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MILITARY EXPLOSIVES OF TO-DAY.

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LECTURE I.

THE subject of explosives is one of the most fascinating branches of chemistry, although studied by comparatively few. Everyone has a general idea of what an explosive is, and yet there is no subject on which the laity are more intensely ignorant, and most seem ready to believe any of the fairy tales of wonderful new explosives which appear at regular intervals.

For instance; early in the War we heard of a French explosive called Terpenite, which killed Germans by the hundred and left them frozen stiff without a mark on them. More recently we heard of an American explosive of which a thimbleful would lift St. Paul's from its foundations. The chemist who understood explosives did not need to even investigate the stories; he knew that they were mere fiction.

The fact is there have been no epoch-making discoveries in explosives such as, say, the discovery of nitroglycerine, for many years. None are likely to be made until someone discovers how to dissociate elements into their primitive constituents in a fraction of a second, in the same way as radium does in a million years or so; and there is little prospect of this at present.

Nitroglycerine, discovered in 1846, still remains the most powerful explosive in practical use. Many useful advances have been, and are being made, but new explosives are merely new mixtures of old materials, given fancy names. The nations at war use practically the same explosives, and no one can be said to be ahead of the others.

I propose first to deal briefly with the principles governing the subject, since it is by the application of these that any claims for a new explosive must be decided. They were first laid down by the great French chemist Berthelot in his work *Explosives and their Power* (la Puissance des Substances Explosifs), a work which can still be consulted with advantage by those interested.

Definition.—An explosive is a substance in which a chemical action, once started, proceeds with considerable velocity, and with evolution of heat and gas. It must be self-supporting, and independent of outside agencies.

When the substance is enclosed the pressure of the gases bursts the envelope, and the shock gives rise to an air wave. We say the substance has "exploded."

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Total energy evolved is given out as heat, and may be measured in the bomb calorimeter. But in order to utilize the heat for doing useful work a gas is required. This, by its expansion, propels the shell or bullet, or disrupts the surrounding material. The Power of doing Useful Work is proportional to the volume of gas per unit weight of the explosive, and its temperature. The temperature is not known with any degree of accuracy, but if we assume that the specific heats of the gases evolved by different explosives are the same it willbe proportional to the quantity of heat evolved.

Coefficient of Potential Energy.—The quantity of heat, and volume of gas evolved, can be measured with considerable accuracy in the bomb calorimeter, and the product—

Vol. of gas per gram (reduced to N.T.P.) × Calories per gram is called the coefficient of potential energy, and affords a useful and reliable means of comparing the powers of different explosives, especially those slow in action, such as smokeless powders. Substances like water, which are gaseous at the temperature of the explosion, are reckoned as gases.

The following table gives such a comparison of some of the most typical explosives in use :--

Name of Explosive.	Vol. of Gas' per gram in C.Cs.⇒V.	Calories per gram =Q.	Coefficient =Q×V ri-1000.	Coeff. G.P.=1.	Calculated Temperature =Q. Assuming C=.24 C=sp. ht. of gases.
Gunpowder Nitroglycerine Nitrocellulose [13] per cept.	280 c.c. 741	73 ⁸ 1652	207 1224	і б	2240° C. 6880 ,,
Nitrogen)	923 ,,	931	859	4.3	3876 ,,
N.C. = 38. Vaseline = 5) Cordite, M.D. (N.G. = 30. 1	871 "	1242	1082	5-2	5175 ,,
N.C. = 6_5 . Vaseline = 5_1 Ballistite (N.G. = 5_0 N.C. =	888 ,,	1031 .	915	4.4	. 4225 ,,
50. Stabilizer=.5) Picrie Acid (Lyddite)	817 ,, 877 ,,	1349 810	1102 710	5-3 3-4	5621 ,, 3375 ,,

The coefficients correspond fairly well with the results obtained in practical use. The temperatures are certainly too high, as no allowance has been made for the increase in the sp. ht. of gases at high temperatures, but they are in the correct order. The actual sp. ht. of gases at such temperatures is not known, and any correction introduced would still leave the matter uncertain.

An experiment quoted by McNab, in which diamonds were found on carbon rods exposed to the flame of exploding cordite, shows that the temperature was certainly above 4,000° C.

The table shows that nitroglycerine is most powerful, and that in mixtures of it with nitrocellulose the power is proportional to the amount of N.C., which is in accord with practice. Also that the power depends more on the amount of heat evolved than on the volume of gas. Explosives like nitrocellulose, which evolve a large volume of gas, are deficient in oxygen, and the gas is mostly CO. In those like nitroglycerine, where part of the carbon is replaced by oxygen, the gas is CO_2 , and the diminution in volume is more than compensated by the extra heat evolved.

Solid products of combustion are unable to expand and do work, although they absorb their proportion of the heat. They are inactive, and merely produce smoke and fouling; 57 per cent. of the products of combustion of gunpowder are solids, which explains its weakness and defects.

The temperature of explosion is of great importance in the case of smokeless powders, as it is found that the erosion and consequent wear of a gun increases rapidly with an increase of temperature.

As examples of different kinds of explosives I first heat some ammonium bichromate in a test tube. At a certain temperature it ignites, and the internal combustion which takes place continues without further application of heat. Large volumes of nitrogen gas and steam are given off, and a residue of chromium oxide many times bulkier than the original substance is left.

 $(NH_4)_2Cr_2O_7 = N_2 + 4H_2O + Cr_2O_3 + Heat.$

It is a true explosive, but a very bad one. It gives little gas (440 c.c. per gram), little heat, and a huge residue.

A little gunpowder, when ignited, flashes off, and besides gas gives a cloud of smoke due to solid residue.

A piece of cordite burns slowly, gives only a trace of smoke, and leaves no residue.

Some loose guncotton flashes off rapidly, because of its porosity, but leaves no residue or smoke.

Products of Combustion.—The products of combustion depend on the pressure under which the explosive burns, except in the case of gunpowder. Smokeless powders, and most modern high explosives, when burnt under atmospheric pressure give off oxides of nitrogen which are highly poisonous. But under fairly high pressure, as in a gun, the nitrogen comes off as free gas and is hatmless.

A simple experiment will show exactly what takes place in a gun when it is fired (Fig. 1).

A tall glass cylinder is filled with a water, and a wide glass tube a little



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longer than the cylinder is immersed in it. The tube is fitted with a cork and stopcock, and another cork smaller in diameter than the tube, so that it can slide easily inside it, is fitted with a piece of glass tube to act as holder for a piece of cordite (about .5 c.c.). I drop the cork with its piece of cordite into the tube so that it floats on the water, then ignite the cordite, and quickly insert the upper cork with stopcock closed. The cordite is seen to burn steadily, giving off gas which drives the cork and water to the bottom of the tube, any excess of gas then escaping.

The tube represents the gun, the cork and water the shell. As the cordite burns the shell moves forward, enlarging the spaces and preventing any dangerous pressures. In the ideal gun the charge has just finished burning as the shell reaches the muzzle.

In the actual gun the rate of combustion of the cordite increases as the pressure rises, but the charge is ignited over the whole of its surface simultaneously, and the total time of combustion is that necessary to burn through half the diameter, or thickness, of a single cord or strip.

The gases contain 40 per cent. of CO and 13 per cent. of hydrogen, and are inflammable. On opening the tap and applying a light they are seen to burn. It is these which give the bright muzzle flash of a gun, and also, sometimes, the back flash when the breech is opened, which is a source of danger to the gunners.

On raising the tube and allowing air to enter the gases turn brown, showing that under these conditions they contain nitric oxide, NO.

True explosion is of this kind, and is merely rapid combustion. The substance is ignited at the surface and burns until the whole is consumed, the time of combustion of a charge varying with the size of the grains, sticks, etc. Detonation is a phenomenon of an entirely different order.

Detonation is the almost instantaneous disruption of a compound or mixture into its elements or simpler compounds, with evolution of heat and gas. Whereas the rate of explosion is measured in centimetres per second the rate of detonation is from 3,000 to 10,000 metres per second.

If we consider a 13.5-in. shell filled with lyddite of density 1.6, and velocity of detonation 7,000 metres per second. The detonator is central, and the detonation has to travel through, roughly, one sixth of a metre: Hence, in $1/6 \times 1/7000 = 1/42000$ th of a second the whole is converted into gas, occupying $1.6 \times 877 = 1,242$ times the original volume at 0° C., but at a temperature of $3,375^{\circ}$ C. The time occupied in the development of the gas is so short that the shell—or even the atmosphere alone—acts as tamping, and the substance detonates in its own volume, the theoretical pressure developed being 11.500 atmospheres, or 77 tons per sq. in. For an instant the shell is intact and filled with gas at this pressure, the next instant it dissolves, and this giant force is applied as a blow to any body in contact with it. Guncotton will cut through its own thickness of iron, and it is probable that lyddite would destroy its own thickness of any material opposed to it, if detonated in intimate contact with it.

Such detonating substances are called *High Explosives*, and their immense shattering effect is due, not only to the volume of gas and quantity of heat, but also to the velocity of detonation and density of the explosive. Shattering power is proportional to—-

Vol. of gas per gram \times Cals. per gram \times Vel. of detonation \times Density.

The disruptive effect is exerted chiefly in the direction in which the wave of detonation is travelling. In a shell with a central axial detonator it is at right angles to the axis of the shell. This explains some of the apparently erratic effects of H.E. shells.

The effects of H.E. shells are very local, and to obtain full shattering effect it must be detonated in intimate contact with the body to be destroyed. To destroy armour plate or concrete walls the shell should have a delay-action fuze, so as to allow it time to penetrate. Shells with instantaneous fuzes have been known to fail to damage a tank, because the shell detonated before coming into close contact with it. On the other hand we have had examples of German aeroplane bombs with such fuzes, which make no crater, as their main effect is lateral. These are meant for man-killing.

The very intensity of the effect of high-velocity detonating explosives diminishes the radius of these man-killing power, as the metal is blown to dust. A lower-velocity explosive gives larger pieces and projects them further.

Detonating Compounds.—In the molecule of a detonating compound each atom is combined with others for which it has little affinity. Take, for example, nitroglycerine, $C_3H_5(NO_3)_3$. The carbon atoms are combined with hydrogen, for which they have little affinity, and the nitrogen with oxygen and carbon. There is a constant tendency to decompose, and such a compound may be quite stable, while undisturbed, but the moment that the cohesion between the atoms is destroyed in any way it falls into its constituent atoms, which immediately re-assemble and combine to form compounds of greatest stability, and give out energy in the process. We say it has detonated, and the detonation passes on from particle to particle through the mass.

$2C_{3}H_{5}(NO_{3})_{3}=6CO_{3}+5H_{2}O+3N_{2}+O+Heat.$

To Start Detonation.—Detonation may be started in several ways. (I). By Heat.—For every compound there is a temperature limit at which it decomposes, and if a detonating compound be heated to this temperature it will detonate fully. But in most cases the heating must be very rapid, as most high explosives undergo a lower order of decomposition at a lower temperature, and do not even explode. Nitroglycerine, rapidly heated, detonates with great violence, but

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heated a little more slowly decomposes with evolution of red fumes. Picric acid ignites and burns with a smoky flame, but if a little be projected on to a white hot plate it will flash off, or even detonate. Similarly with T.N.T. and others.

2. By Shock.-Any kind of percussive shock, such as a blow on an anvil, will detonate an H.E., if sufficiently intense : but a comparatively small shock will suffice if of the right kind. It seems as if for each substance a particular kind of vibration was necessary, and this is the kind which it gives out itself when detonating. Examples :

The shock of exploding gunpowder will not detonate guncotton, picric acid, T.N.T., or nitroglycerine.

The shock of detonating N.G. will not detonate guncotton.

The shock of detonating guncotton will detonate N.G.

Gunpowder is incapable of detonation. Fulminate of mercury will detonate all the above with the exception of T.N.T. cast into slabs and untamped, but with the addition of a little lead azide will detonate them fully.

Increasing the quantity of the initiator of detonation above a certain minimum has little effect. One gram of fulminate will detonate an unlimited amount of picric acid. No amount of gunpowder would do it.

A fulminate detonator provides combined shock and sudden heating, and is, therefore, very effective.

The Explosive Wave.—When a substance detonates a wave which seems to contain a particular vibration peculiar to each substance is thrown out. This sweeps through the substance, detonating each molecule in turn. It is self-regenerating. This is Abel's theory, and is almost certainly true for pure chemical compounds. Berthelot's theory that it is merely a wave of pressure which heats the particles which resist it leaves many phenomena unexplained.

For instance: The more suitable the physical state of the substance for transmitting vibrations the greater the velocity of detonation, and the greater the certainty when once started. It is best when homogeneous and dense, up to a certain point. The velocity of detonation is approximately the same as that of sound in the substance, and sound we know to be a vibration. Gelatinized substances do not transmit vibrations well, and are difficult to detonate.

Liquid nitroglycerine is easy to detonate, and the wave travels well. Frozen N.C. is crystalline. The separate crystals are more sensitive than the liquid, but it behaves erratically, and a portion may be blown away undetonated.

Dry guncotton is porous, and the pores filled with air. It is comparatively easy to detonate. Wet guncotton is quite incombustible, and difficult to detonate, but once started it detonates with greater velocity than dry, as water transmits vibrations more rapidly than air.

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Detonation is more easily started in powder or crystals, probably because there is a less mass to take the initial shock, but the wave travels slowly, and may die out in a loose powder. Advantage is taken of this fact in detonating shells. Detonation is first set up in crystals or pellets and transmitted to the dense filling.

