Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

Miniature Rifle Shooting.—The announcement that a miniature rifle meeting will be held in one of the side buildings of the Agricultural Hall at Islington during the International Sports Exhibition at the end of May will be welcomed by all the shooters and officials who suffered so severely from the inclement season during which the two previous meetings have been held. Dense fog, whether of the November or February variety, is an unsuitable accompaniment for rifle shooting, and moreover multiplies the inconveniences due to the late hours which these meetings inevitably entail. Such meetings being necessarily held indoors, no better month than May could possibly be chosen. The weather whilst favourable for getting about, is at the same time not so wondrously fine as to detract from the success of an indoor show. There are of course those who would like to see the miniature meeting held in the open air during one of the summer months, but all things considered the indoor arrangement is best adapted for the championship gathering. A multiplicity of outdoor meetings at the different club ranges keeps alive the interest of the sport far better than would be the case if the bulk of the interest and the bulk of the prize money were concentrated upon a single large meeting. In the nature of things such an undertaking would be over-loaded with establishment expenses connected with the equipment and maintenance of a suitable ground. Such open-air championships as the National Rifle Association feels called upon to organise can be conveniently carried out in connection with the Bisley Meeting. Therefore the gathering solely confined to miniature rifles has wisely been kept under a roof and within four walls. Greatest wisdom of all it has at last gravitated to the month of May, where it simultaneously terminates the winter period of shooting and initiates the open-air season.

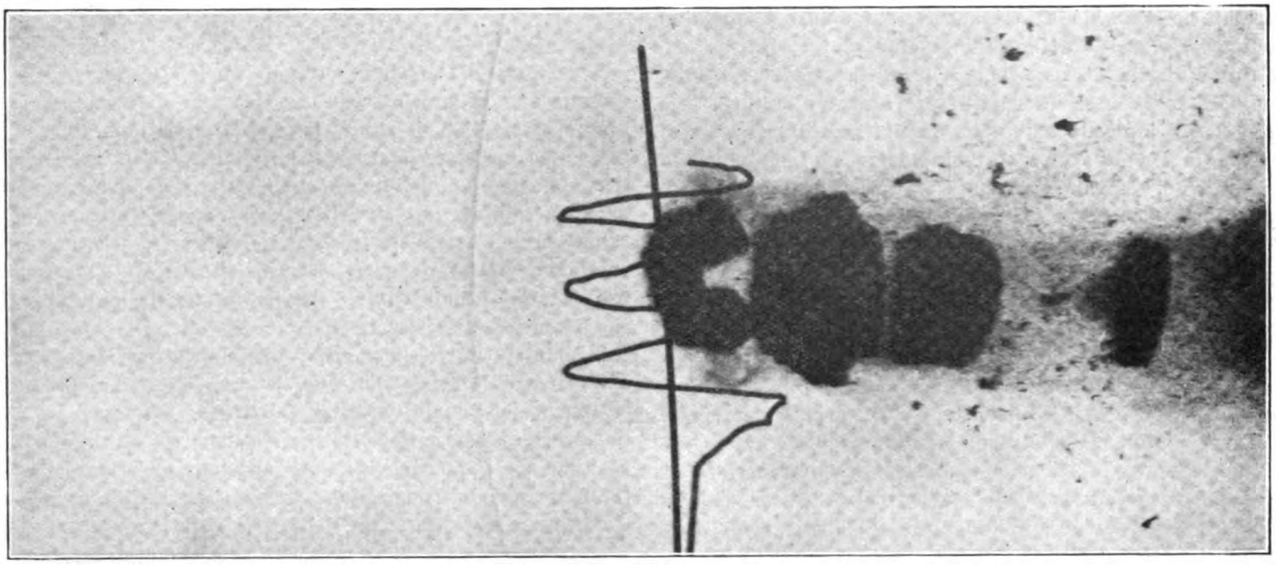
Mr. Borland's Photographs.—The establishment of photographic apparatus for recording the formation of a column of shot on emerging from the muzzle of a sporting gun constitutes an addition to the testing facilities of the explosives trade, the importance of which should become more and more evident as years go by. The dispersion of a charge of shot has only of late years been subjected to exact scientific analysis. Though millions of tests of dispersion have been made by way of counting patterns on the plate it is only lately that the results obtained at all the distances have been co-ordinated with a view to their expression in the form of a curve of dispersion. That the spread is a compound movement and not a simple radiation from a central point is evident to anyone who thinks the matter over with reference to the experimental results obtained. The simplest movement is the direction given to each individual pellets hortly after the emergence of the charge from the muzzle. The other motion leads each pellet to diverge wider and wider in an increasing ratio from the mean line of the whole charge and is doubtless the result of a rotatory movement. The ideal shot pattern would be one which attains the required spread upon emerging from the muzzle, and so continues without further enlargement for the remaining distance of flight. A more practical ideal is a true cone dispersion whereby double the distance gives double

the spread, etc., etc., and no more. Present-day gun boring gives a spread of a less useful form, than that which is characterized by a dispersion proportional to the distance. With choke bore guns this outward curvature of flight is at its worst, whereas with the cylinder form of gun pellets fly more nearly on a straight course. During the past year it has been demonstrated that guns having an equal standard of 40 yards result do not invariably show an equal spread at the shorter distances. The problem of the moment is to repeat as a fixed type of boring the kind that most effectually minimises the rotational motion of the individual pellets around an axis at right angles to their direction of flight. Mr. Borland's photographs have an important bearing on this class of problem, because for a start they so clearly enunciate the underlying principles of choke boring. The practical man, who is the source of most of the useful inventions, should carefully study the results portrayed, in order that the truths demonstrated may be utilised in framing improved methods. The problem is closely associated with the development of the smaller bore shot-guns. These are as a rule bored too near the full choke standard. In other words, whilst they rapidly acquire the reputation of satisfactory killing power at long distance shots, at the nearer ranges they too often present the unsatisfactory alternative of a clean miss, or pounding the game to a jelly.

