BOMBERS' TRAINING

AND

APPLICATION OF SAME IN TRENCH WARFARE

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PREFACE.

This work is intended to be used as a guide for officers and N.C.O.'s in training bombers. The lectures given at intervals as the men advance in the training will emphasize the features to be observed. A syllabus for a bombers' school covering a period of six days is shown on page 35 as a further guide to instructors. A list of material and equipment necessary to carry out the syllabus is shown on page 36.

Prior to the adoption by the British War Office of the present method of fighting on the Western front, namely, the use of bombs and grenades (which for practical purposes require the same care as high explosives), it was not necessary for the rank and file of the Infantry to have any great knowledge of explosives, any work that entailed the extensive use of explosives being left to the Engineers.

In the Manual of Field Engineering, 1911, there is a chapter devoted to Explosives, but as this work was written before the adoption of the bomb method of fighting it could not be expected that the subject, as treated there, applies fully to the requirements of this arm of the service under present-day conditions. The Infantry being called upon to make use of explosives in the form of bombs and grenades, makes it necessary that they have instruction in the matter of handling, shipping and storage of them in order to avoid accidents; and a knowledge of their characteristics and properties to enable them to make the best use of these altogether necessary and useful agents.

The author is indebted to Capt. G. S. Laing and Capt. G. D. Powis for valuable assistance in this work.

J. R. F.

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SAPHEADS.

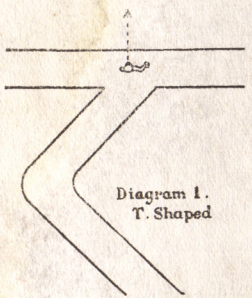

Diagram 1.
T. Shaped

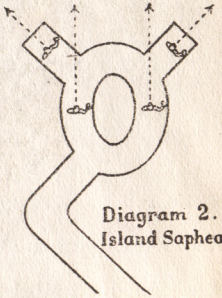

Diagram 2.
Island Saphead

Diagram 1.

(a) Bombs can only be thrown from narrow trenches in the direction to which the trench is running. In order to have complete command of foreground with this type of Sap. it is necessary to make the cross-head too wide.

(b) The total area of Sap. may become effective zone from the fire of one bomb.

(c) Only two men can be employed at one time in constructing this type of Sap.

Diagram 2.

(a) Offers complete range of foreground with the narrowest possible width of trench.

(b) Cannot become effective zone from the fire of one bomb.

(c) A greater fighting area is possible in the same extent of frontage.

(d) When connected up to form line of trenches from which to make assault, takes the place of an island traverse and relieves congestion of traffic at junction of communicating trench and fire trench.

(e) More men can be employed in constructing same than in the T-shaped type.

Bombers' Training

LECTURE I.

EXPLOSIVES.

Working Knowledge.

Handling. In moving cases containing explosives great care should be taken that they are not placed on anything or in such a position that they might topple over or be knocked over, or placed in such a position that other objects might fall on them. Men who are entrusted with the handling of these materials should be most reliable and careful.

The Thawing of Frozen Explosives. Some explosives freeze in a temperature considerably above freezing point, and it is necessary that they be thawed before using. The two recognized methods of thawing frozen explosives are as follows:

1. Place in a steam heated room, but not on the steam pipes. It is desirable that the room have an even temperature.
2. By the use of a double heater; the outer vessel to contain water at a temperature of 125 deg. F., or not hotter than can be borne by the hand; the inner vessel contains the explosive, care being taken that there is no fire in the vicinity.

A Few Causes of Accidents with Dynamite. The following are a few of the causes of accidents with explosives, as taken from statistical information compiled by the Ontario Bureau of Mines, and circulated for the purpose of preventing accidents:—

Dynamite.

1. Forcing primer into hole which is too small for it.
2. Presuming that the charge has a mis-fire, and going too soon to investigate it.

3. Tamping too tightly near the explosive charge.

4. Forcing cartridge into too small a hole or using a metal tamping rod.

5. Thawing dynamite before an open fire, blacksmith's forge, in an oven, or by the heat of the sun's rays through window glass.

Detonators.

A Few Causes of Accidents with Detonators.

1. Attempting to draw a wire from an electric detonator.

2. Attaching a fuse to a detonator carelessly.

3. Trying to destroy a detonator by striking it with a stone.

4. Finding a detonator and tapping it to see if it is good.

5. Holding an electric detonator in a gas flame.

6. By treading on a detonator a number of them have been known to be exploded in the same room.

7. By pricking the composition in a detonator with a pin.

8. A spark from a miner's lamp falling into a box containing fuses and detonators has been known to explode them.

Shipping. When it is desired to ship explosives from point to point by wagons or other vehicles, it is necessary to inspect the wagons and ascertain that everything is in order and good repair, to make sure that the platforms of the wagons and inside of the wagon-boxes are free from protruding nails or pieces of metal that would tend to cause friction on the cases. A bed of straw should be prepared and the cases placed on their flat side, right side up, without any space left between that would permit of displacement or cause friction by the moving of the wagon in transportation. Horses used for this purpose should be quiet and well broken, and care taken that harness and accoutrements are in a good state of repair. Roads should be chosen as far as possible that do not lead through towns or

thickly inhabited parts of the country. In wet weather it is necessary that the load be covered with tarpaulin, and in hot weather with white canvas to minimize the effect of the sun's rays. On reaching the destination, wagons should be carefully unloaded and straw removed to a safe distance and burned. In arranging for transportation by rail or boat, the car or the boat, as the case may be, should be thoroughly examined and not entrusted to the dangerous load unless you are absolutely sure it is in good order. In unloading make sure that no vacant spaces occur between cases that would permit of shifting or friction, and should the entire floor of the car or boat be not occupied with the cases the load should be fenced or blocked in such a way as to prevent it shifting and ensure against friction. Should any packages of explosives, when offered for shipment, show outward signs of oily stain or other indications that the absorption of the liquid part of the explosive in the absorbent material is not perfect, or that the amount of liquid part is greater than the absorbent can carry, these packages must under no consideration be loaded, and must be immediately removed to a place of safety and the parties who supplied them immediately notified thereof. The car containing explosives must be labelled as such in a conspicuous manner and must be hauled as near the middle of the train as possible, and must not be placed next to a car containing oil or inflammable material. A flying switch must not be taken with explosives. In case of a wreck every precaution must be taken to prevent fire. While most of the high explosives burn quietly when lighted in small quantities, and without causing disastrous explosions, it must be remembered that it is not a safe experiment.

Storage. Local conditions have much to do with the type of structure to be built for an explosives' magazine. In general, it may be said that the lighter the construction the better. The laws of some countries require that all magazines be built of such material, and in such a manner, that in the event of an explosion the building will be completely disintegrated and no pieces thrown to any great distance. Storage in caves, tunnels, earth or stone-covered vaults, and in log structures, should under no circumstances be tolerated. The chief objection in all these cases is

that the structure will hold dampness, and any dampness in a magazine containing explosives into which nitrates enter as an essential or accessory ingredient, is certain to affect its quality and render it more or less dangerous in subsequent use. This applies to gunpowder and to practically all dynamites, especially those made in America. It does not apply to Kieselguhr Dynamite of foreign manufacture. When it is desired to protect a magazine from rifle fire, the magazine may be banked with earth to an extent that would be proof against bullets, and to a height well above the cases as arranged in the magazine; arrangements being made for perpendicular air-shafts through the embankment next to the outer wall at intervals necessary to give the required ventilation; ventilating shafts being screened with fine wire netting to exclude vermin and constructed in such a manner that water cannot enter. Explosives should be stored in tiers, box on box, with laths between to prevent dampness accumulating. No cases must be opened in the magazines, a separate building being provided at a safe distance for that purpose. Gunpowder and dynamites in unopened cases, and fuses securely boxed, may be stored in the same magazine, but no fulminates in the form of caps, or otherwise, or loose coils of fuse, should ever be stored in the same building with gunpowder and high explosives. It is important that the magazine be kept clean, and that no men with nails in their boots be allowed to work in a magazine. No fires should be lighted or smoking allowed in or about a magazine containing high explosives.

