecting the best shots of a regiment into the two flank companies, it would be safe to estimate their fire to be twice as effective; the fire of raw recruits to be one half as effective as the standard.

The fire of dismounted cavalry, armed with the single loading carbine, is less effective than that of infantry, both from the inferiority of the weapon and from their condition for a long time after dismounting, so that it may be estimated as about equal to 60 per cent. of that of the same number of ordinary infantry, up to 1,000 yards, and to a smaller fraction beyond that distance.

A battery of eight Gatling mitrailleurs is more

or less destructive in its effects than 16 companies of infantry, according to its location, and the facility of observing the effects of fire. Its fire is modified by circumstances that affect the fire of artillery.

CAVALRY AND ARTILLERY UNDER FIRE.

§ 99. A horseman occupies more space in ranks than an infantry soldier, and exposes more surface to a shower of projectiles.

The loss of cavalry skirmishers at intervals of two and one half yards is about 8 times that of the line assumed as a unit, and that of a single rank is about 20 times.

Artillery, when drawn up in line or battery, with the usual intervals of 14 yards, exposes about 64 cannoniers on a front of as many yards; and it has been found that it sustains a loss about 10 times as great as the skirmish line taken as a unit, and that during the minute which is usually consumed in limbering up and in unlimbering, the rate of loss is twice as great as in battery. This might have been inferred from the principles already explained.

The horses are fewer in number, but suffer more severely than the men. About one half of the men remain with the line of caissons, and if this is sheltered about half as much loss is incurred as when both lines are exposed. If the second line is not sheltered, but removed to a considerable distance behind the first, the principles explained in describing the loss of troops behind the line should be considered. The loss sustained by a mitrailleur, or revolving battery, is somewhat less than that of other artillery, if the battery is partially sheltered. Horse-artillery upon the march, suffers like cavalry.

EXAMPLE OF INFANTRY FIRE.

§ 100. As an illustration of the effect of infantry fire: let it be assumed that two battalions of infantry, in column of companies, advance side by side at a run directly towards another battalion standing up at a distance of 560 yards (700 paces), and firing rapidly upon them; the estimate of loss, which in the standard case amounted to .45 or .80 in one minute, according to chance, would be modified as follows: —

FOR THE FIRST MINUTE FROM 560 YARDS TO 400 YARDS.

Number of Units.

For four companies 4.00

Troops Firing.

For formation in two ranks. 70
For position standing 80
For rapid fire 1.60

Relative.

For movement at trot in line of fire 70
For no hostile fire 1.20

Troops fired upon.

For formation, — in column of four subdivisions . 16.00
For position, — standing 4.00

making a total modification of

$$4 \times .70 \times .80 \times 1.60 \times .70 \times 1.20 \times 16 \times 4.00$$

Performing the multiplication, and rejecting the third figure to the right of decimal point, we find that the number .45 or .80 is to be multiplied by 192, making a loss for the 16 companies of 86, or 154, men, according to the fortune of the firing troops. For the second minute, or passing from 400 to 240 yards (500 to 300 paces), $192 \times .70$ or 1.20, the factor for 320 yards (400 paces), which would make 134 or

230, and a total loss of 220, or 384 out of 512 in the course of two minutes.

TO COMPUTE THE EFFECT OF MUSKETRY FIRE.

§ 101. Find the unit of infantry fire at the corresponding distance.

Place the lower corner of the scale of infantry fire immediately in front of the centre of the firing line, and direct the scale towards the centre of the line of troops fired upon, as if to measure the distance between them, and read the number indicating the rate of loss in killed and wounded from the fire of one company, for one minute under the standard circumstances. Put a black peg in the hole of the Computing Table which corresponds to this number. For distances greater than 1,000 yards put the peg in the hole .11 and move it back five places for each additional 200 yards up to 3,000.

§ 102. In calculating the fire of other than ordinary infantry troops, refer to Table III. (*b*) and advance or set back the peg as many points as indicated. For the modifications of the fire of mitrailleurs refer to Table IV., ARTILLERY FIRE.

§ 103. Multiply by the number firing.

Count the number of companies firing.

Multiply the number of scores turned up on each block by the number of companies which it represents; add the products and subtract two tenths of the sum from the number of companies.

Multiply the number taken from the scale by the number denoting the force firing by placing a second black peg as far in advance of the first as the number in the series nearest that denoting the effective

strength is in advance of 1.0 referring to the Table of Multipliers on the left, when necessary to ascertain this point. Remove the first peg.

§ 104. Multiply by the time of firing.

Ascertain from the number and position of the arrows how many minutes the fire has lasted, and advance the count by putting the first peg as many points ahead of the second as required to multiply by the number of minutes.

§ 105. To modify the result, move the pegs, according to the indications of the line in Table III., headed "Number of Points," back as many holes as shown by the numbers on the left, and forward as shown by those on the right of the column in the centre, which corresponds to the reading of the *scale*.

Consider first the formation and position of the troops fired upon; these give the most important factors. The former is shown by the blocks, and the latter by the topography indicated on the plan. It is always assumed that troops lie down whenever they are not in motion and can deliver their fire to advantage from that position.

The fortification blocks will show whether the troops are protected by abattis, earth-works, etc., and if a minute mark shows that the works are still in progress Table X. B. (*c*) must be consulted; so also if a shelter trench is fired upon from a distance of 1,000 yards or more.

If cavalry or artillery are fired upon, the number of points by which the result is modified will be found from Table III. (*g*).

§ 106. If at this stage of the calculation it appears that the losses are slight, it is better to leave the ar-

rows upon the plan and postpone the computation for a while.

In an unimportant skirmish this estimate will suffice unless there be some very obvious reason for further modification, such as rapid movement or good enfilade fire, etc.

If a more elaborate estimate is demanded by the nature of the fight, proceed to make the necessary modifications due to the different formation and position of the firing troops, etc.

§ 107. The formation and position of troops firing will appear from the troop-blocks upon the map. Their movement, if any, is shown by the indices. Their previous movement will be remembered if they occurred immediately before the fire; if not, it need not be considered, unless the counters show that the troops are fatigued; in this case set back the peg one point for every score on the counter as in case of a hand-to-hand fight hereafter explained.

The rapidity of fire will be shown by the position of the arrows.

Their previous fire by the ammunition blocks.

§ 108. The angle of elevation by the plan.

The angle of enfilade can be estimated by the eye. The angle made by individuals is determined by the direction of their fire in case of skirmishers, or of their movement in case of cavalry.

The apparent size is found by measuring the distance with the scale on the edge of the Firing Board and dividing it by the width of the object as seen from the firing point, *i. e.*, the width measured on a line at right angles to the line of sight.

The direction as well as the rapidity with which

the troops under fire are moving is shown by the indices.

The relative amount of fire is shown by the arrows, and is only to be taken into account in important cases.

§ 109. Finally the dice are thrown, and the pegs advanced as many holes as the number of pips, diminished by one, that turn up on the large die.

§ 110. After the pegs have been shifted about in this manner, the last hole will show the number of killed and wounded in the line fired upon.

Tally the loss upon the Firing Board by placing a peg of the same color as the troops suffering the loss in the upper column (numbered from one to ten) of the two corresponding to the arm of the service, and the side of the battle to which the troops belong. If the loss amounts to more than five men, insert another peg in the proper hole to express the number of scores to be turned up.

It will be explained hereafter that the loss of five men, killed or wounded, may be regarded as diminishing the strength of a company of 64 men by two tenths; a peg in the hole corresponding to three scores would therefore record a loss of 15 men; five holes will correspond to the loss of a company; 20 to that of a batallion, etc.

When further losses are recorded, the first peg is kept in its hole, and another is used to record the new loss, so that the difference between the two indications will show the amount last added, for the sake of reference in other computations.

EXAMPLE.

§ 111. Thus, to calculate the loss in the example given to illustrate the effect of infantry fire: —

For average distance of 480 yards take from scale . .	.45
For four companies set forward 12 points	1.8
For one minute — no change	1.8
Troops Fired upon.	
Formation — four subdivisions — forward 24 pts. . .	27
Position — standing —forward 12 pts.	110
Troops Firing.	
Formation, two ranks — back 3 pts.	80
Position, standing — back 2 pts.	62
Rapid fire — forward 4 pts.	100
Relative.	
Movement at trot — back ($\frac{1}{2}$ + 6 =) 3 pts.	70
Successful troops not under fire — forward 2 pts. . .	90
Chance.	
For VI. on large die set forward 5 points	160

That is 160 men killed or wounded, which is near enough to 154, the number determined by multiplication.

For the next minute, — average distance 320 yards (400 paces) — factor on scale .70 — four places higher in the series than .45, previously taken for average distance of 480 yards (600 paces). To compute this loss advance the peg four points beyond 160, making 240, total 400, in the two minutes.

§ 112. While the peg still remains in the last hole, showing how many men have been hit, calculate the loss of troops behind as follows. Ascertain from the

plan whether the troops behind the line are in the plane of fire, or 5° or 10° below it; measure this distance in yards from the first line by means of the scale on the edge of the Firing Board, and from the Table ascertain how many points to set back the peg. Then consider how the number in the second line compares with that in the first, and whether their position is such as to expose them more or less; move the peg accordingly, and turn up the proper number of scores to express the loss, in the same manner as in the first line.

CHAPTER V.

ARTILLERY FIRE. (TABLE IV.)

§ 113. If a battery of artillery armed with four three-inch rifles is firing with case-shot for one minute at the line of skirmishers taken as a unit in describing the fire of infantry, at a distance of 500 yards (600 paces), and if this battery constitutes part of a line of at least six guns all firing at the same general object, with an interval between the guns of at least 14 yards, if the guns are placed upon hard level ground, if the object of fire is upon the same level as the guns, if the effect is visible and the ground hard and level in front of the target (or object under fire), if the skirmishers are inflicting about the same loss upon the artillery as they are suffering from the fire of the latter, it may be inferred that the infantry lose at the rate of 1.20 or 2.20 men in a minute, according to the fortune of the gunners.

§ 114. If the DISTANCE is 1,000 yards, at the rate of .90 or 1.60; if 1,500 yards, .6 or 1.1 men; if 2,000 yards, .45 or .80 men; provided in the latter cases the distance or range is well determined.

§ 115. If they are firing with SHELLS at 500 yards, .70 to 1.20; at 1,000 yards, .50 to .90; at 1,500 yards, .40 to .70; at 2,500 yards, .25 to .45; at 3,000 yards, .20 to .35; at 4,000 yards, .07 to .14, etc.