Mixtures of H.E. which require different waves are always difficult to detonate. The wave which suits one does not suit the other, and may die out before it has gone very far.

The most striking example is cordite. It contains 57 per cent. of N.G., and 38 per cent. of guncotton, both sensitive substances which detonate easily. It is completely gelatinized. It can be detonated by percussion, but only the portion under the hammer; the wave dies out immediately. Even a fulminate detonator will only detonate about 2 lbs., however large the charge, the amount being evidently proportional to the initial percussive blow. Two detonators will detonate, roughly, 4 lbs.

Amatol, a mixture of T.N.T. and ammonium nitrate, is more difficult to detonate than pure T.N.T.

Another Kind of Detonation.—In the case of many H.E. mixtures much used at present it is probable that the detonation is of a different order. The mixture contains at least one detonating constituent, the remainder being combustibles and supporters of combustion of the nature of gunpowder. Fulminate detonators are used. The detonator, besides delivering a shock, sends a wave of intensely heated gas at high velocity into the charge. The detonating constituent detonates, and this, along with the fulminate, sends a wave of hot gas through the mass which causes the almost instantaneous combustion of the other constituents. For this kind of detonation porosity is an advantage, and also "several detonators in a large charge. The charge should also be tamped. Mixtures for mining are always made in this porous form ; when they set into a solid block, as sometimes happens, they are insensitive, and should be sent back to be re-worked.

Such detonation is more of the nature of a rapid explosion than true detonation, and is much slower. The average rate of mixtures in use is 3,000 to 4,000 metres per second.

Sympathetic Delonation.—The detonating wave can be transmitted through air, earth, water or other materials, and detonate charges at a distance, which are said to detonate in sympathy. As might be expected the greater the facility which the intervening medium offers for the transmission of vibrations the greater the distance at which charges will detonate in sympathy. This applies only to the true detonating wave.

Examples.—If dry guncotton primers are placed $\frac{1}{2}$ -inch apart in air, and one detonated, all the others detonate. If they are separated

by tin screens the result is the same. If placed in an iron tube, which, would confine the wave, they may be 5 ft. apart.

Berthelot states that when 100 gram cartridges of dynamite, 75 per cent. N.G., are placed on firm ground 30 cms. apart the detonation of one will extend to all the others. If placed on an iron rail the distance may be increased to 70 cms.

Also, that 5 kilos. detonated under water detonated other charges 3 metres distant, and the distance is proportional to the charge.

From this it is evident that in a shell dump the detonation of one shell would probably detonate all in contact with it, although others a few yards distant would escape. A torpedo may detonate the shells in the magazine of a warship, and a submarine mine do the same. One submarine mine will detonate all others within a certain radius. Countermining depends on this principle.

Very Rapid Explosion may approach detonation in effects. To show this I ignite a small amount of gunpowder—about I c.c. It flashes off quietly. I put the same amount in a copper tube left open at the upper end, and heat it with a bunsen burner. By this means the whole reaches the temperature of ignition at the same moment, and when it explodes there is a report like that of a pistol.

A substance may either detonate, or merely explode (burn), according to the treatment. For example :---

Fulminate of mercury, when unenclosed and ignited, burns with a sudden flash. But when struck on an anvil detonates with a sharp report.

A spot of nitroglycerine on a piece of filter paper, when struck on the anvil, detonates violently. But a paper soaked in N.G. burns quietly with a greenish flame.

Picric acid, or T.N.T., as already stated, burn quietly when ignited, but can be detonated by percussion, or the shock of a detonator.

Cordite can be detonated by hammering, although the wave does not travel far. When ignited it burns regularly.

But this only applies to small quantities. When large masses are ignited they burn for a time, but the heat given out is almost certain to raise the temperature locally to the detonating point, and the remainder detonates. Cordite is a possible exception. The great explosions at Halifax and in N.E. London are examples.

A. For Use as a Propellant in Guns and Rifles.

(1). It should generate a large volume of gas at a moderately high temperature ; that is, be powerful but not too erosive.

(2). The rate of combustion should be uniform, and adjustable by varying the size of the stick or grain ; that is it must be absolutely non-porous or colloidal.

(3). It must be uniform in quality, so that the shooting will not vary.

(4). It should have a high stability at ordinary atmospheric temperatures.

(5). It should not be liable to detonate by the shock of firing.

(6). It should produce no solid products of combustion, so as to be smokeless.

Cordite and N.C. powders comply fairly well with the requirements, and similar powders are universally used by civilized nations.

B. A High Explosive for Filling Shells.

(1). Should give a large volume of gas at as high a temperature as possible. Incendiary effect is desirable.

(2). Have a high density, so as to get as great a weight as possible in a given volume.

(3). Have a high velocity of detonation, when destruction of material is the object.

(4). Be incapable of detonation by the shock of firing or impact against a target.

(5). Should detonate completely and with certainty when the fuze acts.

Picric acid, T.N.T., and Amatol fulfil the requirements fairly well.

C. An Explosive for Military Mines.

(1). Should give much gas and heat, with a moderate velocity of detonation, so as to have a great lifting effect.

(2). Should be safe under ordinary shocks, even the impact of a rifle bullet.

(3). Should give no poisonous gases when detonated. Craters may have to be occupied, and mine galleries entered, shortly after the explosion.

(4). Should be detonated with certainty by a fulminate or similar detonator.

Ammonal, Blastine, and several other explosive mixtures comply well with the requirements.

D. For Hasty Demolitions by the R.E.

(I). It should be safe under the impact of a rifle bullet.

(2). Should have a high velocity of detonation.

(3). Should detonate completely with a fulminate detonator, and produce intense effects even when untamped. Slabs of wet guncotton comply best, and have been used for a long time. Slabs of picric acid and T.N.T. are also used. Commercial explosives of all kinds are also used when the conditions are suitable, *i.e.* in back areas.

Materials for Explosives.—Before commencing a description of the actual explosives themselves a few remarks on some of the essential materials required for their manufacture may be of advantage.

Nitrates.—In the days when gunpowder was the only explosive saltpetre (potassium nitrate) was essential for the carrying on of a war. It was mostly imported from tropical countries, where it is most plentiful. During the Napoleonic wars the British command of the seas cut off the French from their overseas-supplies, and threatened to stop the War in that way. But the French chemists studied the subject and developed methods for the artificial production of saltpetre which are worked to this day, although neglected of late years.

At present nitrates, or their equivalent nitric acid, are just as essential as saltpetre was in the old days, as all explosives used in guns or shells are products of nitric acid. If the present war had started 10 years earlier the Germans could not possibly have kept up their supply of nitrates. But the process for obtaining nitric acid from the atmosphere by the aid of electricity has now been well worked out. Huge works have been established in Germany, and there is little doubt that most of their supplies have been obtained from this source, and are practically unlimited. The process is being worked now in England.

Chlorates.—Potassium chlorate and ammonium perchlorate are much used. But the materials for the preparation of chlorates electricity and common salt—are plentiful. Potash salts are almost a monopoly of Germany, but the small amounts necessary are easily obtained. There should be no danger of our running short of chlorates.

Cellulose, $C_6H_{10}O_5$.—This is essential for the manufacture of smokeless powders. Its purest natural form is cotton, and this is always used when available. Some chemists who should have known better thought that when the supplies of cotton were cut off the Germans would no longer be able to make nitrocellulose. But it had been shown long before the War that wood could be made to yield about 40 per cent. of good cellulose, and that from this a stable nitrocellulose could be made, although not quite so good as that from cotton. There is little doubt that at present most of the German nitrocellulose is made from wood pulp.

Glycerine, $C_3H_3(OH)_3$.--This is essential for the manufacture of nitroglycerine, which is a constituent of all powders used for heavy guns. The only source is animal and vegetable fats and oils, and the bitter cry from Germany in the early days of the War about the shortage of food fats meant that they were using their limited supplies for the manufacture of glycerine. Every cordite cartridge requires its own weight of fat for the glycerine alone. This statement will explain many things with regard to butter, margarine, cocoanut oil, copra, and similar tropical imported products.

Acetone, $(CH_s)_sCO$.—This is a fragrant liquid boiling at 60° C., which has the property of dissolving both guncotton and nitro-

glycerine, and is essential in the manufacture of cordite M.D. It is made by distilling calcium acetate, which is a product of the distillation of wood.

Aluminium, in the form of powder, is much used in explosive mixtures. It is permanent at ordinary atmospheric temperatures, but when oxidized gives out a large amount of heat. Its manufacture depends on having a suitable ore and plenty of electric power. Works have long been established in both Britain and Germany, and many places on the Continent.

Some electric furnace products, such as calcium silicide, are also used, and various common metals and compounds.

The basic materials for the manufacture of high explosives for use in shells are all products of the distillation of coal, and come from the gasworks. They will be dealt with later. For these we are rather better off than other nations.

EXPLOSIVE MIXTURES.

Explosives may be divided into two main classes, explosive compounds and explosive mixtures.

Explosive Compounds are substances of definite chemical composition, such as nitrocellulose, nitroglycerine, and fulminate of mercury, and are used in the pure form in only few cases.

Explosive Mixtures are mixtures of some combustible, which may or may not be an explosive in itself, with an oxygen supplier, the latter being usually a nitrate, chlorate, or perchlorate. Other oxidizers are available, and used in a few cases.

A third class might be added, consisting of mixtures of explosive compounds with addition of inert materials. Cordite and blasting gelatine belong to this class.

Nitrate Mixtures.—Any one of the nitrates can be used as an oxygen supplier for an explosive mixture. *Potassium nitrate*, KNO₃, is best known and most used. It contains 40 per cent. of its weight of available oxygen, is not at all deliquescent, and mixtures containing it require no special protection from the atmosphere, except in tropical climates.

Sodium Nitrate, NaNO₂, is a much cheaper salt, and contains 47 per cent. of available oxygen. But it is very deliquescent, and cartridges of explosives containing it must be made moisture-proof. In spite of this defect it is largely used in mining explosives of the cheaper variety.

Ammonium Nitrate, NH_4NO_3 , contains only 20 per cent. of available oxygen, and is very deliquescent, but otherwise possesses many good qualities. All of its products of explosion are gases, and are available for doing work, unlike the metallic nitrates. It is also an explosive in itself, and can be detonated into nitrogen, oxygen, and steam, with evolution of heat.

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In its natural form it contains water of crystallization. This is driven off by heat, and the substance packed in barrels in the form of powder. If this is heated above 32°C. it changes its crystalline form and volume; the small amount of water which it still contains combines with the crystals and acts as a cement, so that the whole sets into a solid block. The same thing occurs with ammonium nitrate explosives, which should be kept below this temperature, as when they set solid they cannot readily be detonated.

Barium Nitrate, $Ba(NO_3)_2$, contains 31 per cent. of available oxygen, and is used in some mixtures. This, and others which give colour to flames, are used in compositions for coloured flares.

AMMONIUM NITRATE MIXTURES,

Ammonal.—One of the best known and most used of the ammonium nitrate mixtures is ammonal, in which use is made of the great heat given out by the oxidation of aluminium. A mixture of Al powder with the theoretical amount of ammonium nitrate for complete oxidation would contain 8r.6 per cent. of NH₄NO₅. It would yield 1,578 cals. per gram—nearly as much as nitroglycerine—and 682 c.cs. of gas. But such a mixture is difficult to detonate, and charcoal was added to make it more inflammable. One such ammonal made in Austria and used by Austrians as a shell filling has the following composition :—

Ammonium Nitrate	• •••	 •••	81
Aluminium powder	·	 	15
Charcoal	••••	 	6

The addition of di-nitro-toluene, or tri-nitro, makes detonation more certain, and the new ammonals contain one or the other.

Military Ammonal has the following composition :---

Ammonium Nitrate			 65
Tri-nitro-toluene			 15
Aluminium (coarse po	wder)	•••	 16
Aluminium (fine powe	ler)		 Ι
Charcoal	•••		 3

It is a coarse black powder. Very insensitive, and cannot be exploded by the shock of a bullet or application of flame. When heated strongly it inflames and burns. When thrown on a red-hot, surface it flashes off. It requires fulminate detonators and strong tamping for best effect. With large charges several detonators fired simultaneously are advisable. All cartridges must be hermetically sealed to preserve them from moisture, which quickly ruins ammonal. The velocity of detonation is about 4,000 metres per second, and the effect intermediate between that of gunpowder and dynamite. Power 3 to 4 times that of gunpowder.

Enormous quantities of ammonal are now used in military operations. For charging grenades and bombs. For military land mines ; some of our biggest and most successful mines were charged with ammonal. It is not now used as a shell filling.

In the charcoal ammonal a portion of the aluminium is fine powder to assist ignition, and the remainder coarse to resist oxidation on keeping.

Sabulite.-This is an explosive resembling ammonal, but calcium silicide, Ca.Si, an electric furnace product, takes the place of the aluminium. Its composition is as below :---

Ammonium Nitrate		•••		•••	78
Tri-nitro-toluene	••••	•••	,	•••	8
Calcium Silicide		•••		•••	14

It is a granular, dark greenish-coloured powder. In properties it resembles ammonal, but is more sensitive. It is also used for mines, bombs, and grenades. It is detonated in the same way as ammonal, and has about the same power.

Bellite is one of the earliest ammonium nitrate explosives. It has the composition :-----

Ammonium Nitrate	 ••••		83
Di-nitro-benzenc	 	•••	17

It is used to some extent for mines, grenades, and bombs. It is detonated in the same way as ammonal and sabulite, but is less powerful.

The products of detonation of all the above are non-poisonous gases.