LECTURE II.

EXPLOSIVES.

Classification, Characteristics and Properties.

General Classification. Explosives are classified generally as follows:—

1. Explosive mixtures of the nitrate class.
2. Explosive mixtures of the chlorate class.
3. Explosive compounds of the nitro-substitution class.

4. Explosive compounds of the nitric-derivative class.
5. Explosives of the Sprengel class.
6. Fulminates and Amides.
7. Ammunition.

Of the seven classifications of explosives, we are dealing with but four in the subject of Bomb Fighting, namely, as classified above, 1, 3, 4 and the Fulminates.

Nitrate Class. Explosive mixtures of the nitrate class. The best known example of this class is gunpowder, the characteristics of which are that it consists of a mechanical mixture of nitrates with some base containing charcoal or other substance yielding carbon. The nitrates carry the oxygen which combines with the base, under favorable circumstances developing a large volume of gases at a high temperature, so that if the powder is confined at the time of explosion there will be produced an enormous disruptive effect. The standard composition of gunpowder is:—

Potassium Nitrate or Salt-petre.....	75 parts.
Charcoal	15 parts.
Sulphur	10 parts.

It might be interesting to note that the charcoal employed for military and sporting powder is made from dog-wood, while for inferior grades of powder willow and alder are used.

Explosive Compounds of the Nitro-Substitution Class and Nitric-Derivative Class. The two explosives of these classes which are generally known are gun-cotton and nitro-glycerine, with special preparations made from them, such as dynamite, blasting gelatine, etc.

Gun-Cotton. Gun-cotton is made by treating suitably prepared cotton with a mixture of one part by weight of nitric acid and three parts sulphuric acid. The immersion lasts 48 hours, the temperature being maintained at 60 deg. F. The cotton is then subjected to a thorough and prolonged washing, after which it is carried through various processes to prepare it for use. The cellulose of the cotton has thus been converted into tri-nitro cellulose. By varying the strength of the acids different degrees of nitration may be obtained. Gun-cotton is extensively used for military purposes.

Gun-cotton differs but slightly in appearance from ordinary cotton. It has a harsh feel and is less flexible than common cotton. It becomes highly electrified when rubbed between the fingers and appears luminous when rubbed in the dark. It is entirely insoluble in hot or cold water, but dissolves in a mixture of ether and ammonia. It will rarely take up more than two per cent. of moisture from the atmosphere. It is insensible to pressure, percussion or friction, unless closely confined or firmly compressed. It burns with a flash, but without explosion if brought into contact with burning or incandescent bodies. Wet gun-cotton will not burn or explode. Its ignition temperature is 360 degrees F. Pure gun-cotton will undergo no spontaneous decomposition and is the safest explosive known. Although it will not explode when wet, it may be detonated in this condition by a Mercury Fulminate Detonator with a small initial charge of dry gun-cotton in contact with it.

Nitro-Glycerine. Nitro-glycerine is a nitric ether, or specifically a glyceryl tri-nitrate. Different degrees of nitration yield the mono-di and tri-nitro glycerine, respectively; the latter being the nitro-glycerine of commerce. It is made by treating an exceedingly pure quality of glycerine with a mixture of nitric and sulphuric acids, the proportions commonly adopted being 3 parts of nitric acid, 5 parts of sulphuric acid, and from 1 to 1.15 parts of glycerine. The glycerine is added very slowly and with constant stirring. The agitation of the mixture is now usually accomplished by compressed air.

When made from the purest ingredients, nitro-glycerine is an oily looking fluid, as clear and transparent as water. When freshly made it is whitish and opaque, but on standing it clears. The specific gravity at normal temperature is about 1.6 deg. F., when frozen 1.735 deg. F. Nitro-glycerine dissolves in alcohol, ether, methyl-alcohol, benzine, etc. Freshly made, opaque nitro-glycerine freezes at from 2.2 deg. F. to 7.6 deg. F., while the transparent, or clear, product freezes at from 39.2 deg. F. to 37.4 deg. F. In its frozen state it is less sensitive to shock or concussion than when it is in liquid. It may be completely evaporated when at a temperature of 158 deg. F. Its ignition temperature or

firing point is 356 deg. F. Exposed to a temperature of 365 deg. F. it boils with evolution of vapors; at 381.2 deg. F. it volatilizes slowly; at 392 deg. F. it evaporates rapidly; at 422.6 deg. F. it detonates violently. From this point its behavior changes, passing through temperatures at which it explodes with constantly lessening violence until, at a dark, cherry-red heat, it assumes a spheroidal state and fails to explode. This applies to small quantities only. When gradually heated it is certain to explode at 356 deg. F.

Picric Acid. When coal tar is subjected to a fractional distillation the portion which comes over up to a temperature of 170 deg. C. is called "light oil" and contains all the compounds of low boiling paint contained in tar, and from this several of our most valuable explosives can be obtained. When these light oils have distilled over the next fraction, or "middle oil," yields phenol or carbolic acid, a body which nitrated gives picric acid, which is the basis of the French high explosive "melinite" and the English "lyddite."

Picric acid consists of a very strong nitric acid and carbolic acid, and is a very high explosive. It was introduced by Turpin, who mixed it with collodium and called it "melinite," by which name it is known in the French Service. It forms with metals a class of salts (picrates). The potassium salts were suggested as a bursting charge for shells nearly fifty years ago. Sprengel and, later, Turpin, employed the acid itself as an explosive. It was possible to get a great weight of explosive into small space, as the acid could be melted and poured into the shell in a molten condition. Picric acid is a very safe explosive, but has the drawback of acting on metals, forming "picrates," some of which are more sensitive to disturbing influences than the acid itself.

Lyddite. Lyddite consists of melted solidified picric acid, and has the same disadvantage of forming "picrates" when in contact with metal, making it necessary to varnish the interior of shells when used in them. Experience with lyddite shells shows them to be very erratic, due to the fact that they require a very powerful detonator, the use of which is very dangerous, as they may cause a premature explosion.

T. N. T. These disadvantages in picric acid led to its being largely replaced by tri-nitro toloul, or T. N. T., which has a bursting pressure of 119,000 pounds per square inch as against 135,820 pounds for picric acid. Yet the advantages of the former more than compensate and warrant its use being preferred. T. N. T. does not act on metals to create sensitive salts and is, therefore, perfectly stable. The French name for T. N. T. is "Tolitype," the Spanish "Trilite," and the German "Trotyle." It is produced by heating troulue with a mixture of nitric acid and sulphuric acid.

Troulue. Troulue is a liquid hydro-carbon obtained along with benzine.

Tetryl. Tetryl is another coal tar product containing more nitrogen than lyddite, and is employed in detonators with a little lead azide, making a less sensitive and safer preparation than fulminate of mercury.

Aunnonal. Aunnonal is a mixture of T. N. T., aluminum in fine powder and nitrate of ammonia, and a trace of charcoal. It is safe and powerful, but has the disadvantage of attracting moisture, and for that reason does not always explode.

