in respect to these, only on the actual results springing from them.

The conduct of war is therefore, the formation and conduct of the fighting. If this fighting was a single act, there would be no necessity for any further subdivisions; but the fight is composed of a greater or less number of single acts, complete in themselves, which we call combats. From this arises the totally different activities, that of the formation and conduct of these single combats n themselves, and the combination of them with one another, with a view to the ultimate object of the war. The first is called tactics the other strategy. According to our classification therefore, tactics is the theory of the use of military forces in combat; strategy is the theory of the use of combats for the object of the war. 3rd. Theory of war (or 1st class of activities. 4th. Art or science of war. 5th. Methodicism. 6th. Criticism. 7th. Examples. 8th. Strategy in general. 9th. The combat or tactics. 10th. Military forces, or the consideration of things appertaining to an army, which only come under the head of necessary conditions of fighting. 11th. Defence. 12th. Attack. 13th. Plan of war.

We now come to the second class of activities or preparations for war, the more important sub-divisions being—

1. Artillery. 2. Permanent fortification and the attack and defence of fortresses. 3. Military and field fortification. 4. Military legislation and administration. 5. Military topography, reconnoisance and field sketching. 6. Higher geodesy and trigonometrical surveying. 7. Physical sciences in their military applications. 8. Applied mechanics and machinery. 9. Architectural and hydraulic construction. 10. Foreign languages. 11. Veterinary science. 12. Telegraphy. 13. Photography. 14. Gymnastics, fencing, swimming, etc. 15. Riding. 16. Drill.

ARTILLERY.

If treating of the great sub division of artillery, we should probably divide it into the following parts and sub-heads, viz.:

Part 1.—Ordnance, Carriages and Ammunition—*a*, gunpowder, manufacture and effects; *b*, construction of ordnance; *c*, systems of rifling; *d*, smooth bored ordnance; *e*, rifled ordnance; *f*, construction of artillery carriages; *g*, artillery travelling carriages; *h*, standing and sliding carriages, beds and platforms; *i*, ammunition for smooth bored guns; *j*, ammunition for rifled ordnance; *k*, means of firing ordnance, rockets; *l*, small arms.

Part 2.—Principles and Practice of Gunnery—*a*, importance of the knowledge of the principles of gunnery; *b*, the forces which act upon a projectile within the bore of a gun; *c*, initial velocity; *d*, forces which limit the trajectory of a projectile; *e*, deviation of projectiles and principles of rifling; *f*, penetration of projectiles; *g*, practice of gunnery; *h*, accuracy and rapidity of fire.

Part 3.—Organization and Use of Artillery in Warfare—*a*, progress of artillery in the 16th, 17th and 18th centuries; *b*, artillery in the 19th century; *c*, organization and equipment of artillery.

Part 2.—I would break up into three sub-heads, viz.: *d*, Employment of Field Artillery; *e*, Siege Artillery; *f*, Artillery for Garrison and Coast Service. Our time, this evening limits us to the extended examination of but one sub-head, viz., sub-head *E* of part 2, or deviation of projectiles, and principles of rifling.

Projectile weapons, according to the manner of their flight, admit of a strictly philosophical division into two classes:—They may, like the arrow, keep one end foremost throughout their flight, and strike with that end first; or they may, like a stone thrown from the hand, or a round shot, large or small, travel with any or all parts of the surface in succession foremost, and strike indeterminately.

When a quality is two-sided or two-ended, so that one side or one end is the exact reverse of the other, philosophers call such two-sidedness or two-endedness "polarity"; thus, magnetism is said to be a dual or twin joining of forces. There is a north pointing extremity of the suspended magnetic needle, there is also a south pointing extremity, hence the propriety of the designation "polar."

With equal propriety may the designation be applied to missiles, those which pursue their flight through the air always keeping one end or aspect foremost, are "polar projectiles"; those, on the contrary, which do not are "non-polar projectiles."