If firing shells at an object invisible from the battery, but whose distance is known, the effect is about half as great.

If firing CANISTER with twelve-pounders, at 400 yards, 1.20 to 2.2 men; at 720 yards, .05 to .09 men.

SOLID shot would not be suitable for firing at a skirmish line, unless in a favorable position for enfilading it.

§ 116. If firing with THREE-AND-A-HALF-INCH rifles, the effect would correspond with that of the three-inch at three fourths the distance.

The fire of REVOLVING CANNON is about three times that of three-inch rifles at five fourths the distance, and that of mitrailleurs has already been explained.

When the limbers are withdrawn from the pieces to take advantage of shelter, the fire of a battery is materially retarded unless its supernumeraries can bring up ammunition fast enough to supply the pieces, or unless a force of infantry is available for this purpose.

§ 117. The modifications to be made in these estimates for other circumstance and conditions will readily be understood from what has been said of infantry fire in like cases.

(1.) TROOPS FIRING.

The proportion, if two GUNS are firing alone, will be .60; if four guns, .80, except in case of machine guns.

If the INTERVAL is eight yards, .60; if ten yards, .80, except in the case of mitrailleurs.

If the GROUND on which the guns are placed is irregular, .70; if soft, .80. If each gun is firing but

once in a minute, at slow fire, .60; four rounds a minute, RAPID FIRE, 1.60.

(2.) RELATIONS.

§ 118. If the guns are fired at an ELEVATION or depression of 6°, .60; of 5°, .70; of 4°, .80.

If the line is enfiladed at an ANGLE of 10°, 4.00, etc.; 30°, 2.00; 45°, 1.60; 60°, .120. If the individual members of the line enfiladed make an angle with the line of fire of 10°, 1.20; of 40°, 1.60; of 90, 2.00.

If the APPARENT SIZE is .01 of the distance, .40; .02, .50; .05, .70.

If the surroundings interfere with a good OBSERVATION of the EFFECT of the fire, for example, if the target is partially screened by underbrush, or if the ground in the rear is wooded; when the battery is firing *revolving cannon*, .50; *time shells*, .60; *percussion* shells, .70; *case* shot, .80; *solid* shot, .90. The fire of *mitrailleurs* is reduced to .12 when the effect is invisible.

If the GROUND in front of the target, or between the battery and the target, is soft or swampy, and irregular, when employing *canister*, .25; *percussion* shells, .40; *solid* shot, .50; *time* shells, .80; *mitrailleurs* and case shot(*i. e.* shrapnel), .90.

If the target is MOVING at a *gallop*, .06 if very small, or .25 if one tenth the distance.

If the battery is subjected to hostile fire to which it is *replying*, and this fire is twice as great as its own, .90; if four times as great, .80; if the battery is not under fire at all, 1.20.

If the hostile fire is not RECIPROCATED, and four times as strong as its own, .25; if twice as strong, .40; if equal, .50; if one half as great, .70.

(3.) TROOPS FIRED UPON.

§ 119. If the troops fired upon are in different FORMATION from that assumed, the result will be modified in the same manner as with infantry fire, excepting that in firing upon a column the increase is greater with artillery, namely, a column of three subdivisions requires a modification of 16, and one of six subdivisions, 24.

Where solid shot are used against a column, the number of killed may be taken to be in proportion to the number of subdivisions, *i. e.*, to the density of the target.

The modifications due to the POSITION of the troops fired upon are the same as with infantry, excepting when behind a shelter.

If the troops under fire of shells are firing through loopholes in a wall penetrable by artillery, they derive no benefit from their position, but suffer as much as if standing up in open ground, or four times the unit; if behind abattis the same as if lying down in open ground; so, on the edge of a forest, for in all these cases the splinters of wood and stone, and the falling limbs, are as destructive as the projectiles from which the men are sheltered. From fire of canister and case (shrapnel) the protection afforded is the same as against infantry fire, namely, loop-holes, .06; abattis, .12; forest, .50, of the loss of troops lying down on the open ground; — so if behind the crest of a hill, or in a shelter-trench, for the small missiles of which this fire is composed have but little penetration, and require a flat trajectory to be effective. Shells, however, penetrate the loose earth of a

shelter-trench, and their fragments search out the reverse slopes of a crest which are unattainable by other kinds of fire, and troops firing from these positions suffer 60 per cent. of the loss of those fully exposed.

Moreover, as the deadly effect of shells is not dependent upon their velocity, they are tossed into hollows and places of shelter by firing with diminished charges, with almost one half (.50) of the effect of their direct fire.

When artillery fires with shells or solid shot against the hostile artillery, it will sometimes be fortunate enough to dismount a piece or explode a caisson. This effect has been found to be insignificant in comparison with the loss inflicted upon men and horses; but in critical cases it might have a decisive influence upon the fight.

(4.) TROOPS BEHIND THE LINE.

§ 120. The ratio of loss inflicted upon troops behind the line from the fire of canister and shells is about the same as from musketry, but from that of case shot (shrapnel) and solid shot, and with revolving cannon and mitrailleurs it is often greater.

If in the plane of fire and 300 yards behind the line, .50; 550 yards, .25; 600 yards, .12.

If 5° below the plane of fire and not sheltered at 450 yards behind the line, .50; at 600 yards, .25; at 800 yards, .12.

If 10° below at 600 yards, .50; at 800 yards, .25; at 1,000 yards, .12.

CHANCE.

§ 121. The fire of mitrailleurs is more dependent upon chance than that of infantry or artillery. If properly directed these guns are very effective; otherwise a great quantity of ammunition may be thrown away to little or no purpose.

TO COMPUTE THE EFFECT OF ARTILLERY FIRE.

§ 122. When the range is less than 1,500 yards the factor for the unit is obtained from the scale of artillery fire along the top of the Firing Board.

When the range is more than 1,500 yards and less than 3,000 yards, the scale at the bottom is used as an extension of the former, and for distances from 3,000 to 4,000 yards, the scale immediately above, marked "Shells."

§ 123. The application of Table IV. will be readily understood from the description of Table III.

In computing the fire of *mitrailleurs* the peg is advanced two places instead of one for every pip on the die greater than unity.

CHAPTER VI.

LIMITS TO POSSIBILITY OF FIRING. (TABLE II. A.)

SUPPLY OF AMMUNITION.

§ 124. Not only do troops fire with more or less effect according to the circumstances under which they are placed, but it often occurs that they are not in condition to fire at all when their officers desire it. The expenditure of ammunition, the disorganization of the troops, the time required for preparation, the relations of the topography, and many other influences conspire to limit the destructive effect of fire-arms.

§ 125. A company of 64 men firing at the ordinary rate expends about 400 rounds in a minute. Each man can carry 75 rounds on the march, and twice as many in action, making in all about 5,000 or 10,000 rounds per company.

Each piece of artillery with its caisson carries 240 rounds, which would last for two hours if fired at the rate of two rounds a minute.

Eight Gatling guns carry 120,000 rounds, which would last $\frac{1}{2}$ hour at the average rate of firing.

Four Hotchkiss revolving cannon carry 6,400 rounds, which would last 40 minutes at the average rate of firing.

TROOPS FIRING.

§ 126. Troops dispersed by hostile fire or charge, are for some time too intent upon avoiding danger to use their fire-arms, and long after they begin to rally they are not available for offensive purposes.

§ 127. In the formation in column, or even in line of battle, the voice or signals of officers can generally be heard, although with large numbers some delay occurs in the transmission of orders.

But in open formation, when even a small command is scattered over a great extent of ground and often separated into small fragments by the irregularities of the surface, it becomes difficult to control its action.

§ 128. Unless troops are well disciplined and occupy a sheltered and commanding position, they always reply to a heavy fire from which they are suffering; it is therefore difficult to direct their fire to a distant target, such as the second line of the enemy, when the first line is a dense one, and is inflicting serious damage upon those firing; it is likewise impossible to divert the fire of troops to the right or left under these circumstances.

§ 129. Cavalry can dismount and prepare to fire in half a minute or more. Artillery unlimbers and comes into action in one minute. When artillery first comes into action against a distant object a delay often occurs in determining the proper elevation to give to the pieces, etc., etc. If the battery is provided with a good range finder, and the ground and weather are suitable for observation, this delay is much curtailed, but when it becomes necessary to fire a number

of shells and observe their explosion, and when the ground has to be prepared or the pieces shifted about to put them into position, four or five minutes often elapse before the battery fires to good advantage.

But with revolving cannon the percussion shells follow each other so rapidly that the error is more readily corrected.

Infantry in line cannot fire at all, nor can skirmishers fire rapidly, while marching.

LOCAL RELATIONS.

§ 130. When a position is preparing for defense a portion of the defenders will often be taken from the firing line to intrench, prepare obstructions, or repair the damages caused by the fire of hostile artillery. In such a position only a limited number can use their fire-arms to advantage, especially until platforms have been erected, walls perforated, etc.

§ 131. In a dense forest the range of fire-arms is much diminished.

Infantry in line cannot fire to advantage up a steeper slope than 10°.

The carriage of an ordinary field-piece will not without preparation admit of a greater depression than 6°.

The effect of irregularities in the surface of the country, in limiting the range of vision, is apt to be underestimated.

§ 132. The angle of fall of an artillery projectile may be roughly estimated to be 5° at 1,000 yards, and to increase directly as the distance; and that of a rifle bullet to be the same up to 1,500 yards, but to increase a trifle faster up to the limit of effective range.

WEATHER, ETC.

§ 133. Darkness, fogs, and heavy rains, as well as smoke and dust, diminish the effect of distant fire in like manner.

TO DETERMINE WHETHER IT WOULD BE POSSIBLE FOR TROOPS TO FIRE IN THE MANNER INDICATED BY THE PLAYERS.

§ 134. If the firing troops are detached from the main body, examine the ammunition blocks and compare the expenditure, shown by the number of scores turned up on them, with the original supply, referring to the table, if necessary, for data.

§ 135. If a check is placed *before* the troops they cannot fire unless against those who are charging them at close quarters; if the check is *upon* the block they cannot fire at all.

§ 136. Consider, from the formation and disposition of the troops, how much time would be consumed in transmitting and comprehending orders; and if musketry fire is directed at the second line of the enemy, consider whether the first line is a dense one, or if it is inflicting serious damage upon those firing; likewise, if the troops are supposed to direct their fire to one side, when subjected to a heavy fire from the front.

