

the rate of firing and commencing and ceasing firing. Orders should be written when possible.

#### ELECTRIC LIGHTS, SEARCH AND FIGHTING.

They are used for two distinct purposes, and are controlled according to the purpose for which used. Search lights are used for finding out the position of an enemy's vessel, and are controlled by the Section C.R.A. Fighting lights are used for lighting up the vessels when found, and each Fire Commander should have one under his control. When a vessel is about to pass out of the fire area of a fort, the next Fire Commander is ordered to light up and engage her, and so on.

#### MODES OF ATTACK THOUGHT OUT BEFOREHAND AND SCHEMES OF DEFENCE DRAWN UP.

In every well-regulated fortress there should be a scheme of defence already drawn up, based on local requirements, and this should be kept up to date by being revised every year. In each fort there should be a Fort Book, an Admiralty Chart, Range Boards, Difference and Displacement Tables for Depression Range-finder, and a list of foreign ships, arranged by types, with directions how to employ the guns of the fort to the greatest advantage against each type. In the Royal Artillery every winter each officer below the rank of major is employed solving a tactical problem of an engagement between one or more foreign war ships (given by name), and a fort or group of forts in the fortress in which he is quartered.

What I have said so far gives you an idea of the preliminary arrangements (under the head of organization) which are necessary to be made beforehand to meet an attack by sea, and which could not be deferred until that attack is imminent.

#### ARTILLERY FIRE TACTICS.

The next question in meeting an attack by sea is "By which fort should each of the enemy's ships be attacked, at what part of the ship should the fire be directed, and with what projectiles?" The answer to this is considered under the heading of "Fire Tactics." This involves a knowledge of Naval tactics as we must have some idea what the ships are about. The choice of the objective must be in the hands of the Section C. R. A. and the ship should be selected first whose action, if successful, would most imperil the defence. To obtain the greatest advantage for the forts their fire should be utilized with a definite aim in view and if each Fire Commander were to select his own object, confusion and loss of power would ensue. Good effect can only be produced by concentration of effort.

As soon as the question at what ship we are to fire has been decided, the next consideration is what damage shall we attempt to inflict upon her or in other words what part of the ship shall we try to hit and with what projectiles and fuzes and at what ranges. This necessitates a knowledge of the construction of ships, the characteristics of the three different kinds of armour, wrought iron, steel, and compound, (*i.e.* steel faced iron), the penetration or fracture of armour struck normally or at angles, and (note this) the power of your own guns and the action of your own projectiles—Palliser, Common, Shrapnel, and Case—the shell fired with the different kinds of fuzes or fired plugged.

The choice of the part of the ship to attack lies between the armoured and unarmoured portion, and very heavy damage can be done by attacking the latter. The question of the selection of projectiles with which to attack armoured war vessels is a deep and complex one, full of scientific considerations, and one on which the best authorities are not perfectly agreed, and I will not allude to it further.

#### FIRE CONTROL AND FIRE DISCIPLINE.

There are two more very important elements in the successful Artillery defence of a fortress, viz.: "Fire Control" and "Fire Discipline" but as each itself would form the subject of a lecture, I will only allude to them very briefly. Fire Control has been described by a foreign writer as a system which enables the Commander to hold as it were, the mean trajectory of his guns in his hand and direct a stream of projectiles on to any spot he may wish, with the same facility with which a gardener holding a hose can direct a stream of water on to first one plant and then another." This control can be obtained in three ways, (1) Ranging a battery by means of trial shots; (2) The Depression Range-finder system; (3) The Position Finding system.

The object of "Fire Discipline" is to ensure uniformity in the shooting of the guns. Good Fire Discipline consists in

rapid and correct drill, correct loading with the ammunition ordered, accurate laying at the proper objective, the correct application of corrections which have to be made at the Group as regard range and bearing, and in firing the guns neither too soon nor too late.

To sum up then, in order that the attack of a coast fortress may be met with the greatest chance of success to the defenders and that their guns may be used in the best possible way four qualities are necessary, viz.: good "Organization," good "Fire Tactics," good "Fire Control," and good "Fire Discipline," and the further study of these subjects I would commend to all students of the science of Artillery.

#### SUB-MARINE MINES.

There is a very important factor in the defence of a coast fortress which is Sub-marine Mines. They are made of large charges of gun-cotton confined in iron cylinders and fired by electricity from the shore. Their object is to block channels against the enemy's ships, and their moral effect is very great. They are of two kinds, Contact and Observation, the former float just below the surface and are fired on the ship striking them. They are used in deep water. The Observation mines are used in shallower water on the bottom and are fired as their name implies by observation taken from the shore through a Position Finding instrument. The sea area protected by the Mines is known technically as the "Mine Field." The Mines are in charge of the Royal Engineers but the defence of the Mine Field is in the hands of the Royal Artillery. A clear space known as the "Friendly channel" is always left in the mine field through which friendly ships may be piloted. No enemy's war ships would attempt to enter a harbour that was mined until the obstruction had been removed. This would be done by their small craft. There are three ways of doing it, viz.: by counter-mining, creeping and sweeping. To prevent the mines being destroyed, quick-firing batteries, machine guns, and other movable armament are supplied and are manned by the Artillery of the defence, who must exercise the greatest vigilance in consequence of the rapidity of the movement of torpedo boats, and the fact that their attack on the mine fields would be made by night probably just before day break.

To render the defence of the sea area complete, the defenders must also have some small craft, such as torpedo boats, launches, etc., to provide the power of counter attack, and to perform the duties of guard boats, to watch the entrance of the river or harbour, and the approach to the mine-fields. It is rather a moot point under whose orders these craft should be. As things stand at present, three different branches of the service are concerned in the defence of the mine fields, viz., the Navy, the Artillery, and the Engineers.

#### ATTACK BY LAND.

I think what I have said will be sufficient to give you a general idea of the dispositions relating to an attack of a coast fortress by sea, but it is also liable to be attacked by land or by both simultaneously, and the most vulnerable part of a coast fortress is often its land-side. Its defence would fall to the lot of the infantry, cavalry, and the artillery told off to the moveable armament with which every fortress is provided, and which would consist of siege guns, field guns, howitzers, machine-guns, and quick firing guns on travelling carriages. These would be taken out and placed in carefully selected positions, commanding the different approaches by which your topographical knowledge of the country tells you the attackers must advance. If time admits this evening, I will say a few words later on on the subject of "*Batteries of Position.*"

#### REQUIREMENTS OF A MODERN GARRISON ARTILLERYMAN.

We have now taken a view of the recent improvements in artillery materiel, and the system of coast defence, and we have discussed the characteristics of our objectives, the war-ships; but who are the officers and men who are to man the defences, fight the war-ships, and handle the modern ordnance with its complicated mountings, numerous scientific adjuncts, various ammunition, and intricate stores?

Taking the officers first, Lord Wolsley has said—"I think that the most scientific men should belong to the Garrison Artillery. They should have a very good turn for mathematics and mechanics." So they should, and they should also be instructed in electricity, steam and hydro-pneumatics, ar-