·22 Rifle Dangers.—Following the fatal accident to one of Nobel's chemists, when engaged, not in making nitroglycerine, but in firing a ·22 rifle, news has lately been received of another employee of another manufacturing company being shot, fortunately with good chances of recovery, under practically similar conditions. This cartridge is likely to remain for many years to come far the greatest source of danger on the testing ground. Its efficiency in use is entirely dependent upon the maintenance of a very high standard of accuracy, a requirement that entails incessant testing, usually by means of a rifle held by the barrel in a firmly bedded vice. With none of the larger brands of ammunition can the disturbing influences of recoil be neutralised by the simple expedient of firm holding. Therefore whilst more or less ceremony must be observed in accuracy tests of all the larger rifle cartridges, the ·22 can be fired by an unskilled man who sits down at a bench and probably fires most of the shots without watching them strike the target. The golden rule of safety with ·22 rifle experiments of any kind is to restrict to a single individual the firing of the rifle and the fixing up of the target. Another very effective precaution would be to erect permanent stretches of wire throughout the entire length of the range as near as possible to the line of fire. Their effect would be to discourage, at all times whatsoever, promenading across the zone of danger. The most usual excuse for the pernicious practice of having an assistant coming and going in front of the target is the difficulty of locating the initial shots fired as sighters. The natural desire to get along with the business in hand frequently involves missing the wires, disc, or whatever else it may be that the bullets are intended to strike. The assistant at once goes in front of the target and eagerly searches for a mark made by the bullet. A plain white screen of ample dimensions will immediately locate the first bullet which is fired, provided the elementary precaution has been taken of aligning the rifle through the centre of the barrel entirely without reference to the sights. When once the spot has been fixed the velocity screen or target, as the case may be, should be laid over that mark in preference to the alternative plan of adjusting the rifle or its rest until the bullets strike the pre-determined spot. A first-class telescope mounted so as to be capable of instant alignment in any direction, is a necessary adjunct when dispensing with the services of an assistant. For velocity testing the time occupied in covering the 20 yards separating the rifle from the target is absolutely immaterial. Accuracy tests on the other hand at distances exceeding 50 yards may necessitate the employment of an assistant, but even then the system of wires already referred to should eliminate the most serious sources of danger.

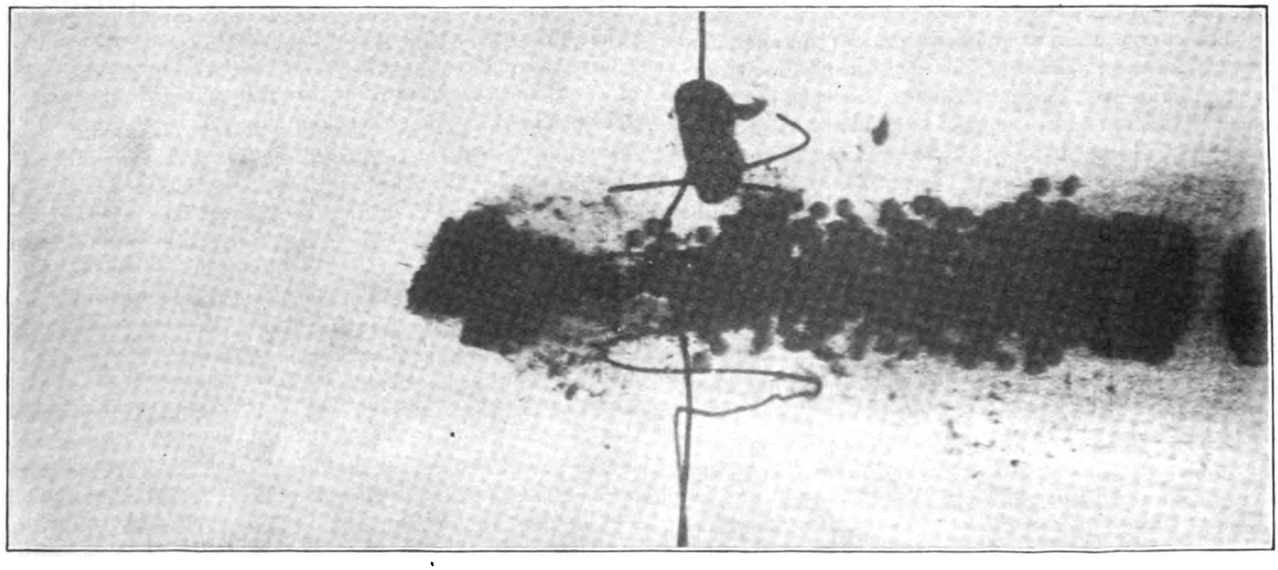
The Cordite Litigation.—Apart from the controversial aspects of this case, and the portions of it that remain *sub judice* pending appeal, it is very interesting to know that scientific knowledge on the subject of mercury analysis has been advanced by the brilliantly clever work which Dr. Hehner so modestly described in the evidence he gave before the Court. According to his own account he made no new discovery, but merely applied well-known processes and principles for the purpose of determining quantitively the mercury present in a given sample of cordite. The question of solubility he dismissed in one wave of the hand with the daring but entirely commonsense assertion that in the quantities under consideration everything is soluble in ether. That he has succeeded where others, to say the least, have been less successful no doubt arises from the work he had previously done in the analysis of beer in connection with the arsenic scare. Following out the same general principle of first collecting, then precipitating, afterwards isolating, and later on rendering visible the material about which curiosity exists, he has been able to show the exact amount of mercury present in each sample of cordite submitted for test. The importance of his discovery consists in the distinction between the new tests and the older prismatic method which was incapable of distinguishing between the faint traces arising from accidental by-products and the still minute but nevertheless more appreciable quantities which are deliberately added for the purposes of sterilization. The explosives trade as a scientific entity can offer no rewards or diplomas for the work that has been done. The highest testimonial that Dr. Hehner has attained is a position in the literature of explosives which future generations, as well as present-day workers, will recognise as having been well earned. The institution of a definite process of chemical analysis to locate and measure the quantity of mercury present in an explosive will assist in removing the cloud of reproach and uncertainty which has overshadowed the trade for very many years. The chemistry of explosives is unexplored in many of the outlying by-ways and side routes; consequently all the more honour and credit is due to one who has installed a row of gas lights along one of the least accessible thoroughfares.