§ 137. The time required for cavalry to dismount and for artillery to unlimber should be carefully deducted from the time of fire. If artillery fire is directed at a new object, the distance is measured, and the die thrown. The number of pips subtracted from the number of thousand yards will show how many minutes to allow for finding the range.

See that no rapid fire is allowed to troops in movement.

§ 138. See if more men are indicated upon the firing line than could use their pieces to advantage while enjoying the full benefit of defensive preparations.

§ 139. Examine the contour lines of the map, and ascertain whether the target would be visible from the firing point; this will be the case in open ground whenever, in passing from the higher to the lower point, the descent is steeper in the former part of the line than in the latter, or if the contour lines are closer together near the higher point.

To determine whether a point is visible from another, first see if any intermediate point is higher than either; if not, ascertain from the figures on the contour lines the difference in elevation between the highest point and the most prominent intermediate one, and divide it by the number of hundred yards in the distance between them, determined from the scale on the Firing Board.

This gives the descent in each hundred yards of the line to the intermediate point.

Find the descent per hundred yards to the other point in the same way; if it is less than the former the point is visible.

Very little practice is required to determine by inspection whether the difference in elevation is greater or less in proportion to the distance.

An ivory scale, or a piece of profile paper covered with silicate slate composition, is sometimes used for the purpose.

The heights of trees, houses, etc., must, of course, be added to the references of the contour lines.

§ 140. To determine whether the crest of a hill affords shelter to troops behind it, proceed as follows: —

Find the number of thousand yards in the distance from the troops firing, to a point midway between the crest and the target; also the number of times that forty yards (two spaces on an arrow) would be contained in the horizontal distance from the crest to the target, and ten feet in the vertical distance: Multiply the number of thousand yards by the horizontal distance (taking forty yards as a unit), and if the product is less than the vertical distance (number of contour lines), the hill affords shelter from fire.

CHAPTER VII.

CONSEQUENCES AND RESULTS OF LOSS FROM FIRE. (TABLE V.)

SECOND PHASE OF AN ENGAGEMENT WITH FIRE-ARMS.

§ 141. THE second phase of the combat is the diminution in the effective strength of troops who have been under fire. Besides the loss in killed and wounded, some leave the ranks through fear, some to assist their wounded comrades, some crouch behind shelter, and some fire rapidly and without aim.

§ 142. It has been found that the loss of strength is from two to three times as great as the number of killed and wounded; a loss of five men from a company of 64 diminishes the efficiency of INFANTRY or CAVALRY by about .2, both for fighting at close quarters and for firing, a loss of 10 by about .4; a loss of 15 by about .6; a loss of 20, .8. After the loss of one third, the remnant is either so exhausted or so demoralized as to be of little or no value for fighting.

§ 143. The effect of exposure to a shower of projectiles, in keeping down the fire of troops, has already been described, in speaking of the mutual influence of the opposite sides of the battle; but besides the permanent loss of power, and the temporary suppression of fire, the demoralizing effect is still more

apparent in a hand-to-hand combat. Troops that lose one twelfth of their number, or five men per company, from hostile fire, immediately before a collision, do not in general fight with more effect than one third of the number of fresh soldiers, and their power is reduced in the same manner by an additional loss of five men.

§ 144. The effect of loss in killed and wounded upon the fire of ARTILLERY is much less than upon that of other arms.

A loss of five cannoneers in the first line will nearly silence the fire of one piece, and will diminish that of the battery of four guns by 0.2; but only until their places are supplied by supernumeraries from the line of caissons.

A half battery detached suffers a greater reduction.

THIRD PHASE OF AN ENGAGEMENT WITH FIRE-ARMS.

§ 145. It now remains to consider in how many cases troops suffering at certain rates from the fire of musketry and artillery are forced to retire, or put to flight and dispersed.

A skillful commander generally seeks a place of safety for his men as soon as he finds that their loss has become serious and the effect of their fire proportionally diminished; but it sometimes occurs in the course of a battle that a great sacrifice at an important crisis is justified by the object to be gained; or the fire may be sudden and unavoidable, or an indiscreet commander may expose his forces unnecessarily.

§ 146. After a line of infantry skirmishers like that

taken as a standard has lost one thirteenth of its entire strength, or 5 men per company, it is dispersed by this fire in 7 cases out of 24 (or in 29 cases out of 100), when the loss occurs within one minute.

When the loss occurs in four minutes, in 3 cases out of 24; when it occurs in six minutes, in 1 case out of 24; but when it occurs in eight minutes, only when other causes combine to demoralize the troops.

Those who remain and suffer a total loss of 10 men per company are dispersed by this fire 13 times out of 24 if the last five men fall within one minute, 9 times out of 24 if within four minutes, or 7 times if within six minutes, etc.

Those who remain and suffer a total loss of 15 men per company are dispersed in 17, 13, or 9 cases out of 24, if the last five men fall in one, four, or eight minutes.

After an additional loss of 5 men in one minute 19 out of 24 are dispersed, etc., etc.

§ 147. When the loss does not exceed five men per company in one minute, they are rallied, and again brought into action on the same day in about three cases out of the seven (above mentioned); but not so frequently after suffering more severely.

If attacked at close quarters before they have rallied they are almost sure to be annihilated.

CIRCUMSTANCES OF TROOPS UNDER FIRE.

§ 148. In the case taken as a standard, the troops under fire are deployed as skirmishers. When they are in line of battle the influence of their leaders is more effective for keeping them in ranks, and still more so if they are in column, and the following fig-

ures show the percentage of cases in which infantry under different circumstances are put to flight.

§ 149. In a skirmish line the more extended the intervals the more easily are the troops dispersed; in one at 10 yards, .16 more than in the one at two and a half yards which has been taken as the standard.

In column .25 less than the unit; in line of battle .16 less; troops acting in small detachments .08 more.

§ 150. If behind shelter, or if the ground they occupy is less exposed than any to which they could flee, .10 or .20 less, and if more exposed, .10 or .20 more.

If they are exhausted or out of breath from marching in double time, .10 or .20 more.

RELATIVE ADVANTAGE.

§ 151. If they have been defeated in a recent battle, although they belong to the side generally upon the offensive, .05 to .20 more.

In making an attack, if the troops fired upon are inflicting twice as much loss as they are suffering, .08 less, if half as much, .08 more.

If acting on the defense, .16, if surprised .33 more, if surrounded by three times their numbers, .50 more.

Infantry acting generally upon the defensive throughout the campaign, .05 to .20 more.

KIND OF TROOPS UNDER FIRE.

§ 152. Recruits are so unreliable under heavy fire that no figures will give adequate expression of the frequency with which they are disorganized; in general terms from .25 to .50 more.

§ 153. CAVALRY at a halt is more likely to be dispersed than infantry, —.25 more.

The horses of dismounted cavalry, .50 more.

§ 154. ARTILLERY has often been styled the "moral element in a battle;" no amount of loss in men and horses can compel the survivors to limber up their pieces and retire. An infantry soldier can run away with his musket and ammunition, a cavalry soldier finds in his horse a good companion for his flight, but from the nature and organization of artillery, the fragments are powerless, and the temptation to desert is much less urgent than with the other arms of the service.

But under a heavy fire the cannoneers are sometimes driven from their pieces, a limber or caisson occasionally takes flight; and parts of the guns and implements are eventually destroyed.

After about one fourth of the cannoneers have been killed or wounded, if the limbers have not been sheltered, the loss to the horses and drivers becomes so great that they must be replaced by detaching others from the line of caissons, and if the battery is not withdrawn from fire long enough to recuperate, its power will be diminished twice as fast as before.

By the time half of the cannoneers are killed or wounded scarcely a horse is left alive. The loss falls more heavily upon the first than upon the second line, and the battery is virtually annihilated.

A platoon of two pieces, detached from the battery, is generally useless after a loss of 14 men.

§ 155. The reserves come up from the line of caissons whenever the fire is not too severe, and in this attempt the men and horses are governed by the same principles that apply to the other arms of the service.

§ 156. Infantry will be deterred from advancing towards a hostile position, in many instances, when the fire is not heavy enough to put them to flight, namely, in about 33 more cases out of 100, or about 8 more out of 25.

§ 157. But this does not apply to the second line, for the reserves are constantly disposed to crowd forward into the firing line, so as to be able to reply to the fire from which they are suffering. It may be assumed that a rate of loss per company that would not drive infantry from its position, would not be too heavy to keep the reserves of infantry or artillery from reënforcing the firing line.

§ 158. When cavalry are charging in full career, their impetus carries them along after their loss has been very severe, and the number of instances out of 25 in which they are dispersed before reaching the point of attack may be found by subtracting 6 from those which apply to infantry at a halt.

§ 159. Artillery when LIMBERED UP is not so completely under the control of its officers as when in battery; it is then driven back like infantry, but not often permanently dispersed.

In limbering up, and unlimbering it is not driven back so frequently as infantry at a halt, viz.: .08 less, or 2 out of 25.

§ 160. Cavalry and artillery when trying to pass at a gallop through an area swept by fire, will endure as heavy a loss as infantry at a halt before giving up the attempt. Infantry will endure more in running by, than at a halt. The probability of dispersing will be about .16 less.

§ 161. But infantry can debouch from a defile un-

der fire in small numbers, by taking advantage of shelter, whenever it can adopt such a formation as to reduce the percentage of loss to that which it can sustain: this will be somewhat greater than at a halt, and the men will often spread out and adopt such a formation without instruction from their officers.

SECOND LINE.

§ 162. When troops who have been scattered and forced to retreat encounter the reserves who are coming up to support them the effect upon the latter is most disheartening. If they have arrived within 100 yards of the firing line when it gives away, they generally take the panic and join in the flight, if the lines are about equal in numerical strength; but if there is a greater distance between them, and the defeated troops can pass through the intervals of the second line, while the latter holds the enemy in check, a portion of the fugitives will usually rally behind it.

RECORD OF LOSS ON THE TROOP-BLOCKS.

§ 163. After the loss has been recorded upon the tally-board, the troop-blocks are turned over to indicate the corresponding reduction of power.