Dynamite. Dynamite is the most generally used of any blasting material in the world. It was invented in 1866 by Alfred Nobel. Its principal consisted in using an absorbent commonly called a "dope," which would take up the nitro-glycerine and hold it after the manner of a sponge.

A suitable dope should possess a cellular structure so that the nitro-glycerine may be subdivided into minute globules, each being held separately in its own cell, completely isolated from every other. In this condition its sensitiveness is greatly reduced, depending, of course, on the amount of nitro-glycerine absorbed. Dynamite may be classified, according to the nature of the absorbent used, as follows:—

1. Dynamites with inert base,
   (Kieselguhr, Magnesium carbonate.)
2. Dynamite with an active base,
   (a) Combustible base.
   (b) Explosive base.

The explosives' bases in (b), as above, may be of the nitro-substitution class, or the nitric-derivative class.

In choosing the dopes for inert bases of dynamite where wood pulp or sawdust is employed, it should be of some porous wood such as spruce or basswood. Woods differ considerably in the amount of nitro-glycerine they will absorb, ranging from 60% to 85%. Before introducing the nitro-glycerine they should be thoroughly dried. Good dynamite should not feel greasy. There should be no trace of free nitro-glycerine inside the wrapper of the cartridge. Slowly heated dynamite explodes at a temperature of 356 deg. F. If rapidly heated, it explodes at 446 deg. F. These temperatures apply only to Kieselghur dynamite. The American dynamites containing wood pulp and nitrates will explode with somewhat lower temperatures. Like nitro-glycerine it is most sensitive to shock and friction just above the freezing point. According to the dope used, it freezes at from 42 deg. F. to 46 deg. F. It is nearly, but not quite, insensitive to shock or friction when frozen. (See page 88, Manual of Field Engineering.)

Monobel. Monobel consists of:

Nitro-Glycerine	7½%	to	9½%
Nitrate of Amm.	66 %	to	70 %
Wood meal	7 %	to	9 %
Chloride of Sodium.....	14 %	to	16 %
Rem. Moisture	½%	to	2 %

Fulminates. These are the most powerful and dangerous explosives in common use. They consist for the most part of metallic salts of fulminic and amic acids. The commonest fulminate, known as mercury fulminate, is formed by dissolving mercury in nitric acid, to which solution when cool is added 110 parts of alcohol. Water is then added, causing a grey fulminate to precipitate. This is carefully washed and air-dried. The operation is attended with great danger. The color of fulminate varies from a white to dirty grey. Its specific gravity is 4.42 deg. F. It has a sweetish taste and is highly poisonous. It is extremely sensitive to heat and shock of every kind. Its firing point when slowly heated is 306.5 deg. F., and when rapidly heated 368.6 deg. F. When wet it is less sensitive, but not secure against explosion. The slightest friction will provoke

its explosion. It may be destroyed safely by treating it with alkaline sulphides.

Fulminates of other metals are capable of being made, such as fulminates of silver, gold, platinum, zinc and copper, but these are more violently exploded and less stable. The only one which has come into any use being a silver compound. Mercury fulminate is the explosive used in the manufacture of detonators. (See page 89, Manual of Field Engineering, 1911.)

Detonators and Fuses. (See pages 89, 90 and 91, Manual of Field Engineering, 1911.)

Theory of Explosives and Fumes. Definition of Explosive: Explosive is a substance either solid, liquid, or jelly, which, when subjected to a shock, suddenly changes from solids, etc., to gases, at a very high temperature, tearing to pieces any vessel which may contain them.

Definition of an Explosion: An explosion is a chemical reaction which is completed in an exceedingly short period of time with the evolution of a large quantity of gas at a very high temperature. If this reaction occurs in a body which is closely confined, the expansive effect of the highly heated gases produces disruptive effects. If the suddenness of the reaction is very great, disrupted action upon solid objects in contact with the body may be obtained even when it is unconfined, because the cohesion of these objects can be overcome more readily in an instant of time than the inertia of the surrounding air. This has given rise to the popular error that nitro-glycerine and other high explosives act downwards; as a matter of fact they act with equal force in all directions. It is evident, therefore, that the violence of an explosion depends upon three things, namely, the time occupied completing the reaction of the explosive body; the temperature produced by the reaction, upon which directly depends the expansive forces of the resultant gases; and the quantity of gas evolved by the reaction. A fourth consideration —whether the products of the reaction are the result of one set of chemical actions occurring simultaneously; or whether the set of new compounds react upon each other, producing a second set of compounds.

LECTURE III.

STUDY OF A FEW OF THE PRINCIPAL TYPES OF RIFLE AND HAND GRENADES.

General. The undermentioned types of grenades, empty, are issued for instruction:—

(a) Grenade, 303-inch, short rifle, No. 3, Mark 1. (J. pattern.)
(b) Grenade, hand, No. 1, Mark 1.
(c) Grenade, hand, No. 5, Mark 1.
(d) Grenades, hand, Nos. 6 and 7, Mark 1.

These grenades were also known as (a) Hales Rifle Grenade; (b) R. L. impact or percussion grenade; (c) Mill's pattern grenade; (d) R. L. grenades, friction, time.

Of these (a) is for firing from the point .303-inch short rifle. Its range is about 200 yards.

The remainder are intended to be thrown by hand.

Hand grenades can be of two classes, Heavy and Light. Heavy grenades weigh about 2 lbs. and light about 1 lb. It is considered that a man can throw a 2-lb. weight about 30 yards and a pound-weight about 50 yards. Heavy grenades project fragments of some weight a fair distance, while light grenades rely for effect principally on the blast of detonation.

The effective area of a light grenade is mainly local, 6 yards diameter, but when possible it should not be thrown less than 20 yards in the open, as stones, etc., thrown up by the explosion would be dangerous to the thrower.

The danger area of the heavy grenade is about 30 yards in diameter, and, therefore, it should not be thrown less than 25 yards in the open. With both grenades the thrower should cover the eyes at the moment of explosion and protect himself, as small frag-

ments of metal may carry further than the distance mentioned.

The types of hand grenades (b), (c) and (d) differ fundamentally in the means by which ignition is effected; (b) explodes instantaneously on impact (by percussion), while (c) and (d) are fired by time fuse, which is lit in (c) by spring action releasing a trigger at the moment the grenade leaves the thrower's hand, and in (d) by an independent action on the part of the thrower before throwing the grenade.

In the case of (b) it is necessary that the grenade fall head first. This is done by the backward pull in the air of the streamers attached to the handle. In using this grenade it is, therefore, necessary to see that the streamers are opened out and free—before throwing, and to throw the grenade well upwards.

In the case of (d) the total time of delay is slightly over 5 seconds, so that from 1½ to 2 seconds should be used in throwing. If thrown hastily it may arrive at the mark 3 seconds before exploding and allow it to be returned by the enemy.

When handling detonators for grenades, it should be remembered that the detonator by itself is capable of blowing the hand off, so it must be carefully handled, and if an igniter is accidentally fired it should be thrown a few yards clear of any one in the neighborhood. When the igniters and detonators are in the grenades reasonable care should be taken to avoid rough usage as violent treatment might fire the grenades, even in the safe position.

Grenade .303-inch, Short Rifle, No. 3, Mark 1 (J. pattern). Description: The grenade consists of a steel body filled with explosive. Down the centre of the explosive is a brass tube into the forward end of which the detonator is inserted. The rearward end of the body is closed by the base piece which carries the needle pellet, two retaining bolts, wind vane and releasing socket with safety pin. To the base piece is fixed a base plug carrying the spring clip and a 10-inch steel rod.