This distinction is not drawn for the mere sake of introducing a new word to the military vocabulary, but to simplify the consideration of projectiles. Knowing whether any particular missile be polar or the contrary, we can better adapt such missile to its intended purposes. Thus, of what avail would it be to furnish an arrow head with a barbed point, if no dependence could be placed on the arrow head being the part of the arrow to strike first? Of what avail would it be again to contrive an explosive shell that should be ignited by the percussion of a cap against the object aimed at, if we had not determined beforehand, whether or not the shell, by virtue of some polarity, (how conferred we need not enquire just now) could be depended upon for strking with its capped aspect foremost? The distinction into "polar" and "non-polar," embraces the widest principles I know of in relation to projectiles. When clearly apprehended, it shows how the greatest possible correctness of flight, in its projectile, may be obtained for each variety of missive weapon, and teaches us the limits within which artillerists may hope for success from the application of percussion shells.

Seldom can a better way be desired for teaching what has been done in any particular line, that to assume nothing of the sort already none, but all remaining to be done.

Suppose, then, a piece of sheet lead were given to an operator, accompanied by the request that he (the man to whom the lead is given) should fashion the lead into such a form as, according to his judgment, would go straight towards a target, when fired from an ordinary or smooth bored gun.

Guided by that knowledge of common things, which most of us possess to some extent—we know not how or why—ninety-nine men out of a hundred (I should say, perhaps the hundredth too) would fashion the lead into a sphere, or ball. A common smooth bore firearm, whether large or small, is not what I will venture to call a "polarizing weapon;" it does not impart to its missile the tendency of keeping one particular end foremost throughout the line of flight.

Very great irregularities occur in the path described by projectiles from smooth bored guns. It is a well known fact that if a number of spherical bullets be fired from the same gun with equal charges and elevation, and with gunpowder of the same quality—from fixed rests and with the greatest care—very few of the shot will range to the same distance, and moreover the greater part will be found to deflect considerably to the right or left of the line in which the gun is pointed, unless the range be very short.

With rifled guns the fire is far more accurate, but still the ranges and deflections are subject to variations of greater or less amount. The term deviation must be understood to mean not only the deflections right or left of the line of fire, but the differences between the ranges of similar projectiles fired under like conditions from the same gun.

Deviation of projectiles may be divided into:

1st. Deviation common to projectiles from S. B. or R guns.

2nd. Deviation of projectiles from S B. guns.

3rd. Deviation of projectiles from R. guns, or the deviation of elongated projectiles

1st. The causes of the deviations of projectiles, whether fired from S. B. or R. guns, are (*a*) wind, (*b*) variable projectile force, and (*c*) rotation of the earth.

(*a*). The velocity of the wind is very low compared to that of the shot, but it remains usually nearly the same throughout the flight of the projectile, whereas the velocity of the latter decreases rapidly; it therefore frequently happens that the wind appears to have a greater effect towards the end of the range, and it may be often noticed in practice that shot deviate in a rapidly increasing curved line.

The wind, if strong, will greatly affect the ranges of projectiles, decreasing or increasing them according as it may be blowing up or down the practice ground. The lower the velocity of a projectile the greater will be the deflection or effect upon the range from the wind; as for instance upon mortar shells, on which, having low velocities and long times of flight, the wind exercises a very disturbing influence. The greater the density of the projectile, the less will its motion during flight be affected by wind, and thus shells are more influenced by wind than solid shot.

The wind exercises a very great disturbing effect upon an elongated shot during its flight, rendering it difficult to obtain very great accuracy of fire at long ranges, except in very calm weather. If the centre of gravity of an elongated shot be placed in, or very near the middle of, the long axis, the force of the wind will be pretty equally distributed over the whole length of the projectile. Should, however, the centre of gravity be placed far in advance of, or behind, the centre of figure, the force of the wind will press unequally upon the shot, and uncertain deflections will occur.

2nd cause of deviation, common to projectiles from R. or S. B. guns. (*b*). It is almost impossible to manufacture large quantities of powder of perfectly uniform quality; but, supposing it could be accomplished, the force from a given charge would be liable to variation according to the state of the atmosphere, and the condition of the powder as affected by the time it had been in store. The consequence is that very few projectiles fired from the same gun, with what are called equal charges, leave the bore with exactly the same initial velocity.

3rd cause of deviation, common to R. or S. B. projectiles. (*c*.) The deviation of a projectile caused by the rotation of the earth from west to east is a problem in the composition of forces; the principle that this rotation will have impressed upon the shot on leaving the bore a tendency to move with the same velocity in the same direction as the point upon the surface from which the gun is fired. It will be sufficient for me to give the deductions generally accepted.

(To be Continued.)