If the troop-block represents one company of infantry or cavalry, a loss of 5 men is recorded by turning up one score; a loss of 10 men by two scores, etc.; if it represents four companies, each score records the loss of 20 men, etc.; a loss of 4, 6, or 7 men can be recorded by one score, or by placing a minute-mark behind the block with the proper figure up. If a battery of four guns or eight mitrailleurs is represented, the loss is recorded upon the block representing the line of pieces, and here the loss of 5 men also corresponds with one score, although but half a company is assumed to be in the first line. If it is found that the loss can be replaced from the line of caissons, the score may be transferred to that block, and the line of pieces restored to its original strength; a half battery detached suffers a greater reduction of power, and the loss of 2 men suffices to reduce its efficiency as much as that of 5 in a full battery. If, however, a check is placed by the artillery block to show that it requires time for recuperation, one score must be added for $2\frac{1}{2}$ men per battery, or for one man per half battery when detached.

TO CALCULATE THE PROBABILITY OF DISPERSING.

§ 164. Whenever the loss along a line of infantry or cavalry has amounted to five, ten, fifteen, etc., men per company, that is, when an average of one, two,

or three, etc., scores are turned up on the blocks, it becomes necessary to consider whether the line is dispersed. To ascertain this, put a peg in the hole in the Computing Table marked .50, after the loss of 5 men; in that marked 1.0, after 10 men; 1.6, after 15 men, etc.; *i. e.*, in the hole 20 places in the series before that denoting the total loss per company. If the troops under fire are those assumed as a standard in estimating infantry fire, and if the loss has been sustained in one minute, throw both dice and compare the Roman numbers over the peg with the sum of the pips turned up; if the Roman number is greater, the troops are to be regarded as permanently dispersed for that day; if equal, as temporarily dispersed; but if less, they are not demoralized.

§ 165. The circumstances that modify the chances for dispersion are accounted for as follows: —

The peg is inserted, as before, in the hole corresponding to one tenth of the number of men per company who have been put *hors du combat;* but if it is artillery unlimbered that is under fire, only when two, four, or six scores are turned up on the pieces and caissons together; *i. e.*, when the total loss has amounted to 10, 20, etc., men per battery of four guns or eight mitrailleurs.

Then refer to the body of Table V., and move the peg forward or back as many points as are indicated in the second line at the head.

§ 166. If the loss of the last 5 men has occurred in 2 minutes instead of 1, move the peg back 2 points; if in 4 minutes, 4 points; 6 minutes, 6 points; 8 minutes, 8 points, etc.

§ 167. For recruits, advance the peg 8 points or

more. If infantry or dismounted cavalry try to pass by a heavy fire, move the peg back 4 points; to determine whether it could advance to make an attack, forward 8 points.

For mounted cavalry to attack, back 6 points; to remain standing under fire, forward 6 points. For the horses of dismounted cavalry to remain in hand, 12 points.

For cavalry or artillery to pass through fire at a gallop, 0 points.

For artillery to limber or unlimber, 2.

For artillery unlimbered to remain in position under fire without suffering double loss, back 6 places, and throw the die. For other troops under fire, consider their circumstances, the relative prospects of success for the two sides, and the influence of the reserves in the second line.

§ 168. If the troops under fire are in column, back 6 points; if in line of battle, 4 points; if a small detachment is fighting alone, forward 2 or more points. If the skirmishers have an interval of 10 yards instead of 2½, as in the standard case, 4 points.

If they are less exposed than they would be if they were to take flight, back 4 or more; if there is a place of shelter to which they could run, forward 4 or more.

If moving at a rapid gait immediately before the time when the loss occurs, forward 4 points; if previously, forward as many points as there are scores upon the counter.

§ 169. If they are doing four times as much execution with their own fire as they are suffering, back 4 points; twice as much, back 2 points; half as much, forward 2 points.

If on the defense, forward 4 points. Surprised, forward 8 points. Surrounded by three times their number, 12 points.

If they belong to the side generally on the defensive throughout the campaign, forward 2 points; if very recently defeated, 4 or more points.

§ 170. To determine whether the reserves can come up to engage in the firing line: find their loss per company and the modifying circumstances under the supposition that they advance, as with the first line; their chances of advancing will be the same as for infantry to remain upon the line, and better than their chances to make an assault.[1]

§ 171. When the modifications have been expressed, throw both dice, and if the Roman number immediately above the peg is greater than the sum of the pips the troops are permanently dispersed and cannot fight again the same day, unless under cover and in connection with other troops, and then with so little effect that it generally simplifies the exercise to remove the block from the plan; but whenever the fugitives are compelled to pass their comrades in the rear, it is better to turn the block around so as to

[1] If a crisis renders it desirable to make calculation of probability at intermediate time: —

1. Put peg in hole corresponding to one tenth of the total loss.
2. Modify for rate, *i. e.*, time for five men to be killed, as in Table of Results.
3. Find how many chances of remaining in 25.
4. Note number in Computing Table equal to this.
5. See how many places between this hole and 25, in the series.
6. Find the hole as many fifths of this distance from 25 as the number of men killed since last count.
7. Put peg in Computing Table as many holes before the 4.0 hole as number of hole last found.
8. Throw the dice and proceed in usual manner.

throw the scores to the left and to lay an index upon them pointing to the rear, reminding the players that hereafter their movements are to be directed by the umpire.

If the Roman number is equal to the sum of the pips, the troops are to be regarded as temporarily dispersed, and are to remain out of action ten times as many minutes as the greater number of pips on either die. A check with as many spots turned up is placed upon the block, as well as a minute mark to note the number of minutes, since the X. minute point, that have elapsed when they are driven back. One more score is turned over on the troop-block; the troops are in condition to resist after twice as many minutes as the number of spots on the check. The minute mark is taken down and placed in front of the block at the first X. minute point, and the check as soon as the troops are in condition to resist or at the subsequent X. minute point at the umpire's convenience.

An index is then placed behind the block to show the line of retreat.

If the Roman number is less than the sum of the pips, the troops are not demoralized, but are allowed to remain. A minute mark is placed upon the block to note the minute when the loss of five men occurred, in order to enable the umpire to remember the time that has elapsed when five more are killed. At the first X. minute point it is taken down.

If the line is composed of more than one company, a single check and minute mark will answer for all.

§ 172. If the troops are about to take part in a hand-to-hand fight, the umpire refers to Table I.,

otherwise all the pegs are removed from the Tally Board, excepting those required to register the aggregate loss. The ammunition expended by the troops firing upon those under consideration is now noted. Each score on the short arrows corresponds to an expenditure of 200 rounds of ammunition per company, or half a minute of common fire, each arrow to five minutes of common fire, and each score on a small ammunition block to one arrow or 2,000 rounds.

If it is desirable under the circumstances to keep a more exact record, one or two arrows pointing to the rear may be so placed as to show by their scores the number of hundred rounds expended above the indication of the block.

CHAPTER VIII.

RATE OF MARCHING, ETC. (TABLE VI.)

§ 173. THE *first* point to be considered in reference to the march of troops, is the distance they habitually gain, in a given time, over various kinds of ground. The *second* is the effect of fatigue upon their fighting power, and upon the subsequent rapidity of their gait; and the *third* is the limit of their endurance.

INFANTRY.

§ 174. Walk. The pace of infantry at a walk varies in length from 28 to 30 inches. The former limit applies more closely to the Latin, and the latter to the Saxon and other Teutonic races. For simplicity of calculation it is here assumed to be 28.8 inches; making 100 paces equal to 80 yards.

The rate is about 110 per minute on hard and level ground, or upon a well-kept road; but marching across the country where the ground has not been recently broken, or over hard pasture land, about 100 paces or 80 yards in distance is all that can be expected in a minute, or 400 yards in 5 minutes.

Infantry walking up a SLOPE lose about 10 yards, in horizontal distance, for each 10 feet of ascent; in walking down, they lose nothing, unless the slope is steeper than 10°, or 10 feet in 20 yards; but for each additional descent of 10 feet they lose 10 yards in distance.

§ 175. Infantry marching in double time take a step of 33 inches or more, and gain ground twice as quickly as at a walk. Running up and down hill they lose 20 yards at this gait where they would lose 10 at a walk.

§ 176. No slope of less than 45° is inaccessible to infantry at a walk, if the surface of the ground is favorable. They run up 10° and down 20°.

§ 177. Over SOFT or ploughed or cultivated land a walk is sometimes reduced to 40 yards a minute; and in a marsh or swamp to 20 yards, or to 200 and 100 yards respectively in five minutes. A run is reduced by four times as much. A FOREST retards the march of infantry according to its density: a thin forest is one through which it can make a distance of 300 yards in five minutes, a middle one 200, and a dense one 100.

§ 178. Infantry skirmishers march across the country FIRING, at the rate of 200 yards in five minutes, and alternately advancing by springs and lying down to fire, at the rate of 80 yards.

§ 179. No general statement can be made about the time required to pass a ford; but any defile delays a march if it demands a reduction of front.

§ 180. The simplest tactical formations require a quarter of a minute for their execution above the time consumed in marching the greatest distance; if the command has to be repeated, or if the troops are in extended formation, or lying down, a still longer time is required for its transmission and comprehension; and at close quarters, or when firing, or in obstructed country, detached bodies are slow to respond to the voice or signals of their officers.

§ 181. After emerging from a forest, infantry require from two to eight minutes, to rally before advancing, according to the extent and density of the forest; and about four minutes after passing the confines of a captured village.

CAVALRY.

§ 182. Cavalry walk a little faster than infantry, especially over a good road.

The power of the horse lies in the heavy muscles of his haunches. The weight of the body when standing still rests upon the forefeet. In walking up a gentle slope this weight is more evenly distributed; and the progress is not retarded by an ascent of less than 5°. Every additional ascent of 10 feet delays the march by 40 yards.

Cavalry walking down hill are retarded 60 yards for every 10 feet beyond 5°. They walk up 30° and down 20°.

§ 183. Cavalry trot for a short time at the rate of 240 yards in a minute: but if this rapid gait is long maintained many of the horses break into a gallop and all become more or less fatigued; but a trot and walk of 880 yards in five minutes, or six miles an hour, does not impair the efficiency of the troops if employed whenever the exigencies of a battle may demand it.

§ 184. Cavalry gallop 1760 yards in five minutes; in marching across the country, both this and the trot are delayed by the same distance as a walk and for every 10 feet of slope in excess of 5°. They trot up 20° and down 10°, and gallop up 10° and down 5°.

§ 185. When making a charge, cavalry run more

than 400 yards in a minute, but only in a good country, and where the slope is less than 5°.