The action of the grenade is that, the safety pin having been removed, on firing the releasing socket sets back from under the wind vane, which is then revolved by the wind pressure as the grenade travels through the air. After a few turns of the vane the

retaining bolts are no longer held in position by its inner surface.

On impact the needle pellet sets forward against the creep spring, on the detonator cap, firing the grenade.

The steel body is serrated so as to furnish numerous missiles.

Package of Grenades: The wooden box provided carries 20 grenades in protecting tins with screw-off lids, 20 detonators, rifle grenades in four tin boxes with lever lids, and 22 special blank cartridges in a tin box.

Preparation for Firing: The grenade is removed from its tin and the ebonite plug in its head is unscrewed by hand. The grenade is held nose down to make sure that the needle pellet is held by the retaining bolts.

If correct, the detonator is inserted and screwed home.

The rod is then gently lowered into the rifle, the clip sprung on the muzzle and a blank cartridge inserted in the chamber.

The safety pin is withdrawn just before firing.

If, after the safety pin has been removed, the grenade is not used, the safety pin may be replaced if the screwed ring has not unscrewed and uncovered the two retaining bolts, but if these are uncovered the grenade is in a dangerously sensitive condition, and if so found should be destroyed. Only the special detonators and cartridges provided should be used.

If by accident a grenade were fired with a bulleted round the rifle would probably burst and injure firer.

This grenade is very safe to handle, as it cannot be fired by knocking or dropping on the ground; it must travel through the air some distance before the retaining bolts fall out.

Pendulum Dial Sights. A pendulum dial sight graduated in yards, for direct aim or high elevation, is issued for use with the rifle grenades, and can be easily affixed to the leaf of the back-sight.

Should the sight not fit tightly on the leaf, the spring sides should be slightly pinched in.

Grenade, Hand, No. 1, Mark 1. Description: The grenade consists of a brass cylinder encircled by a narrow cast-iron ring serrated to break up into 16 fragments.

The cylinder is mounted on a wood block to which a cane handle, with streamer, is attached.

The brass cylinder or body of the grenade is filled with explosive, and has its upper end closed by the detonator holder, fixed by three screws. This holder carries two pins for securing the detonator. The body has fitted above the serrated ring two knobs and two indicating stops.

The firing needle is carried in the removable cap, which has two grooves formed on it in which slide the knobs on the body. The cap is centrally pierced for the safety pin.

On the outer surface of the cap are stamped the words "Remove," "Travel" and "Fire." When the knobs are in the groove "Remove," as indicated by the stops, the cap can be removed and replaced; the central position, marked "Travel," is to be adhered to normally; while in the position "Fire" the cap, after removal of the safety pin, is held in position by friction only, and can be pressed inwards to fire the grenade.

The action of the grenade is simply that the cap is forced in on impact, carrying the needle on to the detonator, the cap having been turned into the position "Fire" and the safety pin having been removed before the throwing.

Packing: The grenades are packed six in a wooden box. Cylinders containing 10 detonators, No. 1 Hand Grenade, Marks I. or II., are issued separately.

Preparation: The cap is removed, a detonator is inserted in the recess, the grooves in the detonator being placed opposite the pins on the body, and the detonator is then pressed home and turned to the left (its flange being under the heads of the two pins) until the spring on the detonator flange is released thus locking it in position.

The cap is then replaced and turned into the position "Travel."

The safety pin must on no account be withdrawn during these operations.

The cap from one grenade will not invariably fit another grenade well, and steps should be taken to prevent caps and grenades being interchanged.

Throwing the Grenade: When it is required to use the grenades, all on the belt should be turned to "Fire," and the whipcord beckets and leather strips should be removed from the safety pins.

When a grenade is taken from the belt, the streamer is unwound and allowed to hang free, and the safety pin is withdrawn immediately before throwing.

The grenade is grasped by the end of the handle and thrown in the required direction, care being taken that the streamer does not get entangled with the thrower.

To insure the grenade firing on impact, it should be thrown well upwards, at an angle of not less than 35 degrees.

Should the grenade not be used the cap should be turned back to "Travel" and the safety pin replaced and secured by passing the whipcord becket over the cap and threading the leather strip through the slot in the end of the safety pin.

Grenade, Hand, No. 5, Mark 1. Description: The body of the grenade is of cast-iron, serrated to provide numerous missiles on detonation. Into one end is screwed a centre piece, with separate recesses for the striker and detonator.

The striker is kept cocked against its spring by its head catching on the end of the striker lever when the latter lies against the body of the grenade, pivoted on its fulcrum pin.

The lever is retained in its position by the safety pin.

The detonator is a separate unit, consisting of cap, cap chamber, safety fuse, and detonator.

The action of the grenade is that, after the safety pin is withdrawn, on throwing the grenade the lever swings outward under the pull of the striker pin spring, thus releasing the striker, which fires the cap. The safety fuse burns less than five seconds and then fires the detonator.

Packing: The grenades are packed 12 in a wooden box, together with a cylinder containing 12 detonators and lengths of safety fuse attached.

Preparation and Use of the Grenade: Unscrew the base plug, insert the detonator, etc., into the recesses provided and replace the plug.

The grenade is then held in the throwing hand in such a manner that the striker lever is held securely against the body of the grenade by some part of the hand.

The safety pin is pulled out by the other hand just before the grenade is thrown.

If not thrown the safety pin should be replaced.

Grenades, Hand, Nos. 6 and 7, Mark 1. Description: The grenades consist of tin vessels filled with high explosives and are packed 40 in each packing case, with four haversacks.

The "HEAVY GRENADE," weight about 1 lb. 13 oz., contains an outer layer of scrap iron. The igniter socket is closed by a wooden plug for transit, and covered by a papier mache cap.

The "LIGHT GRENADE" is entirely filled with explosive. Weight slightly over 1 lb.

The IGNITERS and DETONATORS, packed 10 in a tin and 40 in each packing case, consist of a friction igniter, a length of safety-fuse and a service detonator. The friction igniter consists of the holder to which is fixed a flange with two notches and two springs. It also has two horns, which form a grip for turning the igniter into the locked position. The friction bar is fixed to a button through which the firing loop passes.

The HAVERSACK is intended to be carried similarly to be ordinary service haversack, but the sling is shorter to cause the grenades to rest above the hip and as far as possible clear of other equipment.

The loose strings should be tied round the waist to prevent the pockets sagging and the grenades knocking against one another.

Preparation of Grenade: Remove papier mache cap and the wooden plug from the igniter socket. Tear the strip from the tin box containing the ten igniters, insert an igniter in the socket so that the notches in the flange pass over the brass studs on the grenade. Turn the igniter in either direction until it is locked by the springs on the flange and one of the studs which is then held between the two

springs. If it is required to remove an igniter, one of the springs must be kept pressed down while the igniter is turned till the spring is clear of the stud. Replace the papier mache cap and place the grenade in a pocket of the haversack with the cap uppermost.

Firing the Grenade: Remove the papier mache cap. Hold the grenade in the right (or throwing) hand so that the igniter is towards the wrist, the forefinger over the bottom of the grenade. Pass the forefinger of the other hand through the firing loop and, when ready to throw, pull with a sharp jerk. If a second's time is taken and the grenade bowled or thrown it should explode soon after reaching the mark.

LECTURE IV.