Amatol.-This is a mixture of ammonium nitrate and T.N.T. in various proportions, which is now of great importance. T.N.T. does not contain enough oxygen for its complete combustion, and although the addition of ammonium nitrate increases the weight of the charge the increase of the heat given out more than compensates for this. The equation representing complete combustion of the T.N.T. is as follows :---

 $_{2C_{6}H_{2}(NO_{7})_{3}CH_{3}+2I}NH_{4}NO_{3}=I4CO_{2}+47H_{2}O+27N_{2}N_{2}$ 2×227 21 X 80

2×227=454 grams of T.N.T. require 21×80=1,680 grams of NH₄NO₃ for complete combustion. Such a mixture would contain 78.7 per cent. of NH4NO3 and 21.3 per cent of T.N.T. It would give 1,042 calories and 892 c.cs. of gas per gram, with a coefficient of 929, whereas pure T.N.T. gives a maximum of 732 calories and 987 c.cs. of gas per gram, with a coefficient of 722. Various mixtures are now in use, the proportion of ammonium nitrate to T.N.T. being given as a fraction. Thus-90/10, 80/20, 50/50, 40/60. Some of these are given fancy names.

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The higher the proportion of ammonium nitrate the greater the difficulty of detonation, and the difficulty increases when they are melted and cast into solid blocks or slabs, as is necessary for shells. Hence, the higher proportions are used in the form of powder for bombs, grenades, and mines, and detonated by fulminate detonators. The others, used for shell filling, are detonated by special methods, and will be referred to later.

All varieties of amatol are powerful H.E.; velocity of detonation about 4,500 metres per second. All are spoiled by moisture and must be waterproofed. All are practically smokeless. The products of detonation of the mining varieties are CO_2 , H_2O , and N_2 , and are non-poisonous.

The Germans also use ammonium nitrate explosives. Two used extensively for land mines and mined traps in evacuated territory are *Donarite* and *Westphalite*, both industrial explosives.

A typical Donarite has the composition :---

Ammonium Nitrate		•••		80
Tri-nitro-toluene	•••			12
Nitroglycerine			•••	4
Flour	•••	•••		4

There are several varieties of Westphalite. One has the composition :--

Ammonium Nitrate	•••	•••		70.5
Di-nitro-toluene			•••	II
Flour			•••	2.
Sodium Chloride			•••	16.5

The NaCl is to diminish the temperature of explosion so as to make it suitable for coal mines.

These explosives are made into slabs, which are wrapped in paraffined paper. Several are packed in a tin case hermetically sealed, and form a cartridge. Holes covered with waterproof paper are left in the tins for the insertion of detonators.

There are scores of similar explosives, and several varieties of each, used for industrial purposes, the weaker and slower varieties being purposely modified for special cases.

All ammonium nitrate explosives must be packed air-tight to prevent entrance of moisture, which quickly ruins them. When heated to a temperature of 32°C. the nitrate changes its crystalline form and increases in volume. This change, aided by the small amount of moisture which is always present may cause the charge to set into a solid block which is almost impossible to detonate. Hence, ammonium nitrate explosives should be kept as cool as possible, and never exposed to direct sun rays.

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OTHER NITRATE MIXTURES.

Gunpowder.—For centuries gunpowder was the only explosive, and it is still the best known. It has lost all of its importance as a propellant for use in guns and rifles, yet, owing to the many excellent properties which it possesses, it has at present a greater number of military uses than any other explosive.

Black gunpowder has the following composition :---

Saltpetre,	KNO3	•••	•••	•••	75
Sulphur	•••	•••	•••	•••	10
Charcoal			•••	•••	15

When gunpowder was of the first importance the charcoal was mostly made from willow, alder, and dogwood, as these were found to be best, but at present birch, poplar, and even common charcoal are found to be good enough for many of the purposes for which gunpowder is now used. The sulphur and saltpetre must be pure; the charcoal is the only variable constituent.

There is nothing new in the method of manufacture, and no details need be given. The various processes are to ensure:— (r). Thorough incorporation of the ingredients. (z). Fairly high and uniform density. (3). Uniformity in the size of the grains, these being well polished to give them good keeping qualities. The incorporation used to last from 4 to 8 hours, but has now been considerably shortened for the inferior qualities.

Gunpowder is used extensively as an auxilliary to the more powerful explosives. It is quite permanent, when kept dry, but moisture completely spoils it. It has a high ignition point, 300° C., but then ignites readily, and burns quickly and with certainty. It is this certainty of action which recommends it for many purposes. It is comparatively weak, 57 per cent. of the products being solids, mostly K_2CO_3 , K_2SO_4 , and K_2S_2 . These form a smoke cloud, but this is often an advantage for observation purposes.

The following are some of its present-day military uses :----

As Igniting Primer for Smokeless Powders.—Cordite and N.C.T. powders do not ignite readily, especially when in thick sticks, and a powerful flash is required. In separate ammunition, where the charge is in a fabric bag, a packet of gunpowder is fixed at one or both ends of the charge. In fixed ammunition for Q.F. guns a percussion primer is screwed into the cartridge case. This contains a percussion cap and I to 2 ozs. of gunpowder. The flash from the powder ignites the explosive charge with certainty. It is also used in friction tubes.

As Bursting Charge for Shrapnel.—A shrapnel shell is filled with bullets, and the head is lightly attached. The bursting charge is onlyrequired to blow off the head and liberate the bullets. Little power is necessary, but it must act instantaneously. A charge of gunpowder in a cup at the base of the shell is found to answer best.

As Time Fuze Composition.—The timing rings in fuzes which regulate the moment of the burst are filled with compressed powder. Under atmospheric pressure this burns with great regularity.

Gunpowder is also used for blank charges, for land mines, and has many other minor uses, where certainty of action is of more importance than power. It forms the core of safety fuze.

Picric Powder (also called Brugèrés powder) is a mixture of finely divided ammonium picrate with potassium nitrate, in the proportions of 43 to 57. It can be detonated by moderate percussion. It is difficult to ignite, but a flame will do it, and it requires good tamping to obtain the full effect. It has about twice the power of gunpowder.

When exploded in a confined space the explosion may proceed to detonation, and the wave set up will extend to picric acid. For this reason picric powder, both in powder form and compressed pellets, is used to detonate lyddite shells.

A less sensitive modification of picric powder, in which the potassium nitrate is replaced by ammonium nitrate is used for charging bombs, etc.

Tonite.—This is a mixture of about equal weights of barium nitrate and guncotton. It is a powerful H.E. with great shattering power, and was formerly much used as a blasting powder. It is used in sound signal rockets.

Smoke Compositions.—There are many, some depending on the incomplete combustion of carbonaceous matters. Others consist of nitrates mixed with aluminium or zinc, the oxide of the metal forming a white cloud. Packets are introduced into some H.E. shells to show the position of the burst.

Mixtures of nitrates and chlorates are used in various compositions for flares, and will be referred to later.

WEIGHTS AND MEASURES.

"B.B.E." writes :--With reference to the article appearing in the *Journal* on the subject of "Weights and Measures" with regard to Field Company vehicles, I think I can offer a few explanations of the discrepancies.

Tool Carts and R.E. Limbers.—The Organization of a Field Company does not work in with the loading laid down in the Haudbook. For example, sections of a Field Company must be able to move independently at very short notice. Now the loading tables show all the Cooks' gear on the Cooks' Cart, and the subdivision of Cooks' gear, rations, etc., on the detachment of a section (which might have to take place on the line of march) would invariably lead to confusion and someone going supperless. In consequence it is customary in a large number of Field Companies to put the section Cooks' gear on to the section limbers, and to place the explosive, etc., displaced on to the tool cart. This would lead to a large discrepancy in the weights of these vehicles.

Pontoon and Trestle Waggons.—The weight of these waggons when stripped has been increased by about 1,000 lbs. by the fitting of heavier wheels and all the iron-work "gadgets" for M.T. traction. Any further increase in weight in these vehicles, and also in the G.S. Waggon, can be traced to the fact that Field Companies on service have to carry stores for which little or insufficient allowance is made. Such are :—

- (a). Officers' Mess Gear.
- (b). Office Stationery.
- (c). Chaff Cutter.
- (d). Picket Line Gear.
- (e). Horse Rugs and 2nd blankets (in winter).

I hope these hasty notes will be of some service in elucidating this matter, which are the result of three years' service with an Old Army Company.

MEMOIR.

BRIG.-GENERAL DUNCAN SAYRE MACINNES, C.M.G., D.S.O., ROYAL ENGINEERS.

FEW, if any, among the many valuable officers who have fallen in the present War with Germany have given greater promise from past distinguished service, ability and personal character, of rising to yet higher distinction in their profession, than Brig.-General / Duncan MacInnes. Born in 1870, he was a younger son of the late Hon. Donald MacInnes, of Hamilton, Canada, who, moving from Scotland to the Dominion in early life, became a Member of its Senate, and Mary, daughter of the late Sir John Beverley Robinson, Bart., c.b., Chief Justice of Upper Canada (now the Province of Ontario).

Intended originally for the Navy, he spent some time upon the *Britannia* Training Ship, but afterwards entered the Royal Military College at Kingston in Canada, his father having ultimately determined upon a military carcer for him. From this he passed out at the head of his year, obtaining a Commission as 2nd Lieutenant in the Corps of Royal Engineers, on 16th July, 1891. On 18th July, 1894, he became a Lieutenant, on 1st April, 1902, a Captain, in 1911 a Major, in 1915 a Bt. Lieut.-Colonel, and at the time of his death held the rank of Brig. General in the Army.

He had seen much active service. In the expedition to Ashanti of 1895-6 he was Honourably Mentioned and awarded the Star issued for that Campaign. Later, while a Lieutenant, R.E., he was emploved upon the erection of a fort at Coomassie, the capital of Ashanti, for the defence of the garrison of that place, and here it may be mentioned that in plan and execution this work reflected great credit upon him and all others concerned in its design and construction. When in 1900 a garrison was for some time besieged in this fort by 15,000 Ashantis, it was successfully held, until relieved by a force under Colonel-now General Sir James-Willcocks, who, in From Kabul to Kumassi thus alludes to it :--" Nothing astonished me more during my three years in that country (West Africa) than my first sight of this fort, standing out boldly on a wide open plain. Store-rooms, ammunition chambers and many quite modern improvements make it the best defensive post I saw in West Africa."

Lieut. MacInnes also acted for a time as Resident at Coomassie.



Brig. General Duncan Sayre Macinnes, C.M.G., D.S.O., Royal Engineers.

From a Photo by Amy Cassels, 67, New Bond Street, W.

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In the South African War he performed specially valuable services between February and May, 1900, in the Orange Free State and particularly in the Defence of Kimberley. Here he was employed upon Corps duties and in addition as Staff officer to Colonel. Kekewich, commanding the defence, who, in his Report of 15th February, 1900 (enclosed to the Secretary of State for War by Lord Roberts in his Dispatch of March 20th), thus alludes to him :--- " Lieut. (local Capt.) D. S. MacInnes, Royal Engineers, worked out most carefully and constructed with marked ability and success, the Engineer operations for the Defence of Kimberley. He is a real hard worker, full of zeal, energy and resource. Wherever he went he inspired confidence. On Bt. Major Turner taking over command of the Mounted Troops, Capt. MacInnes relieved him as my Staff Officer, and I cannot speak too highly of the manner in which he carried out his heavy and very responsible duties, both within the fortress and in connection with sorties, reconnaissances, etc." After the relief of the town, a distinguished efficer, who had known his father in Canada, thus wrote to him from Kimberley : "You will, I know, be proud to hear the very high character for gallantry, tact and readiness of resource, which your son in the R.E. has won for himself. His praises are in every one's mouth and I am told that the success was, in a large measure for so young an officer, due to him." No tributes to the value of his work in the Defence of Kimberley could well be higher than the above.

Between May and November, 1900 he was further engaged in operations in the Orange River Colony, and between November, 1902, and December, 1904, acted as Assistant Director of Works to the South African Constabulary. For his services throughout the War he was twice mentioned in Dispatches (in 1900 and 1902), received the Queen's Medal with three clasps, the King's Medal with two clasps, and the D.S.O.

Between 1905 and 1908 he was employed upon the Staff in Canada, first as D.A.O.M.-General at Halifax, Nova Scotia, and afterwards as D.A.A.-General with the Canadian Dominion Forces. Much work now devolved upon him in connection with taking over the defences of Halifax by the Dominion from the Imperial Government, in drawing up schemes for future defence, and training troops for defensive duties. A general officer under whom he worked at this period writes of him as follows :-- "I found his knowledge of both the Regular and Dominion Forces of the greatest use to me-his tact and ability were very marked." And another :-- " His work in adapting the Defence Scheme for Halifax, to the altered conditions. was very valuable. I had many opportunities of judging of it. I then formed a high opinion of his abilities as a soldier, combined with his tact and other good qualities as a Staff officer, so that I was not surprised when a year or two later, an officer holding a very high

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position in England spoke of him to me as one of the best Staff Officers ' he knew. He had the quality of thoroughness in a high degree."

From Halifax he went to Shorncliffe, as Major, R.E., in charge of works, which included the building of the Women's Hospital at that Camp, and from thence to the Staff College.

In 1910 he was gazetted a General Staff Officer (3rd Grade) under the Director of Military Training at the War Office, being in 1912 employed as Secretary to the Royal Flying Corps Committee, appointed by the Committee of Imperial Defence. The result of this Committee led to the formation of the Royal Flying Corps, which has since developed into the Royal Air Force. He also took an important part in the reorganization of the Army Signal Service.

Later (in 1913) he was appointed as G.S.O., 2nd Grade, to the Staff of the Staff College and in 1914, upon the outbreak of the War with Germany, proceeded to the Front in France.