PHOTOGRAPHS OF FLYING SHOT.



EMERGENCE OF SHOT FROM CYLINDER BARREL.

Mr. W. D. BORLAND'S researches in smokeless powders have been versatile enough in all conscience, but wherever possible they have shown an inclination towards photography, which is his chosen hobby outside strict business. He photographed the flash of the ordinary gun cap, and thereby initiated a new mode of examination which has cleared up several difficulties, whilst pointing the way to further improvements. He stereoscopically photographed a gun from the point of view of the shooter's two eyes, thereby demonstrating certain facts in connection with the master eye which had never before been emphasized by photographic proof. In electing to follow in the footsteps of Professor Boys he undertook the biggest photographic task of his life. The actual details of shot photography had admittedly been worked out before. Therefore, in Mr. Borland's case there was no attempt to originate a fresh photographic operation but merely to utilise methods which had already been discovered for the purpose of examining differences between one kind of gun and another, with a view to elucidating sundry unknown ballistic problems. Just how far previous research in this direction had been carried is difficult to say. Colonel Journée's book certainly contains pen and ink sketches showing the supposed formation of the shot and wads at various points in their course,



EMERGENCE OF SHOT FROM FULL CHOKE BARREL.

both inside and outside the gun. Some of them are acknowledged as fanciful sketches, others profess to be taken from actual photographs, but even here there is evidence of artistic licence which throws a certain amount of suspicion upon the veracity of the reproduction.

In Mr. Borland's case there is no theory to substantiate, no fact to be associated with previous suppositions, the problem being reduced to the careful recording of actual happenings, with a view to their elucidation in the form of a theory if sufficient evidence is produced. The actual process of photography is by no means simple, even though other masters in physical experimentation had solved it previously. The right electrical conditions to produce the correct form and duration of spark, the arrangement of the gun, the contacts, the shooting box and the camera are all details of the utmost importance, each requiring far more personal attention than is embodied in the process of ordering well-known apparatus from an illustrated catalogue. As has already been stated, Mr. Borland's work in the photography of flying shot is differentiated from that of previous observers, in so far that he regards the matter as having ceased to be a photographic problem, being now reduced to the purely ballistic interest of relating the behaviour of a charge upon its emergence from the muzzle with the subsequent behaviour at 40 yards.

A good many people suppose that choke boring concentrates the natural spread of a charge of shot by giving the pellets a last push towards the centre. The analogy of the hose nozzle is called in to show that greater concentration of flow results from constriction of the muzzle. The alternative view is that the choke exercises a peculiar effect on the powder gases which delays their emergence from the muzzle to a minute extent, sufficient, however, to minimise the disturbing effect of the overtaking gas blast.

The accompanying specimen photographs show the characteristic relative behaviour of cylinder and full choke boring. The cylinder pattern shows a most extraordinary lateral expansion of the shot charge as a direct and obvious consequence of the pressure of the wads against the base of the shot charge after emergence from the muzzle. This supports the theory that the scattering effect of a charge of shot represents the consequence of an abnormal disturbing influence which makes the spread of greater deviation than would exist if the disturbing rush of powder gas could be abolished. The choke bore pattern absolutely confirms the belief that the effect of the choke is in some way or other to modify the outrush of gases, whereby the charge of shot gets on its journey by its own momentum undisturbed by the bustling effect of the more active powder gases. This is the tale which these two pictures appear to tell, and if anyone can read a different meaning into these two characteristic and untouched photographs the way is clear for him to do so.

THE PATENTS OF SCHÖNBEIN (1846), TONKIN (1862), & ABEL (1865).

By GEORGE W. McDONALD, M.Sc., F.C.S.