BOMBERS' TRAINING—PART I.

Discipline. Soldiers do not receive any training in bombing until they have passed the recruit stage, in which special attention is given that a very high degree of discipline is attained. In bomb fighting and trench warfare a higher degree of discipline is demanded. In addition to the discipline which enables a unit to go on parade and carry out the different movements as one man, it is necessary that every man be taught in such a way that, should circumstances arise, that he should be cut off from his comrades he can carry on intelligently as a little unit by himself, doing the right thing at the right time. It is only by training that enables him to do this in the absence of commanders that the necessary degree of efficiency can be attained.

Organization. The use of bombs was adopted by the British War Office early in the summer of 1915. The organization put into effect in England was as follows: In each brigade was formed what was known as the Brigade Bombers' Company. Men were detailed from each of the units forming the brigade for their initial training, which lasted over a period of six days. During the first of the training periods at least one subaltern per battalion should be attached to the Brigade Company for training, so

that the battalion is provided with an officer qualified to superintend the training of the battalion bombers' section. This officer and others should return to the brigade company for short periods of training from time to time as it has been found that new technical as well as tactical ideas are continually being introduced into this important branch of work.

One sergeant, two corporals and 32 rank and file are detailed from each battalion. The company is commanded by a selected officer, who will be assisted by an additional N.C.O., who acts in the capacity of C.S.M. and C.Q.M.S. The Company is kept up to strength by a system of relays, so that at the end of each three days half the men of the Company are returned to their units for duty, their place being taken by others detailed for that purpose. It will be seen that by this method in a short time the entire brigade will have received their preliminary training in this subject. It must not be considered that their training in bombing is complete at the end of six days, further periods for practices being arranged for in their weekly training syllabus. The preliminary training having been completed, there is formed what was known as a permanent Brigade Bombers' Company.

The Battalion Bombers' Section. The Battalion Bombers' Section, when complete, should consist of about 40 trained men, including N.C.O.'s, but the training of all men should be proceeded with so that ultimately every man in the battalion is qualified. When trained a thrower should be able, when standing in a trench behind one traverse, to place 75 per cent. of his bombs in a bay on the farther side of a traverse 30 yards away. To be an expert bomber, one must be fit. It is therefore necessary to take a certain amount of physical exercise each day while in training and when on active service. In this respect the grenadiers are especially cared for. They are given special privileges, given the best of billets and shorter hours in the trenches, which gives them plenty of time for exercise, and their favorite games, which keeps them in good condition. Drinking is not prohibited, but if a man expects to be able to keep cool and think and act quickly it is better to be

temperate. A bombers' duties in the trenches are looked upon as most interesting and lack monotony. If he understands his work and the grenades, that is, when they are safe, he has nothing to fear, although he will find that some of his more ignorant pals may shun him when he goes about with his full complement, in fact, they will make way wherever he goes. When our First Canadian Division went into the trenches, as also have many other reinforcing battalions, without a sufficient knowledge of bombs, the result was that many accidents occurred through carelessness and ignorance and lack of training in this important branch of work.

Practice in Making and Throwing of Dummy Bombs. In order that the men may become proficient in the matter of throwing live bombs it is necessary to have dummies which represent as nearly as possible in size, shape and weight the live manufactured types which are used in active service. The men are accordingly taught to make these by hand. There are four types of these, as follows:—

(a) **The Jam-Tin Dummy,** which is made with an empty jam tin, three-quarters filled with clay, the top being drawn together and sewn with wire. This type contains no explosives.

(b) A jam-tin made in the same manner but in the centre of the tin is placed half a cartridge of monobel with fuse and cap. These two types of bombs are made to weigh from one to two and a quarter pounds, and may be thrown from thirty to fifty yards.

(c) **Powder Puffs:** A powder puff is representative of a hair brush bomb and consists of a piece of wood 1" x 5" x 17", 7" at one end being left full size, the remainder being cut away on each edge to form a handle. On the broad part of this is placed another piece of wood 2" x 4" x 6" with a hole 1⅜" in diameter bored through the centre. This piece of 2" x 4" is attached by wire nails to the 1" x 5"; the centre space is filled with gunpowder and covered with a small piece of 1-inch board, the fuse being inserted

through a ⅜-inch hole, which is bored through the 1" x 5". The explosive used in the hair brush, which this dummy represents is a slab of wet gun-cotton, 1¾" x 3" x 6" with a 1⅜" cone-shaped hole in the centre to receive a dry gun-cotton primer which has a ⅜" hole in its centre to receive the detonator, which in turn receives the fuse. The weight of slab 15 ounces; the weight of primer 1 ounce.

Hand Grenade, No. 1, Mark 1, Dummy. (d) A piece of 2" x 2" wood, 17" long, one end shaped for a handle, the other end made partially round, a 1¾" gas pipe union being put over the handle end and driven tightly on to the large end of the stick. A groove is cut around the stick about 8" from the handle end, to which is wired three pieces of cotton about 1½" x 24" long. These act as streamers and tend to keep the business end of the bomb forward in its flight.

Note: The idea of the explosive being used in the dummy bombs is to accustom the men to handling explosives, the lighting of fuses and gauging of the time required per inch for a service fuse to burn, at the same time not sacrificing distance and accuracy in throwing. It has been noticed that men in their eagerness to get rid of the live bomb lose sight of the main object for which they are being trained, namely, accuracy and range.

Throwing Position. The correct position for throwing is as follows:—Spread the feet slightly and brace them firmly on the ground, the shoulder opposite the throwing hand being in the direction to which you are throwing. Bring the other hand containing the bomb upwards with a straight arm and circular motion, releasing the bomb when the hand is above the head. It is impossible in a narrow trench to move from a standing position when throwing. The men in throwing practices should therefore be made to maintain a standing position.

Sandbags. It is necessary that all men engaged in trench fighting should be specially taught in the uses of sandbags and the methods of filling, tying and

passing them in the trench. The method of passing sandbags in a trench is as follows: The men place themselves from two to three paces apart with their backs in the direction to which they are passing the sandbags and pass them between their legs from one to another. This method has the double advantage of enabling them to pass them very quickly and keep their heads down out of danger from rifle and M. G. fire at the same time. The men should receive further practice in the manner of building them up to form blockades and breast works, etc., in order that they may acquire speed in this matter. In the absence of a full supply of sandbags, grain sacks or flour sacks may be used.

Training in the Use of Digging and Cutting Tools. Frequent practices should be carried out in order that the men are efficiently trained in this work. It is very necessary that the men should be taught the use of these tools in the different positions, that is, standing, kneeling and lying. This can only be accomplished by frequent practices.

Training in Reconstruction and Repair Work. This can be carried out with success in the dummy trenches which we use for practices in bomb throwing and by changing the front of these trenches and wrecking them it is possible for the men to get practice in the use of the different materials employed in reconstruction and repair work, such as earth, sandbags, sods, timber, brushwood, bale wire and material obtained from old packing cases.

Means of Egress from Trench. On taking up a position in a trench men should be taught to provide means of egress therefrom at their first opportunity. This is done by cutting steps in the walls of the trench, just sufficiently large enough to enable them to get a foot-hold; the bottom part of this being reinforced with a small piece of board to keep the earth from breaking away. A hand hold is provided at the top by means of a stake driven into the ground or a small piece of wood secured by bale wire to a "dead man" buried in the parapet. By these means the whole line is enabled to go forward at the same time should occasion demand it.