After taking a part in the Retreat from Mons, for which he earned the personal thanks of one in high command, he was wounded in November, 1914, when Major in charge of a company of Royal Engineers with the 9th Division, and he returned then to England. The wound, which was caused by a bullet, permanently interfered with the free use of one or two of the fingers of his right hand.

In 1915 he served at the War Office as Assistant Director; and in 1916-17 as Director of Aeronautical Equipment and, during his tenure of this post, more than once crossed the channel by aeroplane, visiting the Headquarters of the Flying Corps and of the Army in France.

The Aeroplane of 29th May, 1918, thus refers to his services in association with the Air Force :--- "As Director of Aircraft Equipment, General MacInnes had to face a most arduous task. It fell upon him to evolve from the formless muddle of 1915, some regular scheme for organizing and increasing aircraft production, simultaneously. All those who served with him at that period bear witness to his unflagging zeal and the amount of personal effort which he expended. If hard work on the part of one man could have produced the necessary aeroplanes and engines, General MacInnes would assuredly have obtained them. Despite an infinity of natural obstacles and personal hindrances he succeeded in effecting remarkable increases in output and at the same time he won the personal affection of all those who worked with him, or under him. The intensity of his efforts nearly broke down his health, but before he left the War Office to take a command in the field he had done much spade work, which afterwards proved of high value. . . . His name deserves to live in the history of Military Aeronautics as one of those who helped the Royal Flying Corps in its blackest days."

One who worked much with him at this period, and is now a General Officer, writes :--" He joined the Military Aeronautics

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Directorate at a time when very little had been done and there was no organization to meet what he knew was to be, a gigantic force. He never spared himself. I think it is only those few people who worked with him in the early part of the War who really recognize how much the Royal Air Force owe to his untiring energy and splendid qualities. I never met a man who worked so hard and so conscientiously, and this in spite of the fact that he was suffering from the effects of a wound, and of general bodily ill-health, brought on by the trying time he had had during the Retreat."

In March, 1917, anxious to see further active service at the Front, although it involved the relinquishment of his rank of Brig.-General, he went out again to France to perform the duties of Commanding Royal Engineer to the 42nd Division and from thence, after nine months, was appointed Inspector of Mines at Headquarters with the rank of Brig.-General. On 23rd of May, 1918, while upon active service at the Front on this duty, he was killed, and was buried in the Military Cemetery at Etaples, close to the sea, on Saturday, May 25th.

During the present War he had been twice mentioned in Dispatches, received the Star for Mons, the C.M.G. in 1916, and the Russian Order of St. Stanislaus, with the French "Croix d'Officier" of the Legion of Honour, in 1917.

Many have been the warmly appreciative letters written at various times, by all ranks of his brother officers, senior and junior, as well as by others, alluding to his services. Several touch upon his great gallantry in the field, others upon his sincerity and unselfishness, all upon his capacity, energy and devotion to duty.

From a few only I can quote here, but I do so from some below, because I feel that they give a better and clearer idea of what he was as a soldier and a man, than could any words of my own, and show that he possessed, to an extent that was marked indeed, high qualities, together with those personally attractive ones that gained for him, not only the confidence, but the affection of men.

From a Field Officer :—" It has been a terrible blow to us all to lose a man of such ability and so splendidly conscientious in his work. He was one of the very bravest and most chivalrous characters I have ever known and he was universally beloved by all who met him, from the highest in command to our car drivers, servants and orderlies. Everyone felt strongly drawn to him."

From a General Officer under whom he immediately served :---"He was my right-hand man and never failed me. We all loved him. . . He was so tremendously brave at Nieuport and other nasty places, a well-known figure in his Division and perfectly splendid at his work."

From a Field Officer :---" He quickly won the admiration of all of us from his gallantry, unbounded energy and kind consideration for others, no matter what rank they held." And (referring to the dangerous work of repairing dams, which the Germans kept repeatedly blowing down) "On one occasion when we were working he insisted upon taking one of the shifts, which was most encouraging for the men and enabled the job to be completed.

But I avoid accumulating further tributes to his memory, and what he accomplished. Above anything that he ever did or said, it was his sterling character that so impressed and attracted all who knew him. Of a buoyant, bright and cheery nature he was enabled to get through successfully a heavy amount of work, although at times of pressure, necessarily frequent under the strain of War, he was disposed to overtax himself. He was never so thoroughly and entirely happy as when in the field, occupied in the duties of the Corps he was devoted to—the Royal Engineers—and death while upon active service came fittingly to him.

By disposition it can be truly said that he was retiring, and certainly the reverse of what is termed a "thruster." Ambition, in its selfish sense, all effort to push himself, all undue striving for honours or rewards, were foreign to his nature, although, in his comparatively brief career, he had earned many medals and decorations.

Just before his death he was in especially good spirits at having successfully completed a task in which he had been taking a keen interest, and was joyfully looking forward to the prospect of a few days' leave to England and then to employment upon other duties after his own heart.

To the Service, to his family, and to his numerous friends he is a very great loss.

In 1902, General MacInnes married Millicent, daughter of F. Wolferstan Thomas, Esq., and he leaves behind him one son (now at Eton) and one daughter.

C.W.R.--R.B.

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NOTICES OF MAGAZINES.

REVUE MILITAIRE SUISSE. No. 4.—April, 1918.

Some Political and Juridical Aspects of the Great War.

The original article consists of the address given to the Lausanne and Geneva Sections of the Société suisse des officiers by Capt. Cuno Hofer of the Swiss Cavalry ; in it he points out that the Conflict which broke out in 1914 presents, from the International standpoint, problems in the domains of Politics and of Law. The question at once arises whether there is indeed any such thing as International Law, or is it The author of the original article is of opinion after all but a chimera? that to postulate a state of affairs in which the relations of the individuals and peoples of the different States, and, indeed, that of the States between themselves, were not regulated by governing principles would be to attempt to create a situation which is absolutely inconceivable. Dependence on law has obtained a strong hold on human nature ; even amongst a community of brigands, the notion of law is manifest as a governing factor, up to a point, in their relations amongst themselves. The conception of law is inherent in the human race. Juridical relationships were first established among peoples at the time that they ceased to wage eternal war on one another and a state of peace was, in consequence, brought into existence-a highly abnormal condition of affairs at the period when man was still a savage. During the course of the centuries which have followed since then a body of governing principles have been developed and have been accepted as a code of International Law; first of all, the early traditions and customs became law, and on this basis has been built up that ever-growing body of law much of which has been incorporated in International Treaties. States found it convenient to recognize the value of giving the force of law to certain rules to which binding effect had been given by the sanction of long-continued voluntary observance. It is alone owing to the recognition of such a codethat international, political, economic, commercial, intellectual, and social relations between the peoples of different States have been rendered possible.

But a law of this nature has its limits; it does not embrace within its folds the entire life of a State, in the same way that the municipal law of a State does not govern the whole life of a subject thereof. In spite of the Civil Code, the Law Merchant and the thousand-and-one supplementary laws, a subject has his being in a free space, wherein he may derive benefit from or abuse his liberty; in each case the individual's character, his tastes and his education determining which of these alternatives will result from his course of conduct.

The free space, outside the limits of International Law, in which

States are at liberty to roam are still more vast than that available to subjects; juridical control is, in the case of States, more incomplete; in a word, the laws that hedge them in are less numerous. Another difference should be noted ; the subject who breaks the laws of the land finds himself, as a rule, in collision with the " sanction " of the competent authority. The subject continually runs a risk that a tort may be . committed to his injury, but in such a case the police will come to his assistance and a judge will punish the tort-feasor. In the terraqueous globe in which States form the international community, there exists neither police, nor " sanctions," nor any other judge than that of public opinion, which may be more or less harsh, more or less impartial. Under such circumstances, therefore, should a State be affected by a tortious act committed to its detriment, a difficulty lies in obtaining redress by judicial process. If the wrongful act in question is not of a serious nature the assistance of diplomacy and the aid of the most elementary rules of 1 equity may provide the remedy necessary; or a submission in respect of the dispute or difference may be made to an arbitral tribunal and the difference composed by the award of such tribunal. Whatever course is adopted to obtain a remedy, where the matter in dispute does not involve an important principle, every effort is made to prevent a rupture of peaceful relations.

However, when differences arise on questions held to be of vital importance, States are apt to stand on their dignity; they then parade their Sovereignty and refuse to recognize any Will but their own. Such was the attitude Austria-Hungary took up towards Serbia in the summer of 1914. It is in circumstances of this kind that International Law is, so to speak, abrogated; then it is that the peaceful régime of law has to yield place to the sway of brute force. The mediation of friendly Powers, arbitration, International Commissions, at such a time, severally cease to inspire confidence as a means for attaining human justice, eithebecause one of the parties to the quarrel may wish to display its prodir gious strength or because it may consider the moment opportune to realize some vast design. Once its own Sovereignty is thus invoked by a State it enters into boundless space, the sphere of Politics.

Some there are who talk of the force of law and the "law of force." The force of law is a conception understood by all intellectual beings, but the expression "law of force" conveys nothing definite to any one. Nations can compose their differences either by force or by law. The choice of one of these means involves the rejection of the other. A private individual who is wronged by another may seek his remedy at law or may personally adopt measures against the wrong doer; by adopting the latter course, however, he would place himself outside the pale of the law. So is it in the case of a State, but with the difference that the use of force by a State is not considered, according to the human code of ethics, unlawful.

The notion of the "law of force" has been invented to mislead and to cause confusion where clear conceptions should prevail. The question for future decision is whether Law, based on juridical principles, shall some day take the place of Force, which, as exemplified in its application for the waging of war, involves a negation of Law. At the present

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time all the essentials to bring about this order of things are conspicuously absent; namely, the law, the tribunal and, indeed, the moral Will necessary to create them.

To the non-existence of organized international justice is it due that the Chief of the State and the Leader of an army have, at all times, invoked the Divine aid in favour of their cause. The adoption of such a course has doubtless been, in the first place, a question of faith, but it arises also to some extent from uncertainty as to the issue and from the anxieties connected with the enterprise on hand; personal conviction and the use of force always come into play in the absence of the procedure of established Courts of Justice. When in such a dilemma those in authority are disposed to seek support from a Supreme One. If Wilhelm II, has done so with much persistence, it can but be because his need has been intensely great.

The prayer before battle of *der alte Dessauer*, a contemporary of Leibnitz and the real reformer of Frederick the Great's army, best expresses the state of mind of an enterprising leader: "Good Lord, send down Thine assistance to me. But if Thou art not willing so to do, nevertheless withhold Thine aid from mine enemies, rogues that they be." Voltaire has recorded his views on the subject in the following terms:—"The marvellous thing about this infernal business (*i.e.* war) is that each chieftain of murderers calls down blessings on the standards of his followers and solemnly invokes the aid of the Almighty before proceeding with the task of exterminating his neighbour." A similar sentiment is contained in the following couplet :—

" On ne peut ni voler, ni violer son monde,

Ni massacrer les gens, si Dieu ne nous seconde."

The situation is in no way changed; it remains the same to-day as in the centuries past. In the days before Voltaire's time, in those that have followed even unto this day, with or without God, the domain of international politics gives free scope to speculations of the widest range, those that are the most egotistical and those that are the most human.

A reference has already been made to the "law of force": therefore, a word or two on the "Divine law," a subject that has also given rise to some confusion, may not be out of place. The popular view is that the titular qualification of the Prussian Sovereign which runs :-- "Wilhelm II., by the Grace of God, King of Prussia" amounts to a claim on the part of the German Emperor that he is a direct representative of the Almighty. Naturally, no Swiss officer would think of introducing himself as "Alfred Cornu, by the Grace of God, Lieutenant of Engineers"; it is common knowledge that the commissions of Swiss officers do not bear the Sign Manual of the Creator, but are signed by Cantonal or Federal Magistrates. In the case of the King of Prussia, on the other hand, the very serious difficulty is met with of ascertaining definitely whence he derives his powers, the rights and privileges enjoyed with the Crown. It is beyond dispute that the powers, rights and privileges in question have not been conferred by the Prussian people ; on the contrary, it is the King who has granted a constitution to his people whereby he has condescended, by a personal act, to limit his

indisputable powers and rights. The Constitution of Prussia contains no provision, of a lawful kind, under which the Hohenzollerns could be deprived of any of the rights pertaining to the Prussian Crown. Thus it is that to the question:—" Whence are these rights then derived?" historic tradition replies:—" From God." In the absence of some other reliable explanation, juridical doctrine has admitted this reply and accepts the *fiction* that the Hohenzollerns reign in Prussia by the Will of God.

Rousseau's declaration that the State owes its origin to the Social Contract also involves a *fiction*; the declaration amounts alone to his political conceptions of an ideal. The origin of the State cannot be ascertained by any process of reasoning from theoretical premises. The existence of the State is inconceivable apart from juridical order (which forms one of the elementary constituents of the State) and, on the other, hand, the existence of juridical order is inconceivable apart from the authority derived from the State; this leads to an argument in a circle. Rousseau's declaration expresses admirably a spiritual conception of human communities; a conception to which weight is given by conviction, but the *fiction* remains.

The fiction employed in the German Science of Constitutional Government in order to explain the *origin* of regal power in Prussia may have been accepted in that country either because it translates into words the sentiments of the populace on the subject, or because that Science is incapable of supplying any other explanation owing to the impossibility of depriving the King of his powers in a legal manner. It would be wrong, however, to confound this theory with the ancient theocratic theory of the Eastern Empires according to which the State is a creation of the Almighty and the Monarch his representative, and therefore a sacred person, invested with divine powers.