SCHÖNBEIN did not take out a patent in England for the manufacture of guncotton in his own name, but in that of John Taylor (1) This patent is of such importance that it may very justly be dealt with in detail. "The invention consists of a manufacture of an explosive compound applicable to mining purposes, the throwing of projectiles, or otherwise, as a substitute for gunpowder by treating or combining matters of vegetable origin with acids. The vegetable matter which is found best suited for the purpose of the invention is cotton, in the state in which it comes into this country, but cleaned from any extraneous matter, it being desirable to operate only on the clean fibre of the cotton, which should be dry. The acids I employed are a nitric acid of from 1·45 to 1·5 specific gravity, and sulphuric acid of 1·85 specific gravity. As far as my experience goes the best mode of using them is to mix them in the proportions of one measure of the nitric acid with three measures of the sulphuric acid, in a convenient vessel of glazed earthen ware, or other material not acted on by acids. By this admixture great heat will be produced. The mixture should be allowed to cool until it reaches a temperature of from 50 to 60°F. The cotton should then be immersed in the acids so mixed, so as to become thoroughly impregnated therewith. It should be introduced as open as practicable, and in order to assure the cotton being fully impregnated with the acids and every part equally and fully subjected to the action thereto, the cotton when in the acids, is to be moved or stirred by means of a rod of glass, or other material not acted on by the acids. The acids are then to be pressed or drawn off. The cotton is to be gently pressed in the vessel containing it, by a presser of glazed earthenware, or other material not acted on by the acids, in order to free it in part from the acids, and is next to be covered and left to stand for about an hour, when it is again to be pressed, in order to remove as much of the acids therefrom as practicable, after which the cotton is to be washed in a continuous flow of water, and well agitated or stirred therein until the water does not indicate the presence of any acid by the ordinary test of litmus paper. The cotton is now again to be pressed to free it from the water as much as possible, and in order to ensure the cotton being perfectly free from uncombined acid it is to be dipped in a very weak solution of potassium carbonate (1oz. to 1gall.) The cotton is now to be partially dried, which is conveniently done by subjecting it to a press, to press out the solution of potassium carbonate. Though the prepared cotton when fully dried has already become highly explosive, it should next be immersed and well stirred in a very weak solution of pure potassium nitrate (1oz. to 1gall.). The use of this solution appears to add strength to the compound, but the use of this solution and also potassium carbonate are not essential and may be dispensed with. The cotton is again to be pressed to remove the solution, and is afterwards to be opened out and dried, which may be conveniently done by spread-

FOOTNOTE TO ARTICLE COMMENCING ON NEXT COLUMN.

(1). *"Improvements in the manufacture of Explosive Compounds" communicated to me from a certain foreigner residing abroad. John Taylor of Adelphi, Middlesex. English patent 11407 Oct. 8th, 1846.*

(2). *"Improvements in the manufacture of Gunpowder." John Tonkin, Poole, Cornwall. English patent 320 Feb. 6th. 1862.*

(3). *Improvements in the preparation and treatment of Guncotton." F. A Abel. Royal Arsenal, Woolwich. English patent 1102. April 20, 1865.*

ing it thinly on surfaces in a room heated by steam or otherwise to about 150°F., and when dried it is fit for use. I would remark that nitric acid alone produces on cotton an effect similar to that produced on cotton by the mixtures of acids above mentioned, but in carrying out the invention with nitric acid alone, the cotton should be removed and washed immediately after it has been soaked with acid ; but I believe that so good a result cannot be obtained by the use of nitric acid alone, and the product is more costly. I do not restrict the invention to the use of cotton, although I have confined my description to the employment of cotton, because of its cheapness and peculiar applicability for the purpose ; other matters of vegetable origin may be converted into explosive compounds by the same acids, and may therefore be used, though as far as my experience goes, not with so beneficial a result. Neither do I confine myself to the above mentioned specific gravity of acids ; acids of inferior gravity may be used, though as far as my experience goes, not so beneficially. In use of the above explosive compounds made with cotton, as substitutes of gunpowder, care is to be observed that much less by weight of the former than of the latter is to be employed to obtain a given result, and I believe as a general rule, three parts by weight of the compounds here described may be given as being equal in strength to (if not more powerful than) one part by weight of Tower Proof gunpowder, and still less of the explosive compound should be used when it is substituted for gunpowder inferior in quality to Tower Proof. The explosive compound made by the use of cotton being in a fibrous state, it may be rammed into a piece of ordnance, a fowling piece, or a musket, or it might be made up into cartridges, or, when slightly damp, it may be pressed into a mould adapted to the different calibres of fowling pieces, and pieces of ordnance, and on being dried it will retain its figure. I have also found that when placed in caps such as those now employed as percussion caps it might be discharged by impact. Explosive cotton, as herein described, and similar explosive compounds may also be used for many other purposes, for which gunpowder has hitherto been employed, and what I claim is the manufacture of explosive compounds from matters of vegetable origin, by means of nitric acid, or nitric acid and sulphuric acid."

It is interesting to note that the pulping of Guncotton is mentioned in a patent of Tonkin (2), in the year 1862. He describes the production of guncotton by nitration with mixed acid, and then goes on to say " The cotton is to be washed in a continuous flow of water, and well agitated or stirred therein, till the water does not indicate the presence of any acid. The cotton has now to be pressed to free it from water as much as is practicable, and in order to ensure its being perfectly free from uncombined acid it is dipped in a very weak solution of potassium carbonate, (1oz. to 1gall. water). The fibre is then taken in the wet state and converted into pulp in the same manner as is practised by paper-makers, by putting the fibre into a cylinder, having knives revolving rapidly, working close to fixed knives." Tonkin, however, makes no claim in his patent for the pulping of a guncotton, but only claims the addition of pulped guncotton to an explosive in the following proportions :—Nitrate of Soda (65). Charcoal (16). Sulphur (16), and Guncotton Pulp (3).