Passing of Orders and Information in the Trenches. Men should be taught the art of passing of orders and information correctly, by word of mouth. This is a very important part of the soldiers' training, and should always be practised when the trench practices are being carried out; a sender of messages being placed at one end of the line and a receiver at the other to keep a record of messages, etc.

Trench Comforts. A little study in the matter of personal comforts in the trenches will prove to be of great advantage to the men. The clothing should be tight fitting about the neck and waist to prevent falling earth and pebbles getting inside the clothing and working down into the boots. The men should be instructed to take a change of socks when they go in the trenches and it is also necessary not to forget to have a supply of smokes; in short, by paying attention to these small matters there may be many comforts enjoyed in the trenches which would otherwise be overlooked.

Uses of Bombs.—The uses of bombs may be classified under two heads, **Defensive and Offensive.**

Defensive:

(a) Throwing from sap-heads to prevent the enemy from pushing their saps too close to our trenches or strong places.

(b) To combat the enemy's enfilade attack in our trench should they be successful in gaining entrance thereto.

(c) From concealed positions bombs may be used to break up and throw into confusion an enemy's attacking force; this especially applies to night attacks when enemy is advancing in close formation.

Offensive:

(a) By throwing from sap-heads when destroying the enemy's keeps and strong places.

(b) Supplying cover fire for wire cutters, sappers, etc.

(c) Assisting in a frontal attack on an enemy's position.

(d) Following up advantages gained in a frontal attack by an enfilade attack to the

flanks and our front from position gained in enemy's trenches.

Advantages of Bomb and Grenade Fire Over Rifle Fire. It must not be supposed that when advantages are claimed for bomb and grenade fire over rifle fire that the latter has not its advantages, too. The advantages of bomb and grenade fire must be at short range and are, therefore, specially adapted to the type of warfare waged at present on the Western front and may be considered as follows:

(a) Owing to the high and pronounced trajectory we are able by the use of bombs to reach the enemy in his trench, whereas with rifle fire the only precaution necessary on the part of the enemy is to keep his head below the parapet, the trajectory of rifle fire being practically flat at point blank range.

(b) It is possible with a single 2-pound bomb to obtain an effective zone of 20 yards and a danger space of 40 yards in the enemy's trench which is dead ground to rifle fire.

(c) The moral effect of bomb fire is much greater than that of rifle fire.

Means of Protection Against Enemy's Bombs.

(a) **The Use of Wire Netting:** Trenches, machine gun pits, etc., are covered with close wire netting to prevent the entrance of enemy's bombs. Low screens of wire netting may be placed in front of the parapet to prevent rolling bombs getting into our trenches.

(b) The **Digging** of small **Ditches** and the **Breaking** up of the **Surface** of the **Ground** in front of our position is an effective way of preventing bombs from rolling towards our position.

(c) The adoption of shallow **Sleeping Pits** in the rear of our trenches to provide quarters for the reliefs has been proven a success.

(d) Trenches should not be made wider or deeper than is absolutely necessary, as the effect of high explosives in deep trenches is much more deadly than in shallow ones, and

the highest part of the parapet and parados should be next to the trench and sloping slightly from the trench, the idea being not to aid bombs in rolling into the trench.

(e) Bomb and splinter proof shelters may be built over keeps, trenches and other strong places.

(f) The use of sap-heads from which bomb fire is provided to keep the enemy from getting into bombing range of our positions. (See Fig. 1.)

(g) **Obstacles** should be placed in front of our trenches at sufficient distance when possible to prevent enemy throwing bombs into the latter from behind these obstacles. This will disallow of bombing covering fire for their wire cutters.

Storage of Bombs in Trenches. Each platoon commander in the trenches is responsible that he has a supply of bombs and grenades and procures the same from the brigade bombers' magazine, which is located anywhere from 1,500 to 2,500 yards in the rear of the front line trenches. They are stored in the trenches in bomb and splinter proof pits provided for that purpose.

General Efficiency and Resourcefulness. When a unit goes into the trenches the success with which it meets depends entirely on the degree of efficiency and resourcefulness and physical condition of the men. We are taught in the different Training Manuals that the British forces do not retreat and should it be necessary that from a tactical or strategical standpoint the commanders of our forces consider it necessary to give ground, the movement is carried out under what is known as a rear guard action and must not under any circumstances be considered in the nature of a defeat, the reason for this being that with anything like equality in numbers, equipment and armament, we are more than a match for the fighting forces of any other nation. Assuming this to be true, it is not so much the training in the building of our trenches that our men require as the raining that will enable them on occupying the enemy's trenches

to reconstruct and repair them to meet our own requirements. This work has often to be carried out in daylight and under fire, making it necessary for the men to work in a prone position. It is therefore necessary that the men be skilled in the use of the digging and cutting tools used in trench warfare in order that accordingly as we occupy the enemy's trenches they may be consolidated for our use and kept in repair as long as they are required for fighting, communication or storage trenches. By this means the ground we gain is consolidated for our purposes as we advance. On the other hand, if we do not consolidate our position as we advance we are left more or less in a state of unpreparedness and give the enemy a chance to launch a counter-attack with good results. All the training that our men can possibly receive on the subjects of musketry, bomb throwing, etc., that fits them for trench warfare is practically lost unless they are thoroughly skilled in the use of the trench digging and cutting tools, in which they require as much training as in the use of the rifle. This can only be accomplished by a systematic arrangement and carrying out of practices in trenches which are built for that purpose. To accomplish the desired results special attention should be given to the instruction and training that will enable a soldier to use intelligently the different kinds of material which may come to hand. For example, our men may be taught to repair a trench by the use of sandbags, sods and brushwood, but might not be able to obtain these materials. At the same time back of the lines there might be all kinds of bale wire, packing cases, cull lumber, etc., by means of which, with a little instruction, the same work of repairing the trench might be accomplished. It is only by getting down into the ground and working out these problems for ourselves and making note of the little things, not being above taking suggestions from the last private in the ranks, that we will be efficient to a degree necessary to outwit and defeat our ever industrious and systematic enemy.

Note.—In the following lectures blackboard illustrations may be used with good results.

LECTURE V.

FRONTAL ATTACK.

Preparation and Organization. In trench warfare, when our movements are changed from the defensive to the offensive, it is necessary to choose certain sections of the enemy's front line of trenches. These are chosen from a tactical point of view, and after having been occupied and consolidated to our use become the bases from which enfilade attacks are directed to the flanks and front, by means of which we extend and connect our positions. The Officers and their Staffs ordering the offensive, make a very careful study of the neighborhood in the sections to be occupied from maps and sketches which have been compiled from information gained by the Air Service and Reconnaisance. They finally decide the exact extent of front which will be occupied in each case by direct frontal attack. The extent of front in each case is never greater than is absolutely necessary, and is clearly defined in orders. Every officer taking a part in the assault is supplied with maps and sketches, which constitute part of his orders.

(Note the necessity for every officer being able to make a study of a locality from information given on maps and sketches.)

Arrangements are made for the co-operation of the different arms of the service taking part in the assault, such as the engineers, artillery, air service and infantry. A schedule or program is arranged covering the movements of the different arms of the service, which are carried out by time-table, each Officer and Non-Commissioned Officer having correct divisional time.

Arrangements are made for reinforcements, ammunition, supplies and materials necessary to carry out the attack and consolidate the new positions to be taken, also for the establishment and maintenance of communication. Artillery fire is directed on the positions to be occupied, also on the trenches to each flank and the rear of the same, and on the enemy's obstacles for a period of from thirty minutes to several hours prior to the advancing of the infantry.