A State is mistress of its own destinies; it possesses sovereign powers and recognizes none other as its superior; it need listen to no counsels of wisdom, nor accept decisions based on international justice, which after all is but the justice of human minds, therefore suspect.

The State consequently possesses very considerable liberty in that boundless sphere of its activities, its politics, which may be defined as the art of handling the affairs of State, of regulating its life, of directing its effort towards definite aims. Policy consists in the sum of the aims a State may be pursuing ; that is to say, it represents the mind and the individuality of a State. Should the policy indicate that it would be in the interests of the State to establish economic relations with certain other Nations, law enables it to realize this purpose by means of a formal Treaty of Commerce ratified in due form. Should the policy dictate that the War Establishment of the Army ought to be increased in order to accomplish some great design; law brings into existence a new military organization. Inversely, low demands that the terms of a treaty which has been entered into and duly ratified shall be strictly observed ; but policy may take up the attitude that only if it should be opportune to do so ought the provisions of the treaty to be complied with; momentous events may follow from the decision taken on the dictates of policy.

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But whatever may be the measures that policy may impose on a State, nevertheless law never ceases to be operative to some extent; as already stated, law is inherent in human nature. Therefore when a State has broken off relations with another and cut all juridical ties which have bound it to its neighbour, in a word when it declares war, at that instant another law comes into force; the *law or customs of war*.

This notion raises a smile ; we have all been made familiar during the past three years with the devastated regions of Belgium, the mutilated tracts of France, both by the word pictures and by the photographic reproductions appearing in the Press. The wholesale destruction of a vast countryside, the terrible cruelties inflicted on a peaceable civil population have, it is urged, been necessary in the military interest. True, the situation thus created may have caused the Western Allies some embarrassment from a military point of view. But, why stop at what has already been done? Why not, asks Capt. Hofer, push the principle further ? The Germans are short of provisions, and, yet, they are giving shelter to and feeding some thousands of prisoners; every day many tons of supplies, which might help to alleviate the distress of the German people, are utilized for nourishing foreigners and the Fatherland's enemies resident in Germany. The question is asked :----Why does not Germany impale these thousands of men ? Why does she not drown them in the Rhine?

Clearly there must be some limit beyond which even the most depraved soldier cannot go, at this point it is that the law of war comes into play; a law which consists of a collection of rules of equity and of honour that come into force at the instant that a state of peace makes way for a state of war. This law was born on the field of battle and has a long history. All that need be said here is that with the progress of civilization two principles were established: firstly, that war is a relation between State and State, and not that between one individual and another; consequently, the idea was developed that the peaceful citizen ought not to be directly affected by war; that he must suffer indirectly therefrom unfortunately is inevitable. Secondly, that all useless cruelty ought to be avoided, since fighting men are not a lot of wild beasts let loose. Rousseau first crystallized these principles, which had been propounded in indefinite language by doctors of international law, into formulæ containing precise terms. By degrees these formulæ were incorporated into the military codes of civilized nations, elaborated and expanded to meet the various requirements of the situations considered likely to come into existence. Finally, a period was reached when the military codes of the civilized Powers appeared to be based on the same principles, more or less ; in consequence, steps were taken to embody the instructions contained in the several military codes in International Conventions, that is to say, to transform these instructions into a fixed law, to be binding on all adherents to these Conventions.

At the time that this law was being elaborated at Geneva and at The Hague by distinguished soldiers, politicians and savants every care was taken to ensure that the text of no juridical rule should violate the principle that nothing should be done to interfere in any way with the effectiveness of military action, the essence of which, it was recognized. consisted in violence and must continue to remain so. At the same time it was admitted that restrictions must be imposed on the civil population in relation to its conduct towards the soldier; the *franc-tireur* was warned off. The essential principles of the law of war represent the maximum limits of the surrender which the civilized soldier should be called upon to make in respect of his right to exercise violence to attain his ends.

The Germans have excused their misdeeds and crimes on the Somme on the grounds of "military necessity"; as already stated a justification of this nature can be made to cover the most extreme excesses and acts of depravity. Of course, there are occasions when a soldier may *suddenly* be faced with a situation in which he has to decide whether he shall conform to the *law of war*, and thereby court the failure of the special task he has on hand, or whether he will violate the *law of war* in order to promote what, under the circumstances, must necessarily be the superior interests of the army of which he is a member.

On such an occasion, the soldier must be guided in the action he may take by his sense of responsibility ; his own temperament will determine how he obeys the promptings of his conscience.

Although in the present Conflict innumerable violations of the *law* and customs of war have occurred, it must not, nevertheless, be thought that the whole of the provisions of this code have been a dead letter. Undoubtedly, the experiences of many an unfortunate combatant would have been more intolerable had no such code existed; to this extent it has been an ameliorating influence.

The events which have succeeded one another in Europe since July. 1914, fall under one or other of three heads, politics, law or despotism. The most important of these heads is that which constitutes the political domain, one covering a very vast field. Those individuals who play the most active part in this domain hold most diverse views regarding morality and justice; modern communities, however, keep their political leaders within certain moral bounds. To enter into a discussion as to what is moral in politics, as to what comprises ideal justice is profitable only so far that thereby we learn how vague, how complex is everything in this domain. Politics possesses two schools, the idealistic and the realistic. At the present moment the nations of the world are grouped round one or other of these centres. In the belligerent countries too, the people are divided into Liberals and into militarists; into apostles of the new era attached to the idea of a juridical organization of nations and into politicians of the old school opposed to progress in the world.

Treitschke's views on morality in politics are quoted by Capt. Hofer. This philosopher, as might be expected, cannot tolerate the idea that any person, howsoever high his position, should have it in his power to impose obligatory rules on the State; dectrines founded on legic have always, he says, had to give way to the realities of life. The greatest moral duty of a State, is according to him, the maintenance of its powers. Treaties are all entered into on the understanding, he declares, that they shall cease to be operative as soon as the circumstances under which they were ratified have altered. A large number of German savants subscribe to these views. To the end of the world, says Treitschke, nations will 1918.]

have to look to armed men for the protection and the safety of the State, and therein lies the sanctity of war.

It is to the political ambitions created in vast populations by philosophies constructed by magniloquent professors that a war spirit was engendered in Central Europe. It is under the auspices of such politics that the present war was declared. When this step was taken the German Chancellor found himself in a tight corner; on the one hand. there was a Treaty clear and precise in its terms, which demanded that the neutrality of Belgium should be respected (a serious juridical hindrance to the complete liberty of action ordinarily enjoyed in the domain of politics), on the other hand, there was the urgent demand of the Great General Staff, which insisted that German Armies must march through Belgium to make success sure ; that is to say, to ensure the safety of the State. The Chancellor, had to weigh a formal law, a solemn obligation in one pan of the balance against the interests of over 60 million souls in the other pan. It was a question of a choice between respect for law or for the supreme interest of a cause. His conscience could alone guide the Chancellor to a decision; this conscience had naturally been moulded by the political education received during a long career in the public service. Von Bethmann-Hollweg vielded to what has been referred to as the law of necessity, reasons of State; in doing so he violated the law. Treaties providing guarantees have, of course, been frequently violated before; but at no period of International Law had a Treaty been framed under . circumstances similar to that providing for the perpetual neutrality of Belgium, or did one possess such binding force both by reason of the status of the signatories thereto and the causes responsible for its genesis. In a word never before had law penetrated so deeply into the free domain of high politics, and yet, the law has, in this case, been entirely subverted.

The Belgian affair was certainly one of law, because there it was a question of complying with the terms of a formal positive law, a solemn engagement duly entered into. But all the other matters; the attitude of Austria-Hungary towards Serbia, the attitude of Italy in coming into the War on the side of the Entente Powers and against her former Allies; the various treaties concluded between the Powers relating to the partition of conquered territory, these are not juridical questions, they are questions relating to political expediency, and do not come within the purview of law. And even when the Leaders of a Nation claim that their actions are dictated not by egoism but by a sense of right, there is still need for caution.

There are naturally inconsistencies in International Law as in all other human institutions; for example, The Hague Conventions provide that a neutral power shall not, during the continuance of a war, be prevented from trading in munitions of war with either of the belligerent parties. It was for this reason that, in the early days of the War, the workshops in the United States of America were openly busy executing war contracts for Great Britain and France. Germany could, of course, have placed orders for war *matériel* in the New World also, but she appears to have shrunk from taking the steps necessary to ensure that consignments, which would have had to be transported across the ocean, should reach the Fatherland with certainty and in safety. Although the conduct of the United States of America was in appearance absolutely *unneutral*, nevertheless it was strictly in accordance with the *law*.

Alliances and facts certainly establish juridical ties between nations, but, to-day when it is the fashion to display so much regard for law, an exaggerated view is taken of their efficacy and sincerity. The documents published by the Revolutionary Government in Petrograd indicates the extent to which the observance of juridical engagements, hitherto looked upon as sacred, are dominated by opportunism, egoism and political intrigue. Further, it has also to be borne in mind that, in spite of the honesty of purpose of a contracting party, treaties are in reality the most fragile of the works of human hands; the Declaration of London, for instance, was soon rendered a "scrap of paper," willing as was the British Government to give effect to its provisions. There is also the case of the Pact made by the Entente Powers that no separate peace would be made by any one of the signatories to the document in question, and yet, owing to the Russian Revolution the Power in whose interests the Western Allies entered into the struggle has been the first party to the contract which has failed to fulfil its obligations thereunder. The action taken by the temporary governors of Russia represents perhaps an extreme case, nevertheless it does show that in the case of the most formal Pact its complete observance by all the parties thereto depends on a number of contingencies; compliance with the terms of a treaty on the part of a State, a party thereto, is really governed by the character of its people, that is to say, it is a question of morality and not of law.

Before juridical laws can acquire any real value in governing the international relations of States, it is essential that the principles of morality which are to govern their policies should be framed on similar and standard lines. There is a morality which abhors arbitrary conduct, violence and untruthfulness in international politics; a morality which is opposed to internecine strife between nations. The tendency in the past has been to level down this morality so as to bring it on to the lower planes of the traditions of politics, instead of raising international usages up to the level of the requirements of this morality, and thus to establish the prerequisite foundation on which the structure of a permanent peace between the peoples of the world must rest.

The author of the original article expresses the view that from a historical, as well as from a dogmatic, point of view an international status is not difficult to conceive in which all differences and disputes between nations can be equitably settled by a submission to a properly constituted tribunal rather than by resort to the uncertain arbitrament of the sword. In the same way that the Ordeal of Battle has completely disappeared as a mode of deciding personal quarrels between subject and subject in a State, so it is thought will eventually also disappear war as a method for composing the disputes of States. The political power is fast passing into the hands of the masses, and it is they who will in the future decide directly questions of Peace and War and

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not a few political place-holders as in the past. Their judgment in a given situation will be exercised on vastly different premises to those which have weighed with the trained statesmen of former ages. The democratization of Europe is proceeding apace; one of the most difficult problems of democratic politics is to reconcile the principles of democracy with the power of the State, and, \dot{a} fortiori, to bring into harmony the aims of democracy and war as a means for attaining those aims.

Undoubtedly, new conditions of life are coming into being to govern the relations of the International Family. What the future has in store, however, still remains an unsolvable mystery, which the wisest men of the age are unable to unravel. It behoves us all then to guide our footsteps along the path of progress by that most precious of human instincts: the sense of the reality of things and men.

DOCTRINES AND DUTIES.

The author of the original article points out that the Great War has given rise to new theories and that situations can no longer be examined by the light of the maxims of former eras only. The General Staffs are at the present time kept busy accumulating by degrees precise knowledge regarding events as they occur, and on that knowledge new doctrines are being formulated.

Some there are who hold that it would be rash to attempt to unravel the enigmas of strategy; the battle they say is an accidental episode and trust must be placed in the offensive spirit of the infantry soldier who is about to come by his own—to meet the situation and carry the day. The opinion is rightly expressed that no decisive result is likely to be obtained by the present-day wearing-down tactics—the war of attrition—which relies on mere wastage to bring about results that can alone be secured by the adoption of active, as opposed to passive, measures in the handling troops.

The course of events during the past three years has shown that the theories, which had been advanced to prove that modern wars could alone have a duration of a few weeks at most, were constructed on false premises. The constructors of these theories, in many cases, disregarded the influence which the advances made in the technical domain would have on strategy; and, unfortunately, it was thought by those responsible for the direction of the operations of war that to seek advice from technical experts could but mean a confession of ignorance. Why, it is difficult to conceive.

There are sceptics living to-day, who find it difficult to believe that war has, in modern times, become a science. They appear to hold the view that a few "intellectuals" are attempting to resolve movements of war into a few simple arithmetical operations or algebraical problems. Yet the great lesson of the present conflict seems to be that the side, which conducts a war on methodical lines and by the application of systematized knowledge in dealing with every problem connected with State-craft and military operations, has the advantage over the side which proceeds on the happy-go-lucky hit and miss principle of a pre-scientific age.

"Intellectuals," however, are a robust race and are not easily to be discouraged. Many of them have been in evidence during the course of the.

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present War. One of the earliest of them to come to notice, since the early days of August, 1914, is Capt. Laffargue, of the French Army, who performed a great service to his profession by the production of his *Endes sur l'attaque* based on his personal experiences. He pointed out that the present-day attack had become a matter of fortress warfare. He urged that this fact should be recognized and measures taken accordingly to provide effectively for dealing with the new situation by orienting the instruction of troops entirely from this point of view.