§ 186. Cavalry walk over hard cultivated land and through a thin FOREST 300 and trot 600 yards in five minutes, and through a forest of middle density they walk 200 yards. In SOFT and marshy ground they move more slowly than infantry.

§ 187. After a charge has been ordered, the troops are no more responsive to the commands of their leaders than are the projectiles of artillery after they have left the guns.

§ 188. Well-trained cavalrymen dismount and prepare to fight on foot in about thirty seconds, but to rally, remount, and to form their ranks they generally require at least two minutes.

Cavalry after emerging from a forest require from two to twelve minutes to rally before advancing.

ARTILLERY.

§ 189. Horse artillery, on hard and level ground, moves like cavalry.

Mounted artillery, upon hard and level ground, moves at the same rate as cavalry for a short distance.

§ 190. Light artillery, in marching up hill, is delayed like infantry; heavy artillery, twice as much; and down hill, both like cavalry; it cannot exceed the following grades without previous preparation; namely, at a walk, up or down 10°, at a trot or gallop, up or down 5°.

Artillery limbers up in somewhat less than a minute, and unlimbers in about the same time.

TRAIN, ETC.

§ 191. A six mule team moves like heavy artillery.

The reserve or wooden ponton train moves at the same rate.

The advance guard, or canvas ponton train, moves like light artillery.

The weight of an army wagon is about 2,000 lbs.; it carries 1,000 rations weighing 3,000 lbs.; total weight, drawn by six mules, 5,000 lbs.

The weight of a wooden ponton carriage is 2,200 lbs.; it carries a ponton, etc., weighing 2,900 lbs; total weight, drawn by eight mules or six horses, 5,100 lbs.

The weight of a canvas ponton wagon is 1,750 lbs.; it carries a ponton and equipments weighing 1,985 lbs.; total weight, drawn by six mules, or four horses, 3,735 lbs.

The weight of 3-in. rifle carriage and load (for six horses), 3,791 lbs.

The weight of mitrailleur carriage (for two horses), about 1,000 lbs.

One thousand rounds of small arm ammunition and box weigh about 110 lbs.

One thousand rounds of 3-inch rifle ammunition weigh about 12,000 lbs.

CONSEQUENCES OF FATIGUE.

§ 192. The second point to be considered in connection with the rate of march is the influence upon the fighting qualities of troops. Even an ordinary walk unsteadies the hand for firing to a slight extent; and immediately after a long run the blood flows rapidly through the veins, the hand trembles,

the eye becomes obscured, and the soldier loses to a great extent the control of his weapon, either for attack or defense.

§ 193. In a cavalry charge, where the horse and rider are hurled at the enemy like a projectile, their velocity forms an important feature of their force; hence a charge is most effective whose length is sufficient to enable the animals to acquire their maximum speed, and not too great for them to reach the enemy as soon as that speed has been acquired.

§ 194. The effects of fatigue from marching may be permanent, or temporary; the latter are explained in connection with the modifications of power in firing and fighting.

If on hard and level ground, the rapid gaits (viz., double time for infantry and gallop for cavalry) are only employed for one minute in four, or one fourth of the time, and the ordinary gait for the remainder; or if the rates of the latter are increased only in this proportion, the efficiency of the troops is not permanently impaired for many hours.

Thus infantry can, throughout a short battle, march at the rate of three and a half miles, and cavalry at that of seven miles, per hour over a good road.

The modifications of these rates for long distances, will be explained in describing strategic movements.

A greater speed is injurious, and its effects are manifest throughout the day.

After about ten minutes of the rapid gaits in excess of this ratio, a body of infantry is reduced in efficiency by one fifth; for some will fall out of ranks and be left behind; and the others will be incapacitated for firing, or using the bayonet to good advan-

tage; and after the pride and confidence of discipline have once been shattered by the example of the stragglers, and the confusion of broken ranks, a heavy fire more quickly demoralizes them than troops who have not been overtasked.

Cavalry is affected both for firing, and for charging, in the same manner; small detachments of picked men do better.

§ 195. As the marching and fighting qualities of artillery are entirely distinct from each other, the effect of over-exertion of the horses appears rather in their diminished speed and power of bringing the pieces into and out of action, or passing through a heavy fire without dispersing, than in a diminution of fire; for after one or two horses have become wearied, instead of straggling behind they are pulled along by the strong ones; and it would rarely happen that a piece or a caisson would be left behind without the knowledge or consent of the officers, unless in a precipitous retreat; in which case the effect is the same as with the other arms.

With heavy artillery it is estimated that a gallop of one minute in 16, and with light artillery, one minute in 8, does not materially fatigue the horses.

§ 196. In marching over ground so difficult that the rate is retarded by 40 yards in a minute, or 200 yards in five minutes, an additional amount of fatigue is incurred, which appears to be about the same as in employing the rapid gait for the same period.

ENDURANCE OF TROOPS IN MARCHING.

§ 197. As the strength of infantry and cavalry for fire and close combat appears to fall off at the rate of

about one fifth for every ten minutes' excessive use of the rapid gaits, so the maximum distance which these troops can pass over in an hour is taken at $5\frac{1}{2}$ miles for infantry and 11 miles for cavalry.

Horse artillery and Gattling batteries on a good road move like cavalry.

The rate of marching for heavy artillery appears to be diminished by $\frac{1}{20}$, and that of light artillery by $\frac{1}{40}$, with every minute of excessive galloping, making the maximum distances respectively 6.7 and 7.3 miles an hour on a level road.

Single horses selected for officers and orderlies run for a short time at the rate of 400 yards in a minute, but suffer as much fatigue as others do from a gallop.

PASSAGE OF WATERCOURSES.

§ 198. Infantry practiced in swimming are said to require ten minutes to prepare their equipments; they swim at the rate of 20 yards (25 paces) in a minute across a gentle current, and resume their equipments in four minutes after reaching the opposite bank. Of troops not specially trained, about 70 out of 100 can swim.

§ 199. One wooden ponton carries from 40 to 50 men, one canvas ponton 20 men, 120 yards in one minute. About one minute is required for the detachment to enter and leave the ponton.

RULES FOR MOVING THE BLOCKS.

§ 200. It should be remembered that each curve on the map represents a horizontal line 10 feet above or below the adjacent one. The figures show the vertical distances in feet from a common point of reference. On a scale of $\frac{1}{5000}$, the short indices measure 200 yards and the long ones 400 yards, and each score 20 yards.

To measure the distance that infantry can march across the country, over hard level ground, in one minute at a walk, lay an index upon the map by the side of the troop-block to be moved, and pointing in the proper direction, and bring the fourth score, *i. e.* the *first heavy score*, against the front edge of the block, then move the block until this edge comes abreast of the point of the index.

For double time or trot, take the *second heavy score.*

For gallop of cavalry or artillery, take the *fourth heavy score.*

For a cavalry charge, take one long index for each minute, *i. e.*, *five spaces* measured by the heavy scores.

§ 201. To measure with two short indices the distance that infantry can march across the country in five minutes at a walk, lay them upon the plan along the path to be followed, with the large end of the first one exactly abreast of the front of the troop-block to be moved, and the points in the direction of the movement, then move the block until the front edge is abreast of the point of the second index.

Over a hard level road, advance the index so that the rear end of the first is 40 paces from the block before moving the latter.

Over rough or obstructed ground move it back until the proper score comes opposite the front edge of the block, referring to Table VI. (*b*) to ascertain the distance.

§ 202. In general, to measure any movement, take from Table VI. (*a*) the number of scores for one minute, corresponding to the kind of troops, the gait and the nature of the ground; for movements other than marching, consult Table VI. (*b*).

Multiply by the number of minutes, and lay as many indices upon the map, if not already there, as may be necessary to express the number of scores determined.

If the troops are firing on the march, or if some of the artillery horses are killed or wearied, Table VI. (*c*) will show what portion of scores to retain, — move the indices accordingly.

Then ascertain from the curves of elevation whether the march will be delayed by the ascent or descent.

For infantry or artillery marching up hill at a walk, set back the indices ½ a score for every curve of elevation crossed; at a trot or double time set back one score; at a gallop, two scores.

For infantry down hill the maximum number of curves that can be passed without a reduction of rate is equal to the number of scores now shown by the indices in front of the troop-block.

Count the curves crossed by the indices, beginning at the troop-block, and if more than one score is found between any two consecutive curves, add one to the number of curves for each excessive score, and after the maximum number is reached, set back the indices ½ a score for each additional curve and exces-

sive score, if marching at a walk, and one score if at double time.

For cavalry up hill, and cavalry and artillery down hill, the maximum number of curves is equal to half the number of scores shown by the indices.

Count the curves and add half the number of scores in excess of two between consecutive curves, and set back the indices two scores for each curve, etc., above the maximum if marching up hill, and three scores if marching down hill.

INFANTRY.

§ 203. Thus for walking up hill five minutes lay two short indices as before and then move them back until the number of scores behind the front edge of the block is the same as half the number of curves on the map covered by the indices in front, then move the front edge of the block to the point of the second index.

Running up hill five minutes, the number of scores on two long indices behind should be equal to the number of curves in front.

Across the country, infantry marches 20 yards (25 paces) in a quarter of a minute and is not retarded in horizontal distance by making a gradual descent of 10 feet at the same time, or one of 40 feet (four curves) in a minute; for each additional 10 feet it loses 10 yards (half a score).

To find with two short indices how far it will descend at a walk in five minutes, count the curves covered by the indices in front of the block (or if more than 20 yards apart, count one for every 20 yards), and after the twentieth move back the index ½ score for every additional curve.

To find the distance for one minute, take 80 yards diminished by 10 (½ score) for each curve above four.

Running down hill for five minutes. Take two long indices and make the number of scores behind, less by 40 than the number of curves (or 20 yard intervals) in front.

CAVALRY AND ARTILLERY.

§ 204. Trotting up hill for five minutes. Take two long indices and deduct two scores for every curve (or 40 yards), in excess of 20.

Trotting down hill. Deduct three scores, for each curve (or 40 yards) in excess of 20.

Galloping up hill five minutes. Take four long indices and deduct two scores for each curve (or 40 yards) in excess of 40.

Galloping down hill — three scores.

Artillery is modified like infantry up hill, and like cavalry down hill.

FATIGUE FROM DIFFICULT GROUND AND RAPID RATES.