Saps are run out in front of our obstacles and as much progress as possible is made in joining up the sap heads to form a new line of trenches from which to deliver the actual assault without the hindrance of our own obstacles.

Our troops are massed as near as possible to the front line in readiness for the assault. The supplies of ammunition and material are brought forward to as convenient a position as possible, to be taken into the new position at the first opportunity.

Saps are extended towards the enemy's machine gun positions and any positions from which they could supply cover fire, and bombs are thrown from these to finish the work of the artillery in the destruction of the same.

At the time arranged in the program the artillery cease fire on the enemy's obstacles and our wire cutters advance, covered by bomb fire, to finish the work of the artillery in the destruction of the obstacles. The wire-cutters are armed with axes, saws, billhooks, crowbars, wire-cutters, and high explosive bombs, and when they have cleared the way sufficiently for our men to pass, the signal is given and the first line of bayonet men goes forward accompanied by a few bombers. They are joined in the attack by the wire-cutters.

The first line is followed by a second line and possibly a third, before the section of the enemy's trench is occupied.

The Assault. The assault may be said to be classified under three heads, as follows:—

1. SUPPRESSION OF THE ENEMY' FIRE.
2. DESTRUCTION OF THE ENEMY'S OBSTACLES.
3. THE ACTUAL DELIVERY OF THE ASSAULT.

LECTURE VI.

CONSOLIDATING THE GROUND GAINED.

Consolidating the Ground Gained. Immediately we have occupied the new positions, it is necessary to reorganize our forces (the flanks being protected by bombing parties while this work is being carried out). The different parties and reliefs necessary are formed, as follows:

(A) SENTRIES AND RELIEFS.
(B) RECONSTRUCTION AND REPAIR PARTIES.
(C) SAPPERS AND DIGGERS.
(D) SUPPLY PARTY.
(E) COMMUNICATION MEN.

Sentries and Reliefs. (A) In each bay of the trench it is necessary at all times to have one man on sentry and, as a rule, three men in relief, and it is very important that means be provided that the reliefs get the necessary rest and sleep. Accordingly, shallow sleeping-out pits are provided in the rear of the trenches for that purpose. This work is accomplished by the sappers and the diggers with the assistance of the reliefs.

Reconstruction and Repair. (B) It is very important that the reconstruction and repair work be got under way as quickly as possible after occupying the new position, as any lack of time affords the enemy an excellent chance to launch a counter-attack. Accordingly, the entire party are put to work until this object is accomplished. Communication trenches and other trenches along which we do not intend to extend our frontage at the present time will be double-blocked by the use of sandbags, sentries being placed to guard same. What was the enemy's communication trench prior to our occupation now really becomes our sapheads, so it is necessary to construct positions in these

from which we can throw bombs to keep the enemy in the next line of trenches at his distance until such time as we are prepared to extend our position in that direction. The work of reversing the fire trench (what was the enemy's parados now becomes our parapet) must be completed as soon as possible, and means of egress from the trenches must be supplied in order that every man can advance at the same instant should occasion arise.

(C) At the earliest opportunity it will be necessary to connect up our new position with our old by a continuation of what were formerly our sapheads, to enable us to get in our supply of reinforcements, materials, food, water and ammunition.

(D) It will be the duty of men reinforcing to bring forward a supply of ammunition, bombs and materials for reconstruction and consolidation of the new position and a supply of food and water.

(E) Arrangements will have been previously made for a line of communication men to establish telephone and telegraph communication and to maintain same.

LECTURE VII.

ENFILADE ATTACK.

Enfilading Parties and Reliefs. Having occupied the section of trenches as pre-arranged, and consolidated same under cover of bomb fire, we use this as a base from which to extend our position to the flanks and front along the enemy's trenches, by means of enfilading parties.

An enfilading party may consist of three or more men. When it consists of three men, they are the BAYONET MAN, the THROWER, and the CARRIER. The bayonet man is really a trench scout, who proceeds ahead and is armed with a RIFLE and BAYONET, or, better still, a PAIR OF PISTOLS. His duties are to spy out the trench and pass back information to the

thrower as to the locality and direction of the bays in front. In giving information to the thrower as to the location of different points which he wants bombed, the clock method may be used; the thrower's position being the centre of an imaginary dial and twelve o'clock directly in front and in line with the section of the trench from which the thrower is throwing. It can be easily seen that by this method information can be given the thrower as to the bends and twists of the trench. Another method the trench scout may use is merely pointing the direction in which he wants the bomb placed, and denoting the number of yards distant. The trench scout should be very careful in watching out for loopholes through traverses from which the enemy could guard against the approach of an enfilading party, also give information when an island traverse or communicating trench is reached. In the former case it will be necessary for an additional scout, one to proceed each way. In the latter case, sandbags will probably be required to double-block the communicating trench and information passed back to this effect so that supply men can rush them forward for that purpose.

It is necessary that the trench scout be a very wide-awake, careful and resourceful man, and have his wits about him at all times.

In the absence of an officer or N.C.O. in the enfilading party the thrower commands and is responsible that signals be given that the artillery know the exact extent of our frontage at all times. This is done by means of a flag which is khaki colored on the enemy's side and red on our own side, so that it can be easily picked up by our artillery, the flag being maintained in a correct position by the use of a double flag-staff. At night the signal may be given by the use of flashes or any other pre-arranged signals.

The carrier's duty is to follow up and keep supplied with a stock of bombs, and to pass back information, messages and orders.

SYLLABUS.

PRELIMINARY TRAINING.

Period of Six Days.

Each Day—Fall in, 8:45 a.m., 1:45 p.m. Roll called by 9 a.m. and 2 p.m.

Class, divided in four squads, take turns in cleaning up.

First Day—

9:00- 9:45—Lecture IV., Bombers' Training, Part I.
9:45-10:30—Make jam-tin dummies.
10:30-10:45—Stand easy.
10:45-12:15—Throwing practices.
2:00- 2:45—Lecture I., Explosives.
2:45- 3:15—Make powder-puffs and jam-tin dummies.
3:15- 3:30—Stand easy.
3:30- 4:30—Throwing practices.

Second Day—

9:00- 9:45—Lesson II., Explosives.
9:45-10:30—Make jam-tin dummies and powder-puffs.
10:30-10:45—Stand easy.
10:45-12:15—Throwing practices.
2:00- 2:45—Lecture III., Part I.
2:45- 3:30—Make jam-tins and hair-brushes.
3:30- 3:45—Stand easy.
3:45- 4:30—Throwing practices.

Third Day—

9:00- 9:45—Lecture III., Part II.
9:45-12:15—Digging trenches in relays.
2:00- 2:45—Lecture IV., Part II.
2:45- 4:30—Digging trenches and saps in relays.

Fourth Day—

9:00- 9:45—Lecture V., with blackboard illustrations.
9:45-12:15—Finish trenches and saps and carry out dummy frontal attack with bombs.
2:00- 2:45—Lecture VI.
2:45- 4:30—Repair and reconstruct trench (consolidate).

Fifth Day—

9:00- 9:45—Lecture VII., Enfilade Attack (b.b. illus.)
9:45-10:30—Make jam-tins and hair-brush bombs.
10:30-12:15—Enfilade attack in trenches.
2:00- 2:45—Lecture, review and oral exams.
2:45- 3:30—Trench practices in passing sandbags and uses of materials repairing.
3:30- 4:30—Throwing practices.