It was in the year 1865 that Mr. F. A. Abel (3), afterwards Sir Frederick Abel, took out a patent for " Improvements in the preparation and treatment of Guncotton." This is historically of sufficient interest to have the more important points in the patent quoted in full, as follows :—

" The method of treating the guncotton, which I prefer to employ in carrying my invention into practice is as follows : I first convert cotton wool by the processes now well known into guncotton. For this purpose I prefer to use the cotton in the form of a loose roving. When the guncotton has been purified from acid by washing in running water and in very dilute alkali, I transfer it to a beating engine of the description commonly used in the manufacture of paper, where it is reduced to a pulp, which is then converted into solid masses, such as sheets, discs, cylinders, and other forms, either perforated or not, by any of the processes ordinarily employed for producing sheets, discs, cylinders, and other forms from paper pulp. A small quantity of gum or other binding material soluble in water may be mixed with the pulp. To obtain any required degree of density of the solid guncotton I subject the mass, whilst in a moist state, to the action of hydraulic or other presses, or of any other known arrangement of machinery for exerting the requisite pressure on the material. To produce a granular structure I either cut the sheets, discs, and other solid forms into small pieces of the required size, or I introduce the pulp containing water and a small quantity of the binding material into a vessel to which a vibrating motion is imparted, whereby the pulp is at once formed into granules of different sizes, which are subsequently sorted, if necessary. In the above processes, in place of water other fluids, such as wood spirit, spirit of wine, ether, or mixtures of those liquids, with or without some binding material soluble in the liquid, may be employed.

Instead of forming the whole of the mass of guncotton into pulp as described, a portion of the same may be left in the original state, and be mixed with the pulp in such proportions that, when subjected to the requisite pressure, such combination will become a solid conglomerate mass of the requisite density. Such solid guncotton, whether formed of pulp only, or of pulp mixed with fibre, may also be coated or mixed with soluble guncotton, known as collodion, applied in the form of solution.

The solidified guncotton may also be formed of mixtures of guncotton of different composition, the properties of which are well known, that is to say, of guncotton which is soluble in mixtures of spirit of wine and ether, and in wood spirit, alone or mixed with spirit of wine, and of guncotton which is insoluble in those liquids, and the mixtures may be produced either by reducing both or only one of the varieties of guncotton to pulp, leaving the other in a fibrous state. Such mixtures may be converted into solid masses, either by the aid of pressure alone (that is, when one or both varieties is or are in the form of pulp), or by making the soluble guncotton present in the mixtures serve as a binding material by their treatment with the liquids above named, which act as solvents, in which case the mixtures may be consolidated with or without the aid of pressure."

ROUND THE TRADE.

THE continuation of Major Jacob's pamphlet has unavoidably been held over in consequence of the large amount of space which had necessarily to be devoted to the report of the Kynoch case.

Messrs. Eley Bros. Ld. have marked the passing of the old year by issuing a calendar for the new which consists of monthly tear off sheets printed in two colours and generally of a striking character.

Major Cooper-Key, H.M. Chief Inspector of Explosives, has issued a circular notice advising the trade that the explosives department had arranged to remove from 54, Victoria Street, to the Home Office, Whitehall, where the office is now permanently located.

The London Small Arms Co., Ld., whose first pamphlet on the War Office miniature rifle showed such good taste, have brought out a revised edition of their booklet entitled "How to form a Miniature Rifle Club." The illustrations are extremely fine and the information and instructions, though brief, appear to cover the necessary ground.

The Financial Times of November 28th, last, contained an interesting report from their Johannesburg correspondent on the subject of the present price of explosives in the Transvaal. It seems that the old contracts have been renewed at a very low price, Kynoch's figure being 45s. per case, as compared with 52s. 6d. for the old contract. The De Beer's price, which is based upon cost plus an agreed interest upon capital, is estimated at about 50s. The Modderfontein factory, which earlier in the year tried to book contracts at 47s. 6d., are now apparently willing to do business at 45s.

Monsieur B. Pedersen, of the Baelen-Usines, Belgium, has written under date November 28th last as follows:—"When reading about the Hale rifle grenade in the November edition of *Arms and Explosives*, I understand that you put forward that Mr. Hale has been the first who has attached a rod to a grenade and inserted the rod in the barrel of a rifle and shot it out with a cartridge. Now on this point you are mistaken, because I got the same idea about four years ago and made a great number of experiments and took my first Belgium patent on March 29, 1905. I have afterwards several times made successful experiments in the presence of Belgian and foreign officers, and I do not only throw the grenades with the aid of a rod, that I attach to the grenades and insert in the barrel, but preferably in order to better guide the grenade during flight and thus increase the range and precision of the projection, I provide the rod with sliding wings."

Col. L. Jacob is the author of one of the latest of the volumes of the *Encyclopédie Scientifique*, the title of which is *Résistance et Construction des Bouches à Feu*. Ordnance construction has made considerable progress during the last fifty years. This has been due not only to the constant improvement in the metal used in construction, but also to the practical and theoretical investigations made on the best methods of assembling the parts. The details of this progress are scattered in a number of publications. Colonel Jacob in his text book has given an account of the progress accomplished. The first part is devoted to the subject of resistance, and contains the formulae necessary for the calculations employed in the construction of guns. The examples are treated in both an analytical and graphical manner. The second part summarises the history of ordnance construction. Here the reader learns how the early theories have been modified by experience, also how difficulties have been overcome and the direction improvements are likely to take in the future.

Mr. J. Taylor Peddie has recently resigned his position with the Birmingham Small Arms Co., Ld,. and has accepted a more responsible one with Messrs. Vickers, Sons and Maxim, Ld.

Mr. Cecil Mack writes from Eley Bros., Ld. that as the result of arrangements recently entered into with Messrs. Westley Richards & Co., Ld. they are about to make the W.R. patent capped bullet in all the more usual sizes. Prices and particulars are available on application.