§ 205. For every two and a half minutes of double time for infantry or gallop for cavalry or artillery, place a counter in front of the troop block with one score turned up, show one more score for every additional two and a half minutes of this gait and at every even ten minute point turn all the counters back one score.

For every time that cavalry makes a charge or heavy artillery a gallop for two and a half minutes show two scores on the counter instead of one. And with all troops, whenever the indices have been set

back on account of steep or difficult ground, show one score for every 80 yards (100 paces) deducted.

After the fourth (or blank) side of the counter is turned up show one more score upon the troop-block, and proceed as before, except that the troop block is never turned back.

§ 206. The scores on the counters for artillery are turned back at every XX. minute point.

For light artillery with a counter, move back the first index one score per minute for each score on the block or counter; for heavy artillery, two scores.

After the fourth side of the counter is turned up add another as soon as necessary to show another score.

POSSIBILITY OF MOVING AS INDICATED. (TABLE II. B.)

§ 207. To determine whether it would be possible for troops to move in the manner indicated by the players, consider first if they have the power of movement.

If artillery attempts to move when two scores only are turned up, the die is thrown and as many pieces can be removed in each battery as the number of pips that appear; if five or six turns up, the die is thrown again or the reading of the small one taken.

If the players indicate that their troops are to swim across a narrow water course, and nothing has been stipulated in the "Special Idea" as to their proficiency in swimming, the die is thrown and the umpire decides what portion to permit to cross.

§ 208. A check will indicate if they are beyond

the control of their officers. The march must then be directed towards a place of shelter in the rear, convenient for rallying, and must not in general make an angle of less than 60° with the general line of battle in their neighborhood.

§ 209. If no check is applied to the troops and they are therefore subject to the control of their leaders, the time required to comprehend the command will be estimated from the *formation* and *situation*, and this time as well as that necessary to make any tactical change, will be deducted from the indications on the plan by moving back the indices or removing them altogether.

If it becomes necessary for cavalry to mount or artillery to limber up in order to perform the movements, the indications are modified in the same way.

LOCAL CONSIDERATIONS.

§ 210. The maps will show whether the troops have been passing a forest or capturing a village, and if any buildings are in flames the ammunition blocks and arrows will point out the direction of the wind and the extent of the conflagration. No troops can then approach within 50 yards upon a calm day, or in a moderate wind, within 100 yards, on the side towards which it is blowing.

The distance between the ten-foot curves of elevation shows the steepness of the slope. Where the curves are thickest apply the corner of the scale of declivity (on the Firing Board) to one of them as if to measure the distance between two adjacent ones along the line of march, and read the number on the scale corresponding to this distance; this will give

the angle of declivity in degrees, or it may be determined approximately by the scores on the indices by referring to Table II. B. (*i*). The other little table shows what slopes are inaccessible to the three arms at different gaits.

If a bridge, a ford, or other defile has been rendered impassable, it will be shown by a piece of card or paper placed upon it. If not, the width of front, the formation, and method of crossing should be stated and the necessary delay expressed.

If a minute mark beside one of the troop blocks indicates a preparation for swimming across a stream, consider how many could pass, and determine the time of passage from the Table.

If a fortification block lies across the stream, it shows that a bridge is building; a minute mark shows the time that preparations were commenced, and the time for constructing it is determined from the Table. The minute mark is removed when the work is completed.

CHAPTER IX.

HAND-TO-HAND FIGHT. (TABLES VII., VIII., IX.)

§ 211. A HAND-TO-HAND fight is a rare occurrence in modern warfare, in consequence of the destructive effect of fire-arms; but darkness and fogs, and the shelter of villages, forests, and undulations of ground impose a practical limit to their effective range, and the bayonet is still retained in the equipment of infantry, although with a cartridge ever present in the piece it will rarely be necessary to resort to its use. This fight may sometimes ensue after a charge of cavalry in overwhelming numbers or when two bodies of hostile cavalry meet unexpectedly or under various circumstances with unskillful commanders. Therefore it becomes necessary to examine the principles that govern this mode of fighting. This investigation is still more valuable in following and tracing out the battles of former ages. The distance between the troops no longer enters into the calculation whether they are armed with muskets, pistols, or naked steel.

§ 212. The *first point* to be considered is the number of combatants on either side and the relative advantages under which they are fighting; the *second* the losses and duration of the *melée;* and the *third*, the consequences to the victors and the vanquished.

§ 213. If the opposing forces are equal in point of

numbers and formation, and meet face to face in open and level ground; if both sides are perfectly fresh and not wearied by previous fighting, nor out of breath from a long and rapid march; and if neither has suffered from the fire of musketry or artillery, they usually remain upon the ground but a short time before one side or the other is forced to retreat, and this time rarely exceeds five minutes in duration.

If the forces of the attack are twice as numerous as those of the defense the attack is victorious in about 70 fights out of 100; the side numerically weaker in 30.

If the attack is one and a half times as numerous as the defense, it is victorious in 60 fights out of 100, if three times as strong, in 85, if four times as strong, in 96, and if five times, in almost every case on record.

INFANTRY FIGHT—TROOPS CHARGING. (TABLE VII.)

§ 214. It only remains to consider the relative power of troops fighting under different circumstances as compared with those assumed as the standard for hand-to-hand fights, and the modifications will be discussed in the same manner as before.

§ 215. If the infantry on one side is in line of battle instead of being deployed, its power is two times that of a skirmish line of equal numbers; if in column, three times.

§ 216. If it has been running for 10 minutes and not recovered breath 60 per cent., if for 5 minutes 80 per cent. of the standard, etc.

§ 217. If it is attacking troops that have been previously engaged at close quarters, and been defeated

so that they cannot be rallied for 30 minutes, 4.0, if for 20 minutes, 2.40, if for 10 minutes, 1.60 times the standard.

If it has just been victorious and engaged in a *melée* which lasted four minutes, .60; three minutes, .70; two minutes, .80; one minute, .90; until twice the time of the *melée* has elapsed for rallying. After leaving a captured village or emerging from a forest its power is reduced in like manner.

§ 218. The diminution of strength from hostile fire has already been alluded to.

Besides the permanent reduction of power arising from the loss in killed and wounded, from desertion, and from the demoralized condition of those who remain in ranks, other causes conspire to render troops who are suffering heavily from fire quite powerless in a hand-to-hand fight. The continuity of the line is broken; the sight of the dead and wounded is disheartening, and many are more intent upon their own safety than upon the general result. With the increasing numbers of those who fall, and those who begin to seek shelter from the projectiles, the chance of success for the remainder is constantly diminishing, and the prospect of engaging at close quarters is less inviting. These and other causes react upon each other and make the immediate effect of fire or the "act of demoralization" a most important factor in a hand-to-hand fight.

After the loss of 2 or 3 men per company in one or two minutes immediately preceding the charge, the power of troops for fighting is reduced to 80 or 60 per cent. of that of fresh troops. After a loss of 5 and 10 men, to 40 and 16 per cent. of that of

troops who have lost the same number half an hour before, or to 32 and 12 per cent. of fresh troops. After a loss of 5, 10, or 15 men in three or *four minutes*, their power is reduced to 60, 40, or 25 per cent.

RELATIVE ADVANTAGE.

§ 219. If the infantry on one side charges up a slope of 20°, .40; up a slope of 10°, .60; and up 5°, .80.

If one side attacks the flank or rear of the other, 2.00.

If it encounters an obstacle to its progress within 100 yards of the enemy, .80, if it surprises the enemy, 1.60; if it attacks an escort of prisoners, 2.00.

TROOPS CHARGED.

§ 220. If a battery is attacked, the cannoneers are of about as much assistance to the supports as one half the number of infantry in open order.

Infantry attacking fortified positions exert but a small portion of their power as compared with the defenders, namely: —

Abattis, .30; village, .30; wall of masonry, .50; fence or dam, .60; hedge or ditch, .80.

The influence of the work of fortification will be explained more fully hereafter.

§ 221. All the infantry within 100 yds. (125 paces) usually take part in the fight; *i. e.*, all who can reach the ground in *half a minute*.

TO DECIDE THE VICTORY IN AN INFANTRY CHARGE.

§ 222. To express the numerical strength of the troops charging, count the number of attacking com-

panies and the reduction of strength as in computing their fire, and put a peg in the corresponding hole in the Computing Table, — all infantry within 100 yards to be estimated in the strength.

§ 223. Refer to Table VII., Infantry Charge, and move the pegs back and forth as many points as shown in the second line at the head, to apply the estimate to the case to be computed.

The *formation* is shown by the troop blocks. For *previous movement* of the *attack* deduct as many points as the number of scores on the counters.

The effect of previous fighting is shown by the checks placed upon or near the defeated troops; and the table indicates that when the attacking party has been *previously victorious*, and the check is still upon the defeated troops as explained in § 228, the peg should be moved back one point for every dot, minus half the number of minutes that have intervened since the previous engagement.

If the attacking party has suffered before the collision a loss in killed and wounded of five men per company in two minutes, move the peg back 8 points; for a loss of 15 men in four minutes 12 points. The peg noting the previous loss is now removed.

§ 224. The map will show if the attack charge *up hill*, and whether an *obstacle* has to be surmounted immediately before the collision. Consider whether the attack falls upon the *flank* or *rear* of the defense, and whether it can be made by surprise.

§ 225. If a battery is entered and the supports are present, the *cannoneers* count as half the same number of skirmishers.

If the defenders occupy a position where the de-

fensive preparations are only partly completed it is necessary to refer to Table X. for corresponding modifications.

§ 226. If all the factors apply equally to all the troops on the side of the attack it is only necessary to go through the table once, before dividing the number of the attacking party by that of the defense; advancing the pegs for those factors that increase the power of the attack, and moving them back for those that weaken it.

For slight differences, a mean can be taken, giving most weight to those affecting the largest number of troops.

If the forces on the side of the attack come into action under very different circumstances: first find the power of one attacking force and calculate its modifications, including that for formation and position of the defenders, then do the same for the others in turn; add them together, and put a peg in the hole corresponding to the total power of the attack: then apply the factors for the defense, as follows: —

§ 227. To divide by the numerical strength of the defense, move back the peg as many points as there are in the series between that expressing the number of companies of the defenders and unity after making the reduction for the scores.

For previous movements etc., of the defense, advance the pegs instead of setting them back.

If the defenders are fighting under different conditions, it is better either to average the factors, or to consider each part of the combat separately. The peg in its final position shows the power of the attack in relation to that of the defense.