The acceptance of this "new orientation" brings into prominence certain old dogmas which remain as true to this day as they were in former ages; they relate to the value of sangfroid, discipline, goodwill, power, and knowledge. The acceptance of this "new orientation" involves that the most shall be made of natural advantages which may exist; indeed, the transformation of the *terrain* into an offensive-defensive battlefield.

The nature and character of the attack as carried out in this War appear to have upset some of the cherished notions of teachers of Military Science and Art in Switzerland and to have created some confusion in their ranks. Regret is expressed in the original article that the Swiss General Staff has not issued some official declaration based on the reports received from the military attachés at the Front. It is felt that if an "official doctrine" were to be notified, it would facilitate the consideration of problems connected with the organization of the Swiss Army.

Fault is found with the methods of training in vogue in the Swiss Army to-day. The short courses of instruction, having a duration of barely a fortnight, are thought to be too short.

It is urged that Europe should take a leaf out of Japan's book and follow the admirable customs of the Samurai and adopt their high sense of duty. The duty of a subject is something that cannot be trafficked in; it should be remembered that such as is the *morale* of a people, the same also will be the measure of its victory in a conflict.

In the original article a programme of instruction for recruits (extending over 67 days) is given in some detail; it has been adopted in one of the Swiss schools.

It is said that in Switzerland curses are often levelled at the infantryman for his alleged ineptitude, nevertheless proper steps are not taken to prepare him for a modern battle. It is suggested that the duration of the recruit's training should be doubled and that instruction should be specialized during the extended portion of the training, *i.e.*, some men should be taught bombing, others the use of trench mortars, machine guns, pioneer duties, etc.

The prolongation of the training is a duty imposed by necessity and no good Swiss will shrink from bearing the burden in connection with the fitting of himself to defend hearth and home.

OUR MACHINE-GUNNERS.

A series of photographic reproductions are published under the above heading and are intended to illustrate the articles on this subject which appeared in the January and February numbers of the *Revue* for this year (vide R.E. Journal for June).

NOTES AND NEWS.

Belgium.—A special correspondent draws a comparison between the military code of ethics of Belgium's soldiers from the Congo with that of the soldiers coming from the banks of the Spree and the Oder, much to the disadvantage of the latter.

Attention is called to the part played by Belgian Colonial troops in the East African Campaign and the eulogies won by them from the British Commanders. Regret is expressed that Belgian Colonial troops were not permitted to take part in the liberation of Jerusalem. Many Belgians took part in and gained distinction during the Crusades; the memory of their exploits still lives in their native land, and it is, perhaps, natural that Belgians should wish again to have the names of distinguished compatriots associated with the present-day achievements in the Holy Land.

There are Belgians, too, who are ambitious that their country shall possess a Navy; such a thing could not have been dreamt of in 1913, but, in 1915, whisperings concerning Belgian aspirations on the deep Blue could be heard. It is said that there is a large body of opinion in favour of the creation of a Belgian Navy.

INFORMATION.

Switzerland.—A short article appears under the head of "The Soldier's Duty." The Nouvelle Société Helvétique has been interesting itself in military matters. A discussion, having taken place recently on the education of the soldier, a contributor to the Revue has prepared an epitome of "the soldier's duty," which according to him consists of :—

(1) Pride of uniform; (2) Loyalty to the flag; (3) A proper sense of duty; (4) Energy in carrying out duties; (5) Courage; (6) Respect for constituted authority; (7) Comradeship; (8) Truthfulness and nobleness of character; (9) Discipline; (10) Vigilance.

The *law of self-sacrifice* is, and must remain, the paramount consideration by which the soldier should regulate his daily life.

The number of the *Revue* concludes with a *Bulletin Bibliographique*; it contains, *inter alia*, brief notices relating to a number of works dealing with the Great War.

A further part of M. Epuy's translation of Lord E. Hamilton's work, The First Seven English Divisions, accompanies the April number of 'the Revue. The story is brought down in this part of the translation to the events which took place in the neighbourhood of Messines and Wytschaet towards the end of October and the early days of November, 1914.

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THE FUTURE OF THE CAVALRY IN SWITZERLAND.

The author of the original article deals with the question of the rôleof cavalry in modern war from the point of view of the experience gained during the great conflict now in progress. He is of opinion that, from the lessons learnt so far, no very revolutionary changes in cavalry tactics or in the technique of the cavalry combat would appear to be necessary under present-day conditions of fighting. Modern armies will continue, he says, to have need for a certain proportion of cavalry in the future; and cavalry will still remain the eyes and ears of the Higher Command; still act as a screen in front of an army prior to the actual collision; still form the strategic reserve required for the purpose of delivering the knock-out blow in the battle; still cover the exposed flank or flanks of an army; still be the saviour of an army in retreat; still transform a retreat into a rout; as much as is herein stated was accomplished by the cavalry in 1914. On the other hand, it is recognized that a strategic reconnaissance by cavalry is a thing of the past; further, this arm can no longer hope to penetrate the dense screen which nowadays covers an army during the period of its mobilization. The air service must henceforward undertake these duties and others of a similar nature that cavalry can no longer effectively perform.

The extent to which cavalry can be usefully employed as a screen to an advancing army, or one halted, will necessarily depend on the plans of the Higher Command and the character of the fighting about to take place. The Germans in the present War have discouraged the employment of their mounted troops for bringing about purely cavalry encounters. The German cavalry has, as a rule, followed the infantry, and, at times, the advanced infantry detachments. On the other hand, the French cavalry, at the beginning of the War, acted on its old traditional lines, and it reaped the harvest of its mistakes. The raid of Sordet's Cavalry into Belgium was a useless and wasteful jaunt; on reaching Liège, Sordet found the town invested by the Germans and was compelled to return without having been able to do anything effective.

The instructions issued to the French cavalry in September, 1914, by Joffre, brought the hazardous enterprises being undertaken by this arm to an end. The French cavalry, in consequence, proceeded forthwith to adapt itself, as best it could, to the requirements of the day; for more than three years now, it has been largely employed as infantry. On the Western front, the German cavalry has also had to a very great extent to act as infantry, but in Galicia, Poland, Russia and Roumania it has often been able to play the part for which it has been raised, trained, and equipped. The opinion is expressed that had it been possible for the Central Powers to employ a cavalry corps in Italy in the Autumn of 1917 the discomfiture of the Italians would have been complete; fortunately, the solid wall of the Alps caused the latter to be spared this supreme distress.

The case for the continued existence of cavalry is, in the opinion of the author of the original article, " proved in," as our American cousins would say. • However, it is only after the infantry fight, and particularly in a retreat, that cavalry can nowadays usefully intervene.

Its great mobility enables cavalry to act wide of a flank and to cover it, and cavalry can also be employed for the purposes of momentarily filling up a gap in a front, one which cannot be closed by any other means. But, in order that it may successfully undertake such duties, cavalry should be armed accordingly and also be provided with the technical equipment necessary to enable it to act on the offensive or the defensive according to the requirements of the moment.

Cavalry is an expensive arm, one particularly vulnerable and difficult to handle. The principal advantage cavalry possessed over other arms.

formerly was the greater speed with which it could move from one point to another; in view of the great developments in mechanical transport that have taken place in recent times, this superiority in speed is, to-day, largely discounted; infantry can nowadays be carried almost as quickly from one locality to another as cavalry would take to move across the space intervening between these localities.

Although it can no longer be said that the use of cavalry is absolutely indispensable in a modern battle, yet it remains true that its employment in attack may on certain occasions still prove invaluable, in others absolutely necessary. The opinion is expressed that, at the beginning of the War, it would have proved advantageous to the French if, instead of having ten cavalry divisions, they had had fewer such divisions, but more machine guns and more heavy artillery. On the other hand, in view of the heavy losses in horses suffered by the Germans, their cavalry force has not been too large for the tasks imposed upon the German Army.

Turning to the question of the Swiss cavalry, the author of the original article states that, although cavalry nominally existed in Switzerland before the days of General Wille, it was he who has made the Swiss cavalry what it is to-day. General Wille was the first Swiss officer to recognize the possibility of turning militiamen into good useful soldiers.

In spite of all vicissitudes the cavalry arm still possesses to-day a peculiar fascination, and the cavalryman continues to exhibit the old spirit of dash with which this arm has always been associated; nowhere more so than in the case of the Swiss cavalry.

The author of the original article has no hesitation in saying that the retention of the whole of the divisional cavalry of the Swiss Army—the Guides—is necessary. However, he has some doubt as to the strategic value of the remainder of the Swiss cavalry—the so-called *cavalerie de combat*—consisting of 24 squadrons of Dragoons with 32 machine guns. The great development of machine-guns, the introduction of Q.F. guns into the artillery, the flattening of the trajectory of the projectile fired from the infantry weapon, the enormous growth in the mechanical transport with an army, the progress made in the aviation services all seem to point to the same conclusion; namely, that the Swiss cavalry, unprovided as it is with horse artillery, would not have the ghost of a chance should it come into collision with the cavalry of the Powers which are Switzerland's neighbours.

It is urged that the pompous title of "brigade," which is given to the formation consisting of six squadrons, with their eight machine guns, should be dropped in the Swiss cavalry and that the use of the term regiment substituted therefor; further that the present regiment should be styled "group." But, since Switzerland cannot hope to compete in armaments with her neighbours, it would be preferable, in the opinion of the author of the original article, to abolish the Swiss cavalry as *cavalerie de combat* altogether.

Now that machine-guns have been allotted to infantry battalions, the mounted machine-gun groups in the Swiss Army have, it is thought, practically lost their raison d'être. It is urged therefore that a more suitable use could be made of Swiss resources by a reorganization of the cavalry and the mounted machine-gun groups, and by forming out of them a division of a type hitherto unknown in the Swiss Army. Such a division should, it is suggested, consist of a cavalry brigade of two regiments, each of six squadrons of Dragoons and three of mounted machine-gunners. This division would thus absorb 12 squadrons of the Swiss cavalry, six of the groups of mounted machine-gunners at present with the divisions and also the group of machine-gunners with the Landwehr cavalry. The remaining 12 squadrons and two machine-gun units should, it is recommended, be distributed between the six groups of divisional cavalry.

The foregoing reorganization would still leave over a certain number of horses now with the 12 squadrons which, it is recommended, should be split up among the divisional cavalry; these animals, it is suggested, could be utilized in connection with the raising of two new batteries of 15-cm. howitzers. These howitzers should, it is recommended, be hauled by mechanical transport on the roads; the horses being available to bring the pieces into action when necessary to move them off the roads.

THE PRESS IN BELGIUM.

The original article is based on a very entertaining volume entitled La Presse clandestine dans la Belgique occupée by M. Jean Massart. We have all been made familiar with the skill and ingenuity displayed by enterprising Belgian patriots who not only published the paper styled La Libre Belgique after the German occupation of the Belgian capital, but also managed regularly to furnish a copy thereof to General von Bissing, the Governor of the invaded territories, at his offices. Greatly daring the Editor of this publication contrived at and succeeded in photographing von Bissing in his office, whilst he was in the act of perusing the latest number of the La Libre Belgique delivered for his use. This photograph was reproduced in the publication under the title "His Excellency Governor von Bissing with his intimate friend " and under it appeared the explanatory legend: " Our beloved Governor, sickened at the lies in the censored Press, seeks for truth in La Libre Belgique." Von Bissing was duly favoured with a copy of the number in which this photograph appeared. In spite of all the measures adopted by the German authorities to track down the publishers of the paper in question and the precautions taken to suppress it, the Editor was able to defeat German vigilance, so that the representatives of Might found themselves defeated by the defenders of Right.

Before the Germans marched into Brussels the majority of the owners of the printing presses had rendered them useless, whilst the remainder refused to submit to the German censorship. During the first fortnight or so after the arrival of the Germans in the Belgian capital, it was still possible to obtain foreign newspapers in Brussels. The Germans' then put a stricter guard on the Dutch frontier and it became extremely hazardous to smuggle papers into Belgium from Holland. About this time the publication of certain pseudo-Belgian papers was started in Brussels, but, being under German control, the news therein was thoroughly distrusted and to this fact is it due that the clandestine Press came into existence. The Germans, very early after their arrival in Brussels, took in hand the task of keeping the Belgian population informed concerning the course of events connected with the War (naturally from their own point of view). Four methods were employed by them; they distributed leaflets free of charge and put up posters; they caused to be offered for sale printed. notices; they allowed certain Dutch papers to be sold in Belgium; and they caused a certain number of pseudo-Belgian dailies to be published.

I. Distribution of Information (Without Charge).—The information supplied gratuitously was contained, at first, almost exclusively imposters, and related to the military operations. It was untruthful in many particulars; for example, in one of these posters an allusion was made to the first Battle of the Marne and in the very brief reference thereto it was stated that the rumours current alleging a want of success on the part of the German arms were false.

Feeling that the posters alone would not attain the object in view, pamphlets printed in German, French and Flemish were also distributed broadcast free of charge; these pamphlets dealt, *inter alia*, with such matters as the Anglo-Belgian Conventions, the Chancellor's speeches, etc. Further, an immense amount of propaganda literature was poured into Belgium from the region E. of the Rhine; therein the violation of Belgian territory, the sack of Louvain, etc., were written up from the German standpoint. Finally, Belgians, having family or commercial relations with persons resident in the Fatherland, were inundated with letters, in which they were told that Germany was sure to be victorious and that Belgium would be annexed, etc.