Mr. Oscar Guttmann completed his series of four Cantor lectures at the Royal Society of Arts on the 14th ult. The chair was occupied by Sir Boverton Redwood, who concluded the proceedings by thanking the lecturer for his interesting review of a subject of national importance.

Reports are current that the recent issues of Kynoch's ammunition show remarkably good results up to the highest club standard, claims which have been substantiated by reason of a sample which recently came our way. The mean 20yds. velocity, shooting on a cold day, was about 1,030 f.s. The bullet weighed 38½grs. and the propellant was 1·3 grs. of chopped revolver cordite Mark I. This success affords yet another argument for abandoning German cartridges in favour of home products.

The Marlin Firearms Company of New Haven, Connecticut, have sent the latest edition of their catalogue of repeating and other rifles. All the well-known types of weapon are fully described and illustrated, and a good deal of information is given concerning powder charges and bullet weights. The high power cartridges carrying nickel-coated bullets are necessarily in the minority in the case of a firm which has specialised so largely in black powder rifles of the kind used by back-woodsmen who reload most of the cartridges they use.

In their energetic administration of Proof House law the Birmingham guardians recently prosecuted John Nullburn, auctioneer of Aylesbury, for having sold a gun bearing a foreign proof mark which had not, as required by law, been re-proved in this country, as a sequence to marking it with an English name. Mr. Joseph Rowlands, who conducted the prosecution, explained that the object in view was not the enforcement of a severe fine but the vindication of the law that all arms must be properly proved before sale. The justices, taking into account the attitude adopted by the prosecution inflicted a fine of 1s. with added costs of £5 15s.

The point of main interest about the annual report of the Birmingham and Provincial Gunmakers' Association is the continued evidence of income far in excess of expenditure whereby the cash surplus has been further augmented, and now exceeds £500. The accounts remain enigmatical as usual for want of separating the balance sheet from the profit and loss account. This is a matter which should receive attention from the honorary treasurer, Mr. Bonehill. By a resolution passed at the annual general meeting the committee's proposal to reduce the subscription from £1 to 10s. for Birmingham members and from 10s. to 5s. for provincial members was duly put into force.

Lord Ribblesdale presided at the extraordinary general meeting of the British South African Explosives Co., Ld. on the 3rd ult., where he explained at length the reasons which had prompted the decision to return eight shillings per share of the Company's capital. The trend of affairs in South Africa was such that the Company's capital far exceeded the requirements of the business. The re-payment of £440,000 out of a capital of £1,100,000 could be effected by disposing of their investments in marketable securities and short term loans which amounted to £485,770. The accounts showed a reserve of some £97,000 and a carry forward of £96,000 which meant that there were ample funds for carrying on such business as it would pay to accept.

THE WAR OFFICE AND KYNOCH'S.

THIS case, heard before Mr. Justice Pickford, on the 25th, 26th and 27th November, was a petition of right by the firm of Kynoch to enforce payment for cordite delivered to the Government. There were also counter proceedings which admitted the original claim, but put forward a demand for the extra cost of the cordite which had been purchased to replace that delivered by Kynoch's to which had wrongly been added an ingredient not in accordance with the contract. By arrangement the two cases were heard as one, and after some discussion it was decided that the Attorney General should open on behalf of the Crown. The Treasury Solicitor conducted the case on behalf of the Government, and there were with the Attorney General (Sir W. S. Robson, K.C.) Mr. S. A. T. Rowlatt, and Mr. Graham Campbell. Sir A. Cripps, K.C., Mr. Horace Avory, K.C., and Mr. Kerly, instructed by Messrs. Morris and Bristow, agents for Mr. W. Morris, Messrs. Kynoch's solicitor, appeared on behalf of Kynoch's.

The opening speech made it clear that the War Office had withheld the payment of some £4,203 odd as a set-off against the loss on re-purchasing from other sources cordite to replace deliveries from Kynoch which had been rejected on account of the presence of mercury. The actual difference between the contract price of the Kynoch cordite and that purchased to replace it was £5,038. The War Office refused to allow fresh deliveries to be made on the ground that the use of the material in question amounted to a breach of the contract which had been entered into. Kynoch's had in their possession some 2,980 cases belonging to the War Office which they declined to return. They also refused to take back the contents of certain cases containing rejected cordite which remained in the possession of the War Office. The matters in dispute turned upon two main issues; first, whether the addition of mercury constituted fair grounds for rejecting the deliveries which had been made; and second, whether the War Office were entitled, in view of what had happened, to cancel the contract and buy the goods elsewhere, holding the contractor responsible for the difference in the two prices.

The contracts under dispute cover various dates from April to October 1906. Further deliveries were declined in April 1907 when the amount in default totalled 406,570lbs. The quantity which had been delivered and in respect of which payment was withheld, was 59,565lbs. The War Office wrote to Kynoch's on July 30, 1907 as follows:—"With reference to the recent correspondence which has passed between you and this Department on the subject of the presence of mercury in a soluble form in your supplies of cordite, I am commanded by the Army Council to inform you that the introduction of perchloride of mercury into the manufacture of cordite in the circumstances in which it has been done constitutes a grave breach of the contract placed with you by this Department. I am also to call your attention to the fact that the outstanding deliveries under these contracts have not been supplied within the periods stipulated for delivery under the contracts. In the circumstances, therefore, the Secretary of State for War is not prepared to allow the lots which have been rejected under these contracts to be replaced, and I am to inform you that he further gives you notice that he hereby wholly determines all the said contracts. The question of enforcing your liability for any excess cost which may be incurred by the purchase in your default of the quantities of cordite outstanding on the said contracts is under consideration and a further communication will be sent to you on this point."