§ 228. Now throw both dice. The difference in the number of pips determines the length of the *melée* in minutes, and the sum indicates which side is victorious, as follows: If the Roman number immediately above the peg expressing the ratio of strength is equal to, or greater than, this sum, the attack is successful, — if less, the defense. Put a peg in any unoccupied hole corresponding to the number on the right of the Roman number equal to the sum of the two dice.

A check is placed *upon* the block representing the defeated troops with as many dots turned up as the difference of the dice or the length of the *melée* in minutes, an index is laid upon the plan pointing in the direction that the defeated troops are to take in their retreat, also a minute mark, noting the number of minutes at the end of the *melée* since the X. minute point.

The check shows not only the length of the *melée* but also the extent of the disorganization of the defeated troops, and the time required to rally is equal to 10 times as many minutes as the number of dots on the check.

CAVALRY FIGHT. (TABLE VIII.)

§ 229. The strength of cavalry in a hand-to-hand fight is affected by like causes, with the following exceptions: —

If cavalry charges over a distance less than 1,000 yards it does not acquire the necessary impetus to produce its full effect; if for only 100 yards, 60 per cent., if 200 yards, 80 per cent.

Cavalry charging down a slope of 10°, 60 per cent.; — down 5°, 80 per cent.

Cavalry after emerging from a forest and before rallying suffers from the confusion like victorious cavalry.

Cavalry that encounters an obstacle within a minute before the collision, 60 per cent.

§ 230. Cavalry that charges in open order the same number of infantry formed in square, 1.00; — in line, 1.20; in groups of four, 1.60; deployed as skirmishers, 2.00.

If, however, the skirmishers are lying down no harm is incurred from a charge of cavalry when the discipline and courage of the troops are sufficient to keep them from rising. So great is the aversion of the horses to tread upon the men that only those who are "scared up" are the sufferers, unless circumstances permit the cavalry to halt, which would be impossible under a heavy fire from the supports in the second line.

All cavalry within 300 yards take part in the fight: *i. e.*, all who can reach the ground in half a minute.

TO DECIDE THE VICTORY IN A CAVALRY CHARGE.

§ 231. The victory in a cavalry charge is decided in the same manner as in an Infantry Charge, from the indications of Table VIII., excepting that when the sum of the two dice is equal to the Roman number, the fight is drawn, and two indices are placed to show that both sides withdraw, and remain out of action for ten minutes.

RESULTS OF A CHARGE — THE MELÉE. (TABLE IX.)

§ 232. The second feature of a hand to hand fight

is the *melée*. Its duration is sometimes inappreciable, but it generally lasts from one to five minutes, and sometimes a little longer.

§ 233. The loss of life in a *melée* is insignificant, it rarely amounts to more than two men in a minute for the defeated troops, for each company on the side of the greatest numerical strength, in a fight between two bodies of infantry; and about one half as many for the victors; so in a fight between two bodies of cavalry. But in a combat between the two arms, the horseman enjoys a decided advantage. Defeated infantry lies at the mercy of the cavalry; but if the charge is unsuccessful the cavalry is pursued by the fire and not by the bayonets of the victors.

Each defeated company of cavalry loses one half, — of infantry, twice as much as in the first case.

If a battery of artillery, without support from other arms, is entered by infantry or cavalry, each company of the latter inflicts an injury upon it equivalent to the loss of five men in the first minute of its occupation, and 10 men every subsequent minute; so, also, for each portion of the attacking force that enters a battery while another engages the supports; if, however, the attack does not penetrate beyond the line of pieces the damage is but half as great.

THE ROUT.

§ 234. The third feature of a hand-to-hand fight is the disorganization that ensues.

After an infantry or cavalry fight, the defeated troops are unable to come again into action until they have withdrawn from fire and pursuit, and taken from ten minutes to one hour to rally and re-

form their ranks, unless they are supported by a second line of at least half their own strength, not so near as to become involved in the *melée*, and not much more than a minute's march behind them, namely, 100 to 300 yards for infantry, and 300 to 600 yards for cavalry. The scattered remnants of the first line can rally in ten to twenty minutes, under protection of the second.

THE PURSUIT.

§ 235. As, in a fire-fight, a heavy slaughter precedes and produces disorganization, so in a hand-fight, the disorganization is essential to a heavy slaughter; only in the pursuit does the victor reap the fruit of his labors.

In the homogeneous fight, the victors pursue with a force sometimes but one fifth as numerous as the flying enemy, and each company inflicts a loss estimated at two or three men in a minute.

§ 236. The circumstances, already enumerated, that limit the range of vision, could alone render a close pursuit excusable on the part of infantry; the victors as well as the vanquished are dissolved by this service, and require at least twice as long to rally as the time spent in the pursuit. After about ten minutes in open ground, the fugitives outrun the victors, and the pursuit ceases.

§ 237. But the horseman here finds his favorite service, and rides down the helpless infantry at the rate of five per company in a minute; and the fugitive cavalry meets the same fate, when driven against an obstacle that bars its course; such unfortunate troops require ten times as long to rally as the time spent in pursuit.

§ 238. The loss of 10, 15, 20, or 25 men per company, inflicted in the pursuit, has the same effect in diminishing their power to fire or to fight, as if incurred in any other manner.

The diminution in the power of troops while rallying, has already been explained.

After about twice the time occupied by the *melée*, the troops can make more or less resistance if attacked.

TO COMPUTE THE RESULTS OF A CHARGE.

§ 239. To determine the number of killed and wounded in a *melée*, refer to the Firing Board for the figure on the right of the Roman number equal to the sum of the pips in the two dice. Find the number in Table IX. in the column headed with this figure (Number on Right) and in the line denoting the nature of the fight. This will give the number of killed and wounded per company in a minute. The rate of loss of the victors may be taken the same for all combats, namely, as 50, 55, 62, or 70 hundredths of a man in a minute to each company upon the side having the greatest number in a fight between two bodies of infantry or two bodies of cavalry. The rate of loss to the defeated party may be taken at one half the figure on the right as shown in the line headed DEFEATED. The four other lines show the rate of loss for the defeated troops in a fight between the different arms.

§ 240. When the rate of loss has been determined, multiply it by the number of companies on the side of the greater numerical strength and the number of minutes in the *melée*. Record the loss by turning

over the scores as for loss from fire, in the manner already explained. Remove the peg on the Firing Board that recorded the number on the right of the Roman number, and consider how long the defeated troops are to remain out of action. Table IX. (*d.*)

§ 241. In a fight between troops of the same arm the time is ten times the length of the *melée* or the number of spots on the check. If cavalry are repulsed by infantry, this time does not in general exceed ten minutes, and the check should be turned back, if necessary, so as not to expose more than one dot. But if infantry is defeated by cavalry it should not show less than five dots. For the first minute that a battery is occupied, the check should show one dot; and one more, for each subsequent minute or two, according to whether one or both lines are entered.

If, however, the first line is supported by reserves between 100 and 300 yards distant in an infantry fight and between 300 and 600 yards in a cavalry fight the check should be turned back so as to show but two dots.

TO COMPUTE THE LOSS AND CONSEQUENCES OF A PURSUIT.

§ 242. The number required for a pursuit after a combat between two forces of the same arm depends upon the extent of the defeat, and is taken at an equal number, or at one half, one third, one fourth, or one fifth of that number, according as the check has one, two, three, four, or five dots turned up. The loss inflicted in each minute of the pursuit by each victorious company is shown in the seventh col-

umn, Table IX. (*h.*), and in the eighth, the additional time in minutes that the victors and vanquished require for rallying before they can again assume the offensive. This should be expressed upon the check as before.

§ 243. If the fugitives come within reach of a strong position, from which they can hold their pursuers in check, they can rally behind it in the same manner as behind the reserves.

But if in a cavalry pursuit the fugitives are driven against an obstacle that bars their flight, the check should be turned over or another added, and twice as great a loss should be recorded by turning over the proper number of scores to represent the reduction of power.

§ 244. When the loss in the pursuit has amounted to 10 or 15 men per company, a peg is placed in the Computing Table at 1.0, 1.6, etc., the dice are thrown, and if the Roman number is greater than the sum of the pips the troops are regarded as permanently dispersed for the day.

§ 245. The minute mark which indicated the termination of the *melée* is now advanced to note the minute of the termination of the pursuit measured from the last X. minute point; for the time of rallying is not to commence until they reach a place of shelter; accordingly, if a X. minute point is passed during the pursuit, the check should not be turned back as at other points.

As in the case of troops temporarily dispersed by fire, the minute mark is taken down and placed in front of the block at the first X. minute point and the check as soon as the troops are in condition to

resist, or at the subsequent X. minute point at the umpire's convenience.

The time that troops are unable to resist, is twice as long as the *melée*, or one fifth as long as the time required to rally.

PRELIMINARY CONSIDERATION OF THE POSSIBILITY OF FIGHTING. (TABLE II. C.)

§ 246. Troops with checks in front of the block cannot attack.

Troops with checks *upon* the block cannot resist.

A surprise is possible when cavalry makes a sudden charge and arrives within half a minute's distance, 240 yards (300 paces), without being observed, or when infantry fires or charges from 80 yards (100 paces) under like circumstances.

An attack in flank or rear should only be indicated in case of a surprise or of overwhelming numbers, or when fresh troops attack those engaged in a *melée*.

After a hand-to-hand fight between two forces of the same arm, from a half to a fourth of the number of defeated troops will generally be required for the pursuit according to the nature of the defeat; when cavalry is victorious over infantry, one fourth.

If half as many fresh troops attack those with a check upon the block, the latter are dispersed; if they enter a battery it is to be regarded as captured.

CHAPTER X.

ENGINEER OPERATIONS, WORK OF CONSTRUCTION, DESTRUCTION, ETC. (TABLE X.)

VILLAGES.

§ 247. AFTER troops have been occupied for 20 minutes in preparing a building for defense, it will afford the protection in a hand-to-hand fight assigned to it in § 220, provided that the workmen number at least 1 for every 2½ yards of the line to be defended.

§ 248. In wooden villages, not more than 2 men can fire from each 2½ yards (3 paces) of a fence, or a house of a single story, and in other buildings the same number from each 2½ yards of every available floor.

§ 249. The protection against musketry and artil lery fire at different periods of the preparation is shown in Table X. B (c) (d), which will be read ily understood from what has been explained heretofore.