2. German Printed Matter in Belgium.—German printed matter reaching Belgium consisted of newspapers, pamphlets and picture postcards. The Belgians never believed what they read in German newspapers; and an incident confirmed their suspicions. It was one day discovered that the issues of the Dusseldorfer General Anzeiger were published from two points of view; one containing news for consumption on the Western Front and another that for consumption on the Eastern Front. Owing to missortation copies intended for Russia reached Belgium, and the Belgian public saw on the front page of one version the announcement of "A new German advance in the Argonnes," whilst in the other version they observed an announcement, in the same position of the front page, that the Russians were ripe for peace.

It was intended that the Belgian public should believe that the pamphlets referred to were the handiwork of compatriots loyal to their country; they were not to be thus deceived; for it was at once recognized that the contents thereof were the production of German brains.

The picture postcards absolutely failed in their object and, indeed, made the Germans appear ridiculous in Belgian eyes; in some of them Uhlans were depicted guarding the Eiffel Tower, in others Germans were shown carrying the ramparts of Liège (an open town) by assault, civilians were represented firing on Germans in the streets of Louvain, etc.

3. Dutch Newspapers.—Only Dutch papers of Germanophil tendencies, such as the Nieuwe Rotterdamsche Courant, were permitted free circulation.

4. Pseudo-Belgian Newspapers .- A fortnight after the arrival of the

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Germans the first pseudo-Belgian newspaper put in an appearance. At first, no news from the Entente territories was permitted to be published, but later a concession was made to the public on this point. However, these newspapers very quickly fell into discredit.

It was the strictness of the German censorship and the persistent effort to misrepresent the actual state of affairs that gave birth to the clandestine Press in Belgium. Books and papers were smuggled into Belgium; they were recopied, reprinted and distributed to the public in secret and German vigilance was completely defeated.

(a). Importation and Reprinting of Newspapers and Books.—Almost simultaneously with the arrival of the German battalions in Brussels, en route for Paris, a few bold patriots organized a service for the importation of home and foreign newspapers into the Belgian capital. Thus the residents in Brussels were able to read Le Matin and La Métropole (of Antwerp); La Flandre libérale and Le Bien public (of Ghent) which were smuggled into the city in vegetable hampers and sold secretly by hawkers of fruit, etc., at 65 centimes apiece. Among the foreign papers purchaseable were Le Journal, Le Petit Parisien, Le Matin, Le. Temps, the English Times and The Daily Mail; the Dutch De Telegraaf; the Swiss Le Journal de Genève.

The difficulties of getting these papers into Belgium became so great that the price of the *Times* rose to 5 francs a copy, and, it is stated, that as much as 200 francs has been paid for a single copy of this paper.

Soon German agents (in disguise) were sent out to sell the prohibited papers in the streets of Brussels. This gave rise, on one occasion, to a collision between one of these German agents and a Belgian hawker who resisted arrest by the agent. Two Belgian policemen thinking that their countryman was being unlawfully attacked, and not realizing that he was engaged in trafficking in smuggled goods, went to his assistance. The upshot of this encounter was that a fine of five million francs was imposed on Brussels.

Books such as Les Crimes allemandes, by Bédier ; La Violation de la neutralité belge et luxembourgeoise par l'Allemagne, by Weiss ; J'accuse ; La Belgique neutre et loyale, by Waxweiler, were also smuggled into Belgium. Naturally, the circulation of these books was very limited, and those who trafficked in or had them in their possession ran great risks. The rarer publications were manifolded by photography and by the typewriter. Leaflets were also circulated daily or periodically; some of them were devoted to military events whilst others contained extracts from the Entente Press. Further, even Raemacker's drawings were reproduced and circulated in La Cravache. The thirst for information brought many into trouble and they were sentenced to long terms of imprisonment ; a punishment which was borne, as a rule, with cheer-The Germans were able to muzzle an individual here fulness. and another there, but they have not succeeded in putting an end to wide spread propaganda.

(b). Original Publications.—The most interesting and most extensive productions of the Belgian Press have consisted of original contributions from Belgians who have remained in the occupied territories and have suffered all manner of vexations and persecution at the hands of the

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invader. Among the papers printed and published during the German occupation of Brussels La Libre Belgique easily takes first place for audacity. This bulletin, published at " regularly irregular " intervals (as stated on the title page) would, it was notified, be sold at a price per copy which was " elastic from zero to infinity (vendors requested not to go outside these limits) "; the telegraphic address of the paper was given at the " Kommandantur, Bruxelles"; and its offices, "not being a place of complete repose, were located in an automobile cellar." The publishers announced that they did not accept advertisements, since "business is at a complete standstill under German rule; the advertisement columns have, in consequence, been suppressed and customers are advised to save their money for use in more propitious times." There was a complete mystery concerning the identity of those responsible for the publication of this paper ; some suggested that it was being run by Jesuits, whilst others gave the credit to Freemasons.

Many a hoax was played on the military authorities by putting them on a false scent. On one occasion a patrol was, in consequence of a communication received on a certain subject, sent to the André Vésale Statue, in the Place des Barricades, and the number of *La Libre Belgique* issued directly afterwards facetiously published a drawing representing the arrest of the Statue in question. Other incidents of a similar nature are referred to in the original article.

La Libre Belgique was not the only prohibited paper in circulation in Belgium, La Verité, Le Belge, Patrie kept it company, as also De Vlaamsche New which announced that its editorial offices were located at the "Kommandantur, opposite to the printing press of La Libre Belgique." De Vlaamsche New was entirely devoted to satire; it was nearly run to earth and therefore ceased publication. Every copy of La Libre Belgique was, on an average, read by at least ten individuals, and the Editor of this paper was as defiant towards the military authorities in Brussels as John Wilkes proved to be towards the British Government of his day in connection with the authorship of the well-known North Briton.

After three years and more of their occupation of Belgium, the Germans find that the Belgians are untamed and untameable. To this day, they are being lampooned, in the clandestine Press of Belgium, in relation to their Goth-like cruelty, which has stimulated Belgian resistance instead of crushing it out. The measures adopted by the German authorities in Belgium have had the effect of turning practically the whole civilized world against them and has won for them the "holy hatred" of the Belgian nation.

A DURABLE AND IMMEDIATE PEACE.

Colonel Feyler informs us, in the original article on the above subject, that a Swedish author, M. Ragnar Paijkull Sturzenbecker, has sent him a pamphlet entitled *Droit au but*. Les conditions essentielles pour une paix durable in which the peace problem is discussed. The author of the pamphlet starts with the proposition that a moral reform is first necessary before peace can be secured on a permanent basis. He is of opinion that every one, the peoples of every country as well as the Governments thereof, must renounce their vanity, their unleavened Imperialism, as a first step. To this end the distinction between the "Great Powers" and the "States of secondary importance" must be abolished. The rights of all Powers, he urges, should be co-equal irrespective of their territorial extent. They should also all obtain free access to the sea; this can be secured, he points out, by the internationalization of all the means of communication, the railways, the rivers and the free space above land and water. M. Sturzenbecker proposes further to internationalize the navies and armies of the world, and to transform them into an international police for the purpose of preventing acts of violence between nations and in order to maintain the *statu quo*. Finally, his scheme is completed by the proposal to establish an International Parliament, wherein each State shall be represented by a similar number of members; this Parliament to be assisted by an International Bureau created for the purpose of providing advice and exercising Executive Powers.

The foregoing proposals are really not any more illegical than those which have already been put forward for the formation of a League of Nations, nor do they bring us any nearer to Utopia.

M. Sturzenbecker seems to think that the acceptance, in principle, of his proposals by the world at large must lead to an immediate peace. Colonel Feyler expresses the opinion that a perusal of the pamphlet in question creates the impression that in spite of the author's evident effort to steer a straight course, his bark yaws dangerously between Charybdis and Scylla, and in trying to shun one of these rocks it runs into the other; in consequence, M. Sturzenbecker does not appear to advantage as a navigator in turbulent waters. Moreover, his propositions are based on the postulate that "objectivity" is not concerned with the question as to whose is the responsibility for starting the War. What matters, he says, who began the War; it exists and the whole world wishes to see the end of it. Three matters alone, according to him, require to be cleared up in connection therewith, namely;—

For what reason or reasons have the several nations participating in the War entered into it ?

What are the present aims of each of them ?

On what conditions would each of them negotiate a peace at the present time?

The author of the pamphlet claims to have discovered the replies to these questions in the speeches of the Statesmen of the several belligerent countries and in the proclamations issued therein. The replies to the three questions are, in his opinion, identical in each case.

As regards the first question, they all say that they are at war because they were attacked; they all claim that their adversary has had recourse to arms owing to rivalries on land and on water; they all add that they are at war against their wish.

As to the second question, *all* the belligerents affirm that their object is to win victory for the sake of humanity and in order to secure a durable peace which may guarantee free development to the nations of the world.

As to the third question, they all demand that all territory conquered shall be restored and an indemnity paid for all damage done.

Thus the whole world is, according to M. Sturzenbecker, saying the same thing and he argues that therefore the whole world is in agreement on the subject of the War and the desire to bring it to a conclusion. An understanding can be arrived at, he thinks, by the restoration of conquered territory and by payment of indemnities for the damage done; he proceeds to show how a settlement can be arrived at according to his conception of the situation. He places the belligerent countries in three categories :—

Belgium and Greece are, he says, incontestably entitled to have their full sovereign rights restored to them and to the payment of indemnities for the damage done; they were in no way responsible for the War.

Italy, Roumania and Montenegro entered the fray of their own free will and, therefore, the question as to how these countries should be dealt with must depend, says M. Sturzenbecker, on whether the doctrine that war produces definite results and each side must consequently accept its gains and losses is to govern the situation or, on the other hand, on whether the doctrine that neither the aggressor nor the party attacked, neither the victor nor the vanquished have positive rights is to prevail.

France, Russia and Serbia have, according to the author of the pamphlet, every right to claim back their occupied territories. Germany and Austria have no right to keep the property of others seized by them under the pretext of war.

Similarly, he argues that Germany is entitled to have restored to her the German Colonies seized by the British, since it was Great Britain that attacked Germany, although he admits that she was *forced* to do so under "the circumstances."

Colonel Feyler states that he does not know whether M. Sturzenbecker's arguments are to be taken objectively or subjectively; in any case, he does not accept the logic of the latter's reasoning. It was not, says Colonel Feyler, "the circumstances" that compelled Great Britain to declare war against Germany, but "a circumstance" voluntarily created by Germany, one which she was free to create or not as she desired. In invading Belgium, Germany was guilty of committing a felony, and it was the commission of this crime that brought Great Britain on the scene to deal with the malefactor. For this reason, Germany must be mulct in the costs of the trial. M. Sturzenbecker draws no distinction between acts which comply with the highest standard of probity and those that are tainted with the deepest iniquity.

M. Sturzenbecker considers that it is the modern military system universally adopted by all nations that is responsible for the present conflict, and that the European States have been led into the War by a demon, whose predominating idea is that all disputes must be settled by acts of violence.

This method of reasoning naturally implies that the author of the pamphlet is of opinion that all the belligerents are alike guilty and have all been inspired by the same demon. Colonel Feyler docs not accept this sweeping assertion. He points out that whilst certain individuals certainly acted on the promptings of the demon, yet there were others who not only resisted the tempter but also endeavoured to prevent the others from being led astray. It is important to keep the individuals in question in two different classes, according to the attitude shown by them at the outset.

M. Sturzenbecker has made a fundamental error in ascribing the same value to the utterances of the spokesmen of the various belligerents. He shuts his eyes to the fact that Wilhelm II. presided at the Council held on the 29th July, 1914, at which the War was decided upon; he appears to attach no importance to the fact that Wilhelm II. suppressed the telegram sent him by the Ex-Czar appealing for a submission of the matters in dispute to an Arbitral Tribunal to be appointed under the provisions of The Hague Conventions; he ignores the fact that the reasons given by the Kaiser in declaring war against France were a tissue of lies.

With what confidence can the belligerents, in view of past experiences, accept-the declarations of the Central Powers regarding their respect for the independence of other nations? The negotiation of a peace on the basis of "no indemnities and no annexations"? No one is likely willingly to allow himself to be made a dupe as have been the Bolsheviks.

If a moral reform of humanity is a condition precedent to the establishment of a durable peace, then in order there may be immediate peace, as a further condition precedent, it is also necessary that by some means confidence should be restored in the good faith of the Central Powers, in order that their word may be believed; at the present time three-quarters of the civilized world places no reliance on any promise that may be made by these Powers. Even the propaganda of the Central Powers in neutral countries is so glaringly untruthful as to make it stink in the nostrils of all honest and impartial men.

Colonel Feyler thinks M. Sturzenbecker makes agreat mistake in considering the present struggle as being a simple conflict between nationalities, identical in all respects with those which have taken place in ages past. The present struggle, on the contrary, is something vastly different, it is a conflict between two ideals of civilization; on the one side, that of the civilization of liberty and of one affecting the dignity of the human race, and, on the other, that which the Germans have themselves baptized the "civilization of organization." It is impossible to reconcile these two ideals; liberty and subjection are ideas very wide apart. Which of these ideals shall prevail must now be decided on the battlefields of Western Europe. Neither the homilies of neutrals nor those of pacifists can procure a judgment of binding force on this question.

Humanity is, at the present day, divided into three camps; the belligerents whose cult is subjection; the belligerents whose creed is liberty; and neutrals, who, by the very fact of their neutrality, admit that their fate must be scaled by the belligerents. If success falls to the former of the belligerents, neutrals see vassalage staring them in the face; on the other hand, if victory is secured by the latter of the belligerents, neutrals can breathe freely, for an era of progress and development is assured them.

M. Sturzenbecker's sincerity is not questioned, but he has, says Colonel Feyler, made the mistake of not treating acts done in bad faith as being in a different category to acts done in good faith.