Mr. W. G. West, a War Office clerk, gave particulars of the contracts, deliveries and rejections. *Major W. F. T. Corrie*, assistant to the Inspector of Laboratory Stores, gave evidence as to the cause of the rejections.

Lieut.-Col. Sir F. L. Nathan, R.A., Superintendent of the Royal Gunpowder Factory, Waltham Abbey, gave evidence concerning the ingredients and manufacture of cordite. The purity of the finished explosive is determined by the heat test. When mercuric chloride is present in a sample of cordite subjected to this test the mercury, or more probably the vapour of mercury, acts on the iodine liberated in the test paper by the action of the nitrous fumes, thus forming a colourless body and preventing the colouration of the starch on the test paper. The nitrous fumes are continually given off in increasing quantities, so that either the mercury is used up or the iodine is liberated so rapidly that the presence of nitrous fumes is eventually asserted. The time element, which is the essence of the test, is thus prolonged. The witness made experiments in 1896, the results of which are set out in Table I., and further experiments in 1897, the details of which are given in Tables II., III. and IV.

TABLE I.—*Influence of Mercuric Chloride on the Stability of Explosives.*

Description of Sample.	Exploding Points. 1	2	3	Mean	Heat Test.
GUNCOTTON—	°C.	°C.	°C.	°C.	Minutes.
Unpulped after 2nd Washing, dried over calcium chloride	141·5	137	138	138·83	At once in cold.
Unpulped after 7th Washing, dried over calcium chloride	138·5	134·5	134	135·6	4
Unpulped after 7th Washing, treated with 0·1% solution mercuric chloride	134	140	136	136·6	11
Unpulped after 12th Washing	167	168·5	169	168·16	28½
Unpulped after 12th Washing, treated with 0·1% solution mercuric chloride	170	172	171	171·0	60 N.A.
Pulped after 12th washing	173	169	172	171·3	23
Pulped treated with a 0.1% solution of mercuric chloride	169	168	166	167·6	170 N.A.
NITROGLYCERINE—					
From pre-wash tank	164	165	166	165·0	At once in cold.
From pre-wash tank treated with 0·1% solution mercuric chloride	163	164·5	167	164·83	11
From washing tank after 1st washing	168·5	167·5	168	168·0	13
From filter tank after 1st Washing	167·5	164·5	165	165·6	32
From filter tank treated with 0·1% solution mercuric chloride	170	169·5	170	169·83	43

NOTE:—*N.A.=No Appearance.*

TABLE II.—(*a*) *Guncotton at Various Stages of Purification.*

Vat No.	Guncotton.	Heat Test in minutes. 3 hrs. boiled.	6 hrs. boiled.	9 hrs. boiled.	12 hrs. boiled.	Finish. boiled.	Remarks.
3	Untreated	6	7	19	11	17	Tested same day as mercuric chloride added.
	Treated with 0·002% $HgCl_2$	21	100 N.A.	23	19	22	
	Untreated	8	13	19	19	17	Tested one day after mercuric chloride added.
	Treated with 0·002% $HgCl_2$	13	32	23	40	20	
29	Untreated	—	9	9	17	18	Tested same day as mercuric chloride added.
	Treated with 0·002% $HgCl_2$	—	25	15	60 N.A.	23	
	Untreated	—	12	15	18	18	Tested nine days after mercuric chloride added.
	Treated with 0·002% $HgCl_2$	—	120 N.A.	30	30	19	

(*b*) *Finished Guncotton Untreated and Treated with various Percentages of Mercuric Chloride.*

Mercuric Chloride %	Untreated	0·0001	0·0002	0·0005	0·001	0·002	0·01	0·1
Heat Tests mins.	18	27	18, 19	19, 17	17, 17, 16	25, 32	180 N.A.	180 N.A

The heat tests were made on the same day as the mercuric chloride was added except in one test (0·002 %), *which was made one month afterwards.*

(*c*) *Finished Guncotton, Treated and Untreated; Uniformity Tests.*

Guncotton.	Heat Test in minutes.					
Untreated	19	19	19	19	19	21
Treated with 0·002 % $HgCl_2$ ..	21	22	23	23	56	103

TABLE III.—(*a*) *Nitroglycerine.*

Nitroglycerine from Pre-wash Tank.	Untreated.	Shaken with 0·1 per cent. solution of mercuric chloride in water and filtered clear.	0·002 per cent. mercuric chloride on the nitroglycerine added to test tube in acetone solution, acetone evaporated and nitroglycerine added and allowed to stand 24 hours before testing.
Before addition of Na_2CO_3	4½ mins.	5 mins.	4½ mins.
After addition of Na_2CO_3	7 ,,	8 ,,	10 ,,

(*b*) *Finished Nitroglycerine Treated and Untreated; Uniformity Tests.*

Nitroglycerine.	Heat Test in minutes.					
Untreated ..	27	27½	27½	27½	27½	28
Treated with 0·002 % $HgCl_2$ ..	25	26	27	27	28	30

TABLE IV.—(*a*) *Cordite.*

Sample.	Heat Test.	Minutes.
Cordite	27	28
,, with 0·002% $HgCl_2$	28	30
,, ,, 0·01%	152	152
,, ,, 0·1%	180	N.A. (2)

(*b*) *Cordite Treated and Untreated; Uniformity Tests.*

* Cordite.	Heat Test in minutes.					
Untreated ..	35	36	36	36	36	37
Made from G/C treated with 0·002% $HgCl_2$	52	65	65	65	66	68

* *These two samples not same Cordite treated and not treated, but test for uniformity when $Hg\ Cl_2$ is, and is not present.*

Mercury may be present in cordite as a non-volatile compound and not affect the heat test. Such compounds would probably not be soluble in ether, being thus unlike mercuric chloride. The Dupré test would only show the presence of mercury compounds soluble in ether. Mercury had been found in Waltham Abbey cordite, but it had no doubt been introduced as an impurity in one of the raw materials used in the manufacture, probably the sulphuric acid, in samples of which mercury has been found. Mercury thus introduced would exist in a form not soluble in ether. Metallic mercury has more effect on the heat test than the chloride.