The loss is compared with that which the same number of men would suffer if they were lying down in open ground at the same intervals.

§ 250. Where several tiers of fire proceed from the same building or enclosure, the defenders in the second story suffer about one half as much from fire

directed upon the lower one as the troops posted there, unless at very close quarters.

The loss from musketry is estimated for men firing from the village or building at the average rate, — otherwise the defenders are completely sheltered from leaden projectiles after remaining a short time in possession.

§ 251. In buildings of brick or stone, but one man in 2½ yards (3 paces), can find room to fire until loop-holes are made, a work which occupies two men for 40 minutes; moreover, if a wall of masonry is too high to fire over without a platform, one man in 2½ yards will be obliged to devote 15 or 20 minutes to its preparation before any fire can proceed from it; after these precautions the same amount of fire proceeds from stone and brick buildings as from those of wood.

Much heavier fire can be delivered from a well-garrisoned castle or a loop-holed permanent work, and the loss to the defenders is much less than in villages.

§ 252. The shells of three-inch rifles penetrate at short range 4½ feet of wood, 3 feet of brick, or 1½ of good ashlar masonry; those of one-and-a-half-inch revolving cannon have about one third, and those of three-and-a-half-inch rifles four thirds of this penetration. At long range, walls of corresponding thickness afford good protection for a short time.

A 400-grain musket ball penetrates 12 inches of wood, or earth, at 200 yards, 10 inches at 500 yards, and 4 inches at 1,000 yards.

§ 253. A little delay occurs after capturing a village before any fire proceeds from it. The time re-

quired to rally after an assault has been already mentioned.

In villages composed of separate sections, the defenders can retire from one to the other; but those who have been actually engaged require 10 minutes to rally. After the outskirts of a compact village have been carried by assault, if the victors are compelled to fight their way from house to house, they lose at about the same rate as in the assault, if they advance 20 yards per minute; at twice this rate if they advance 40 yards; and three times, if 50 yards.

§ 254. A barricade across the street of a town requires the labor of a company for half an hour for its construction, affording, however, no protection against artillery fire. For the latter purpose two hours are required for every 10 yards.

It is said that a company can open a passage through a brick wall six feet high and one foot thick in 20 minutes.

§ 255. It follows from the preceding data, that where the outskirts of a town consist of walls of masonry which have been put in state of defense and have a good command over the ground in front, the position can seldom be carried without the aid of artillery.

FORESTS.

§ 256. After the edge of a forest of middle density has been occupied for 10 minutes, the defenders derive as much advantage from their position in a hand-to-hand fight as if behind a fence or dam.

Abattis is prepared at the rate of one yard per man in two hours; its advantages for defense have

been explained, as well as the protection it affords against fire.

The reserves in a forest of middle density suffer one sixth as much from shells as troops behind the line in open ground, or less, according to conformation of the ground. Their loss from musketry and case-shot fire is insignificant.

EARTH-WORKS.

§ 257. Infantry with the trowel bayonet or small intrenching knife, when kneeling throw up a protection against musketry fire in 5 minutes in favorable, or 20 minutes in unfavorable, soil.

If the ground is sloping to the front, so as to be exposed to hostile fire, or if the enemy's position is higher than the trenches, so as to give him the advantage of plunging fire, more time is required to obtain perfect protection.

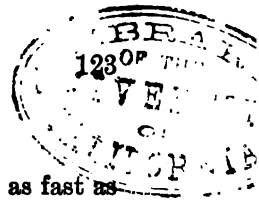
The work proceeds about half as fast when the troops are lying down.

§ 258. A battery covers itself from artillery fire in about 4 hours in ordinary soil; a company of infantry throws up a breastwork for itself in 3 hours.

BRIDGES.

§ 259. When a ponton division arrives at the bank of a stream 15 or 20 minutes are expended in unloading the material, and the bridge then advances about two yards in a minute.

A narrow foot-bridge advances about one yard in a minute, and a bridge twelve feet wide half a yard, requiring, however, 10 or 20 minutes' preparation after the material is on the spot.



SIGNALS. TELEGRAPH.

§ 260. A field telegraph line can be built as fast as infantry can walk, and dispatches are sent as fast as they can be written. Other signals are sent at the rate of 5 or 10 words in a minute.

CONFLAGRATIONS.

§ 261. The incendiary effect of artillery fire upon buildings is very uncertain, but from the best authority upon this point it appears that when a battery of four three-inch guns, provided with carcasses, attempt to burn wooden buildings 1,000 yards distant, in about 50 cases out of 100 the fire will start after cannonade of four minutes; in 75 cases after eight minutes; in 87 cases after twelve minutes, etc.

About twice as much time or twice as heavy fire is required for strong buildings of ashlar masonry, and somewhat less than twice for brick or rubble.

If more pieces are firing at the same object, the time before the fire breaks out is proportionately less.

If the distance is greater the time is longer in proportion to the efficiency of the fire.

§ 262. Under favorable circumstances a battalion of 250 men extinguish such a fire in four minutes.

If the flames are extinguished, about the same fire is required for the artillery to rekindle them. At this rate a battalion of four companies engaged exclusively at the work would about neutralize the efforts of a battery of four pieces at the distance of 1,000 yards.

Carcass-firing varies with the distance, about as shell-fire.

If burning villages are uninhabited, or unfavorably situated with reference to supply of water, or facilities for transporting it, the attempts to extinguish the fire are proportionally less successful.

After engaging in this work, about 10 minutes are required to rally before the troops are available for other purposes.

§ 263. In a period varying from 5 to 10 minutes after the fire breaks out, a light wooden building becomes untenable, if no attempt is made to extinguish it. A building of brick or stone, in 10 or 20 minutes.

By about the same time the fire will have spread to the next building on a calm day, if not more than 50 yards distant, or more than 100 on a windy day.

DESTRUCTION OF BRIDGES AND FORDS.

§ 264. When four three-inch guns fire upon a bridge 1,000 yards distant with shells it will in the general case be destroyed in about 10 or 15 minutes.

§ 265. A wooden bridge is rendered impassable by tearing up the planks, in 15 or 20 minutes; a brick or stone bridge in 30 minutes or 1 hour. To burn a wooden bridge at least half an hour's preparation is required. To prepare to blow up a wooden bridge at a particular time, 90 minutes; a brick or stone bridge, 2 or 3 hours.

A ford may sometimes be destroyed in 1 or 2 hours.

EFFECT OF FATIGUE.

§ 266. The effect of fatigue from hard work for 10 minutes may be estimated to be the same as that from running for 2½ minutes.

TO COMPUTE PROGRESS OF WORK.

§ 267. The method of noting the occupation of villages has already been described; the minute mark should not be removed until the work is completed.

The time of constructing a shelter trench depends upon the nature of the soil, and the position of the troops. The latter is explained by the troop leader, and the former estimated from the map. If the troops are in open order and lying down instead of kneeling, the minute mark is not removed until twice the indicated time has elapsed, *i. e.*, until two scores are turned up on the fortification block.

The construction of abbatis, barricades, and field works is noted in the same manner. If fewer men are engaged in the preparation, more time must elapse before the block is removed.

The method of indicating the construction of a ponton bridge has already been described: the scores successively turned up show by their distance apart the actual progress of the work.

§ 268. When the minute mark is removed from the fortification block, a counter is placed upon or near the troops who have been at work with one or more scores turned up to express fatigue, and these scores are turned back at the X. minute point, like those noting double time, etc.

§ 269. The figures in Table X. A. (a), in the line headed "workmen 2½ yards," show the number of blocks representing skirmishers that must be placed behind the fortification block to complete the work in the time indicated in the next line, and the figures in the line (d) show the maximum number that can derive the full advantage expressed in the table.

TO COMPUTE PROTECTION.

§ 270. The next two lines show the diminution in the strength of the attack, or the number of points to set the pegs back in a hand-to-hand fight, and are used in connection with Table VII. (Infantry Charge).

§ 271. The next two lines show the number of points to allow in computing the loss that defenders suffer from fire of musketry, mitrailleurs, case-shot, etc., directed upon the fortified position, in case they reply at the ordinary rate. If no fire proceeds from the position no loss need be computed from leaden projectiles, but a short interval must elapse before the fire from the position begins. The next two lines relate to fire of shells and solid shot.

§ 272. Calculate from these lines the loss of the troops upon whom the heaviest fire is directed, and if more than one tier of fire is represented, take one half of the loss per company for the second tier, and one fourth for the third, etc.

The last lines also indicate that in forests, after the loss of the reserves has been computed from the table of infantry fire, only one sixth of the result should be taken.

§ 273. The last columns show the number of points to substitute for those given in the tables of fire, to determine the protection afforded by a shelter trench at long ranges.

TO COMPUTE PROGRESS OF DESTRUCTION.

§ 274. If artillery fires upon a building to burn it, the fire of carcasses is indicated by a long and short arrow at the battery, and an ammunition block and an arrow at the building. To determine the result of this attempt, compute the artillery fire from Table IV., employing the same scale of fire as for shells, and record the effect by turning up one score on the ammunition block, placed at the large end of the arrow, for every one man that would be hit by shells, in the standard target, if the buildings are stone; for every .7 if brick; for every .5 if wood. If any troops attempt to extinguish it, turn the block back one score for every minute that four companies are so employed; when the fourth or blank side is turned up, throw the dice, and if IV., V., or VI. turn up on the large one, move the ammunition block to the point of the arrow to show that the building is ignited; otherwise leave it behind the arrow, and every time that the blank side comes up throw again.

§ 275. After the building takes fire the block should show one more score for every minute, in a wooden building, and every two minutes in one of brick or stone, to indicate the spread of the flames; and scores should also be added for artillery fire and deducted for parties of firemen as before; when the block has been turned forward four times, the die is thrown as before to see if the building is untenable, in which case it is assumed that the nearest buildings have all started to burn, if they are not more remote than 50 yards, on a calm day, and on a windy day all on the side towards which the wind blows, that are

not more than 100 yards distant; another arrow and ammunition block are then applied to the buildings at each end of the line, and when a considerable area is in flames, it is expressed by covering the burning district with paper as explained above.

§ 276. When a wooden bridge is set on fire, the same method is pursued, excepting that not more than one score per minute can be turned back, whatever may be the numbers of the party attempting to extinguish it.

When a working party of not less than one company is destroying a bridge, the scores show the number of 10 minutes of the progress of the work, and the table shows the time required for its completion.