NOTES AND NEWS.

Switzerland.—The Swiss who are fighting in the Forcign Legion on the Western Front come in for a word of praise. They have, says the writer of the original article, the good fortune not to be "neutral" and, having fought against an enterprise whose aim is domination, they have been fighting for their country.

Attention is called to a work entitled Articles et discours by Colonel E. Secretan; the contents thereof deal with the period 1st August, 1914, to 1st August, 1917. Colonel Secretan has been a staunch champion of Swiss neutrality. The volume in question contains matter of two kinds; one kind relates to the events of the Great War, its strategy, the spirit of the conflict, the armies and peoples of the belligerent States; the other deals with the situation of Switzerland whilst surrounded by nations at war, the internal troubles of the Republic, and the mistakes made by its Government. There is much food for reflection in Colonel Secretan's work.

Another work claiming attention is Le témoignage d'un citoyen (subtitle Études de politique Suisse) by Albert Bonnard, who was at one time a collaborator of Colonel Secretan. This work has been compiled by M. Louis Debarge, Director of the Semaine littéraire, who has collected therein articles contributed, before and since the War, by Bonnard to the Foyer romand, the Semaine littéraire and the Bibliothèque universelle and other publications. The Swiss Army and its affairs occupy a prominent place in this collection of articles; as also do the opportunism and arbitrary conduct of those who have been responsible in recent vears for directing the policy of Switzerland.

M. Henri Naef has written a pamphlet on Antimilitarisme et défense nationale; therein he expresses the opinion that the first duty of every honest man is to go to the succour of a neighbour who may be unjustly attacked; further, that it is an unnatural thing for a man to commit suicide and equally so for a nation, which is but a collection of individuals; to do so. A people that ceases to defend itself, he points out, disappears in time from the face of the earth and, in doing so, does not contribute to the advancement of the interests of humanity.

INFORMATION.

Switzerland.—Shorthand, it is said, has been somewhat neglected in the Swiss Army. Much time is lost at the present time by taking down minutes in long hand and in transmitting orders over the telephone. A necessity for a more wide-spread knowledge of shorthand is urged by the writer of the original article.

This number of the Revue concludes with a Bulletin Bibliographique.

The final part of M. Epuy's translation of Lord E. Hamilton's The First Seven English Divisions accompanies the May number of the Revue.

W. A. J. O'MEARA.

RIVISTA DI ARTIGLIERIA E GENIO.

JULIUS CÆSAR AND THE WAR OF POSITIONS IN THE SPANISH MARSEILLES CAMPAIGN, 49.

Marseilles, the most important commercial town in the western basin of the Mediterranean, was at the period under notice a land and maritime fortress of the first order. Surrounded on three sides by the sea, it was closed on the fourth by a strongly fortified girdle the value of which was increased by more numerous and powerful engines of war possessed by any other fortified places of that epoch.

The principal factor of the defence, however, was the fleet. Marseilles had an important maritime arsenal and a port defended by powerful fortified works which offered to the fleet a secure base both for the offensive and the defensive. When Domizio Enobarbo assumed the command of the city, his first care was to reinforce the fleet. After the experience of the preceding campaign in Italy, he had reason to suppose that Cæsar had met with difficulties in procuring ships, and that on the sea there was the possibility of obtaining a victory. All the war ships were sent into the neighbourhood charged to requisition as many boats or ships of any kind that they might find, transforming them for war purposes, and demolishing some, using the material for the repairs and adaptations. Cæsar, as it was known had arranged for the equipment of 12 war ships in Arelate and had entrusted the command to Decio Brutus. The attack on the land side was to be conducted by Trebonio with his three Gallic legions.

When he arrived Trebonio made his preparations for the siege. After having enrolled a great number of workmen, he transported to the town a large quantity of material, and commenced the operations for a regular siege by the construction of two colossal terraces.

Owing to the depression of the ground in front of the walls, these terraces had to be made with an average height of 80 ft., and their construction required an enormous movement of earth and the use of great quantities of material. On the other hand the great powers of the Marseilles machines, both as regards their range, and the penetration of their projectiles compelled the assailants to commence their works at a certain distance from the walls and to adopt those of greater dimensions than those commonly in use. This was the cause of the slowness of the attack and necessarily it delayed the decision for the attack on the land side. A resolute action had then first to be made from the sea.

The ships ordered by Cæsar were ready in a month—towards the end of May—and then selected troops drawn from the legions were embarked, they were abundantly equipped with grappling hooks, landing platforms, and light machines.

The marine element, properly so called, consisted of crews taken from the merchant ships leaving as many as might be necessary. Brutus occupied the small group of islands opposite the port and awaited the enemy's fleet which consisted of 17 great war ships, and a great number of smaller ships manned by mercenary troops, but with selected sailors considerably better than those of Cæsar's fleet.

. On the 27th June the Marseilles fleet under the command of Domizio

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Enobarbo sailed out of that port. Brutus had drawn up his ships in front of the group of islands selected by him for his naval station. The Marseilles ships were extended on an ample front, attempting to turn the Cæsarian fleet and manœuvring in a manner that several might attack each of the enemy's ships simultaneously and damage their oars. Owing to this manœuvre the Cæsarians found themselves at a great disadvantage, but they did not try to avoid the enemy's attacks, and even made their ships to approach nearer in order to bring into action their grappling hooks, and to bring on hand-to-hand combats in which Cæsar's veterans excelled.

Several of the Cæsarian ships succeeded in capturing two of the enemy's ships. In this manner after the Marseillaise had lost nine ships they had to abandon the combat and to retire to the harbour closely pursued. It was this naval combat the notice of which going to Ilerda had produced so great an impression.

The Marseilles fleet although beaten was not destroyed and with the powerful resources that it had at its command was able to return to the attack. Fresh ships were brought out, a great number of fishing vessels adopted for war purposes and armed with light engines, and on these were embarked detachments of archers.

In the meantime unexpected assistance had arrived at Marseilles. Pompey had sent from Greece 16 ships under the command of the legate Nasidio. These had succeeded in surprising the Cæsarian fleet which was found in the straits of Messina and had forced a passage; one ship was captured, a swift sailing ship was at once sent to Marseilles to announce the speedy arrival of reinforcements. Nasidio with his 16 ships anchored near Taurenzio, a coast fortress situated about 30 km. from the city. The Marseillaise did not allow the occasion to escape them for taking a reprisal. With all their fleet they left the port, and undisturbed joined Masidio near Taurenzio. The two fleets reunited advanced in line against the Cæsarian naval station, the Marseillaise on the right and Nasidio on the left. In the meantime Brutus had reinforced his fleet with ships captured from the enemy in the last combat, profiting by the time gained to drill his sailors.

On receiving notice of the reunion of the two enemy's fleets he set sail with his ships to meet them. The battle took place half-way between Marseilles and Taurenzio. As soon as each ship had the necessary freedom for manœuvre Brutus tried to extend his line as far as possible, endeavouring at the same time to provoke the enemy's attack. But they had become prudent; cach time that one of their units came to board the Cæsarians, some ships that were in reserve at once hastened to give assistance and compelled the enemy's isolated ships to retire.

The combat was protracted in this manner without either of the contending ships being able to obtain a victory. Two of the Marseillaise ships attempted then simultaneously from two sides to ram the ship of Admiral Brutus; but he at the last moment succeeded in avoiding the shock, sailing rapidly ahead so that the two enemy's ships came violently into collision, each being so much damaged that they remained helpless for defence. Several of Cæsar's vessels closed in at once on the two Marseillaise ships which were sunk.

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Brutus hastened to penetrate into the gap produced in the enemy's lines, and succeeded in separating the left wing commanded by Nasidio and compelling them to take to the high sea. The mass of the Marseillaise, isolated and weary after their losses, took refuge in the port. Five of their ships were sunk, four were captured, one which remained isolated succeeded in escaping towards Spain together with the detachment of Nasidio which had not undergone other losses. The Marseillaise fleet was now out of action, and the strong maritime city found itself blockaded from the sea front.

By force of circumstances, the operations proceeded more slowly on the land side. Notwithstanding the great quantity of material that Trebonio had collected at the commencement of the works it is related that the normal types of the works for attack were not sufficient. Not: only the powerful engines of the besiegers were effective at a great distance, but the penetrating force of their projectiles was such, that the means of cover used up to then did not offer the necessary resistance. Against the long beams pointed with iron, there were thrown gigantic balls from a great distance, the defences consisting of wooden beams and entanglements. This being the state of things, it became necessary to construct in front of each of the two terraces a strong parapet, under the protection of which they proceeded to the construction of terraces. in the usual manner, levelling the ground step by step, but with a structure more solid than that adopted in other sieges.

The nearer the besiegers approached the walls, the greater became the confusion. Heavy projectiles and incendiary materials were thrown in great quantities, and the besieged becoming fatigued had to seek protection from the losses caused by the projectiles, and suffocated by the burning pitch, but they also had to repel the attacks always more frequent and violent as the distance diminished. To oppose a more effective resistance, especially to the sorties, the troops occupied in the construction of the terraces on the right endeavoured to create a point d'appui outside these terraces. They built up a tower of bricks of four stories IO m. in width, with great beams (1.60 m.), covered with a roof formed of beams and planks. When they found that the towers offered the necessary protection they decided to raise them and in an ingenuous manner effected the elevation of the roofs. On these a screen was fixed consisting of rope netting hanging downwards. The whole mass of the roof and screen was raised by windlasses and then followed the construction of the walls of the new story. The tower in this manner reached to a height of six stories, so as to dominate the city walls ; the upper story was provided with loopholes from which by means of engines placed in the interior they were able to successfully resist the crowning of the The work originally erected with a defensive scope became finally walls, a most efficacious means of attack.

Owing to difficulties of the ground, the construction of the terraces proceeded very slowly, the legionaries, always protected by their towers, constructed a strong movable musculus, 20 m. in length, made of planks covered with bricks as a protection against incendiary projectiles. The musculus pushed forwards on rollers was suddenly thrust from one of the towers of the wall, and from this they commenced the work of demolition. 1918.]

The besiegers saw the danger, and overturned the walls, using at the same time burning pitch, also damaging the musculus. Finally one part of the mural tower collapsed and the remaining part had, to be evacuated by the defenders; the breach was open.

It was the 10th of October and the Marseillaise thought that the city could not hold out any longer; and considering the exasperation of the Cæsarians believed it better to capitulate than to await the enemy's attack. An armistice was then decided upon until the arrival of Cæsar and then they made an unconditional surrender. Trebonio had received from Cæsar a formal order to prevent the sacking of the city, the result was good; he accepted the demands and made a cessation of hostilities.

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AUSTRIA-HUNGARY.

Dismounted Cavalry.—Distribution of Mitrailleuses.—From notices collected from La France Militaire it appears that portions of the cavalry divisions, especially the 5th, 6th, 10th, and 11th, are dismounted. The regiments have a new organization with reinforced effectives, and a larger allotment of mitrailleuses. Each of these regiments are composed of two half regiments with three squadrons armed with rifles and one squadron of mitrailleuses. To every half-regiment there will be added a 4th squadron of rifles whilst up to the present time there has only been one for each division.

The squadrons of mitrailleuses have four sections each with two mitrailleuses. But according to an order of 19th July, 1917, issued to the 7th Army, all the dismounted squadrons have a section of four light mitrailleuses with the infantry companies. So that the regiment has altogether 48 mitrailleuses.

Belgium.

A New Type of Mortar.—One of the sectors at the front where mortars are largely used, is that occupied by the Belgian Army. This new arm has been minutely studied in that army. La Revue Militaire Suisse, in an article on artillerie de tranches, gives some data on the new perfected mortar in use in the Belgian Army.

Its principal value seems to be the great exactness of its fire combined with lightness of material and facility of service. Four men are sufficient for the transport and service of the mortar; it can discharge two kinds of projectiles of weights respectively of 36 and of 19 kg, with rapid fire. The fire once regulated there are no displacements which have to be regulated in the installation of the mortar. The deviation in the range does not exceed 3 m. in 1 km. of distance. The construction of the new mortar is also very simple and the cost is small.

GERMANY.

War Organization for Pioneers.—At the commencement of the War to each army corps, active or reserve, there was assigned a battalion of pioneers of three companies. Other formations of this service were destined for the attack and defence of fortresses. According to information in La France Militaire in the course of the campaigns the number of units of pioneers has been much increased by companies created from existing regiments and battalions, and also by independent companies. In the great units, the companies are assigned not often to the army corps but directly to the divisions; in addition to those with the army corps there are reserve companies of pioneers which are assigned to different sectors according to requirements.

At the commencement of the current year the organization was stated to be complete, giving to each division two companies of pioneers. Other formations, not comprised in the organization for divisions are at the disposal of the great general staff and the commands of armies, and comprise regiments of fortress pioneers and companies of miners, besides the special battalions destined for the service of flame throwers and asphyxiating gas.

Perforating Bullets for Rifles.—The introduction into the service of shields for field artillery has caused trials to be made in order to obtain perforation of the shields by small bullets of special make for rifles fired at a moderate distance.

An article published in the *Genie Civil* that to the German selected marksmen there are distributed cartridges with small perforating bullets which are distinguished from others by having an internal nucleus of steel with tungsten.

JAPAN.

New Rifle.—The Japanese Colonel Kijiro Nambu—as reported in an extract from the Corriere di Haifong published in La France Militaire had invented a new rifle, which is stated superior to the rifle now in use, by its range, its simplicity, the strength of its mechanism, and its lightness and rapidity of fire. The calibre is stated to be increased. Mention is not made of its being an automatic rifle.

E. T. THACKERAY.