Sixth Day—

9:00- 9:45—Throwing tests for range and accuracy.
9:45-12:15—Oral exams. by squads and practice in use of repair materials.
2:00- 2:45—Practice in use of digging and cutting tools by relays.
2:45- 4:30—Final throwing tests and oral exams. by squads, alternately.

Note.—If instructors are available it is a good idea to work in squads alternately as suggested by the arrangement of Syllabus above.

Equipment and material for school of fifty, period of six days: 1 keg gunpowder, ½ case monobel, 1 coil fuse, 1 packet detonators (100), 36 shovels, 36 picks, 3 pairs snips, 3 pairs wire plyers, 3 hammers, 3 hand saws, 3 hand axes, 3 Marlin spikes, 2 braces, 2 bits (⅜-inch), 1 auger (1⅜-inch), 5 yards cotton, 2 lbs. 2-inch wire nails, 2 lbs. 2½-inch wire nails, 2 lbs. soft wire (stovepipe), 2 bbls. empty jam tins (1 to 2 lbs.), 100 lin. ft. 1 inch x 6 inch common boards, 36 lin. ft. 2 inch x 4 inch scantling, 1 good sized blackboard and chalk, 2 work benches (improvised), 3 boxes fusee matches, 2 dozen sandbags with ties attached, brush wood, cull lumber, bale wire, sods, etc.

EXAMINATION PAPERS.

Lecture I.

1. What care should be taken in handling explosives?
2. What should oily stains on dynamite indicate?
3. What should be done with cases showing oily stains?
4. What two methods should be employed in thawing dynamite?
5. Name a few causes of accidents in handling dynamite.
6. Name a few causes of accidents in handling detonators.
7. What care should be taken in shipping explosives by wagons? By rail?
8. What are the principal features to be considered in the construction of a magazine?
9. Is it wise to store explosives in tunnels or caves?
10. How may a magazine be made bullet proof?
11. What precautions should be taken with men working in or about magazines?

Lecture II.

12. Name the explosives used in the service.
13. In what shape is gun-cotton put up for service use?
14. What are the characteristics of gun-cotton?
15. How is wet gun-cotton detonated?
16. To what use is dry gun-cotton put?
17. Is gun-cotton generally considered a safe explosive?
18. What uses are made of gun-cotton?
19. Explain how you would prepare a gun-cotton charge.
20. What is a detonator?
21. What kind of explosive is used in service detonator?
22. What kinds of fuses are used in the service?
23. At what rate do service fuses burn per second?
24. At what rate do instantaneous fuses burn per second?

25. What use is made of picric acid? T. N. T.? Nitro-Glycerine?
26. Is picric acid a safe explosive?
Ans. No.
27. And why?

Lecture III.

28. Explain the working of a .303 short rifle grenade.
29. How are they packed ready for shipping?
30. How are they prepared for firing?
31. How are they carried?
32. What arrangements are to be used with the rifle for giving the necessary elevation?
33. What kind of ammunition is used with them?
34. Explain the working of a hand grenade No. 5, Mark 1.
35. What explosive is used in No. 5, Mark 1?
36. How far may it be thrown?
37. What is meant by cane and streamer type of grenade?
38. Explain the working of hand grenade No. 1, Mark 1.
39. Why do we use dummy bombs?
40. Why do we put explosives in dummy bombs?
41. Explain the manufacture of the jam-tin dummy?
42. Explain the manufacture of jam-tin bomb?
43. Explain the manufacture of the powder-puff.
44. Explain the manufacture of the hair-brush bomb?
45. What explosive is used in the hair-brush bomb?
46. Describe the impact or percussion type of grenade?
47. How is the dummy type made which represents the impact and percussion type?
48. Up to what weight may dummies be made?
49. How far may a 2-pound bomb be thrown?
50. How far may a 1-pound bomb be thrown?
51. Explain the correct throwing position for trench work?
52. When may a man be said to be trained in throwing from a trench?
53. What are the defensive uses of bombs and grenades?
54. What are the offensive uses of bombs and grenades?

Lecture IV.

55. What is a saphead?
56. Explain some of the different types of sapheads used.
57. What advantage has it over a "T" shaped saphead?
58. What is meant by an island saphead?
59. Name the digging and cutting tools?
60. What materials are used in trench warfare?
61. How are sandbags filled? Tied? Passed? Built?
62. What are the uses made of sandbags?
63. What is meant by "bond" in use in sandbags?
64. To what uses are the following materials put in trench warfare: Earth? Sods? Timber? Brush? Barb Wire? Bale Wire?
65. How are sods built to obtain the best results?
66. What is a revetment? Traverse? Bay? Parapet? Parados? Obstacle?
67. What are obstacles used for?
68. How many men usually constitute a sentry and relief per bay in a trench?
69. What arrangements are made for sleep and rest of reliefs?
70. Why are relief pits put in rear of trench?
71. Why are they made shallow?
72. What style of a trench is best suited to bomb warfare?
73. What precautions may be taken to prevent enemy's bombs getting into our trench?
74. What are the disadvantages of having relief pit under the parapet?
75. What are the disadvantages of having a deep trench?
76. What provisions should be made so that our men could advance from the trench at the same instant?
77. What is a "dead man"? "Funk Hole"?

Lecture V.

78. Who are usually the first men of the Infantry to advance in a frontal attack?
79. How are they armed? What tools do they carry? What are their duties?
80. When the first line advances what do the wire cutters do?
81. What part do the bombers take on a frontal attack?
82. Who is responsible that there is a supply of bombs in the trench?
83. How are bombs stored in the trenches?
84. Where is the reserve supply of bombs stored?
85. What general arrangements are made preparatory to frontal attack?
86. What arms of the service may take part in a frontal attack?
87. What extent of frontage is usually planned to be occupied in a frontal attack?

    Ans. Only the extent of frontage that is absolutely necessary.

88. Why?

    Ans. The odds are against the attacking forces.

Lecture VI.

89. What is necessary to be done on occupying a portion of the enemy's trench?
90. What is meant by consolidating ground gained?
91. How is our position protected while work of reconstruction and repair is going on?
92. How will communication be established in the occupied portion of the enemy's trench?
93. What is meant by double-blocking? When is it done? How protected?
94. What precautions may be taken to provide comfort for the men in the trenches?
95. What are the principal advantages of bomb fire, or rifle and machine gun fire?
96. Generally, what work will the sappers and diggers do on occupying the enemy's trench?
97. How are the enemy's communication trenches used to our advantage?

Lecture VII.

98. What is an enfilading party?
99. How many men may constitute an enfilading party?
100. When party consists of three, what are they called?
101. What are the duties of a trench scout?
102. Name some of the most important things he should look out for?
103. What qualifications should he possess?
104. How is he armed?
105. How does he pass information to the thrower regarding location of targets?
106. What are the duties of the thrower?
107. What are the duties of the carrier?
108. In the absence of an officer or non-commissioned officer, who commands the enfilading party?
109. How are the artillery advised of the extending of our frontage when enfilading?
110. What precautions should be taken as we gain ground in enfilade work?
111. What men follow up and keep in touch with enfilade party? What are their duties?
112. What are the advantages of gaining ground by enfilade bomb attacks over that of frontal attacks?

    Ans. (a) We have a minimum of exposure to the enemy's rifle or machine gun fire.

    (b) Enfilade attacks provide the means by which we use the enemy's trench as our fortification against him.

    (c) As we advance the ground occupied is consolidated to our use so that at no time do we have an extent of frontage in an unprepared position.

    (d) The disorganization immediately following an extensive frontal attack gives the enemy a chance to launch a counter-attack.