Mr. F. H. Dupré, who in conjunction with his brother is consulting chemist to the explosives department of the Home Office, gave evidence of the nature of the spectroscopic test for the presence of mercury in explosives. The mercury salts are extracted from cordite by the solvent action of ether. The test is made with 15 grammes, and a spectrum of nearly the highest brilliance is given by the 100th part of a milligram of mercury. About one-fifth of this amount would give a perceptible spectrum. Silver foil cannot be used to annul the effect of mercury, because silver foil by itself has a powerful masking effect. Gold foil has an opposite effect.

Mr. W. F. Reid, F.I.C., F.C.S., who described himself as the introducer of gelatinised smokeless powders, gave evidence concerning the interference with the heat test entailed by the presence of mercury in an explosive. He dealt especially with the inability of the stoving process to which cordite is subjected during manufacture to drive off any material proportion of the mercury which may be present even though it exists in a volatile form.

Mr. A. Seip, Manager to Curtis's and Harvey at Rochester, who gave his evidence under subpœna, went to Kynoch's as superintendent in the smokeless powder department in April 1898, and remained at their Thames factory till March 1901. He called the attention of the then manager, Mr. Cullen, to the low heat test given by cordite from the stoves in the winter of 1900, and was instructed to add from 25 to 40 grains of mercuric chloride to each 150lbs. charge. He was afterwards given further instructions to make the amount 40 grains, and at his request this order was conveyed in writing, but he had lost the slip of paper. The cordite which had given too low a heat test was re-worked with the 40 grains of mercury, the same having been added to the acetone, and the result was that the heat test, which had previously been 16 to 24 minutes, rose 36 and 40. That cordite was made up into lots and sent to Woolwich, where it was accepted.

Sir W. Crookes, of various titles and degrees, said he had maintained since May 1900 an intimate association with the laboratory at Woolwich in connection with explosives. His evidence was mainly concentrated upon showing the material influence which is exercised by the presence of extremely minute quantities of mercuric chloride on the heat test. He further affirmed that the nitroglycerine in cordite is a much more powerful sterilizer than the minute traces of mercury could be.

This concluded the evidence on behalf of the War Office. Mr. Rowlatt, before sitting down, lodged a formal request for the production of a letter dated March 25, 1899 from Kynoch, Ld., Arklow to Kynoch Ld., at Thames; also for the answer to it and a letter of March 29, 1899 from Arklow to Thames. Mr. Avory declined to produce them. At this stage of the proceedings, instead of the usual statement by the defendant counsel showing the line which the defence would take, Mr. Avory explained that his side had decided it would be more convenient for his Lordship if they called their evidence at once, and afterwards dealt with the whole case.

Mr. W. F. Helcke, manager of the factory at Kynochtown since September 7, 1905, had made the whole of the cordite concerned in this dispute. He gave evidence to the effect that all the materials were of the best, and the final product in accordance with the War Office specification. Mercuric chloride was being used at the time when he took over the duties of manager, he continued using it till January 1906, its use was resumed in July 1906 and was finally stopped on November 10th of the same year. The mercuric chloride was always added by dissolving it in the acetone, the proportion being 25 grains in a charge of 160lbs., which works out at 22·3 parts in a million. With Mark I. cordite, as distinguished from M.D., the charge used was 241lbs., but the amount of mercury remained the same. He had worked out the exact history of the different lots under dispute in this action from what was described as the History Book. The blend book was also produced in the same connection. A percentage of the old cordite was worked in with the new, in some instance being incorporated in the machines; in others the blend was produced by assembling old sticks with new. As a consequence the quantity of mercury in the finished delivery varied according to the proportion which existed between the old cordite, containing 22 per million of mercury, and the new which was entirely free from this material. He presented a table showing the various lots in dispute and the proportion of cordite arrived at in this manner,

the quantity varying from ·7 in certain instances to 13·6 as a maximum. In the course of cross-examination the witness explained that he had held various positions at Kynochtown previous to being manager. He did not regard the addition of mercury to the acetone as a breach of the specification. He put it in to sterilize the cordite, and he knew that in sufficient quantity it would mask the heat test, but he believed it was driven off in the stoving process. The history book contained no reference to the use of mercury, which was such a small matter as not to be worth while recording. The table of blends was compiled from his recollection that the use of mercury was stopped on November 10, 1906, but there was no written record of the instruction, which had been delivered verbally. There was similarly no written record of the other dates. In re-examination it was explained that the whole of the old cordite used in the blending was assumed to contain the maximum proportion of 22 parts per million.

Mr. J. M. Goodall, nitroglycerine chemist at Arklow, joined Kynoch's in May 1901 as a guncotton chemist, and during the time he was there mercuric chloride was never to his knowledge used in the manufacture of guncotton, nitroglycerine and cordite. He gave particulars of the heat tests which had been applied to sundry batches of explosives, and he referred to the difficulties associated with the presence of ozone in the atmosphere which acted on the test paper.

Mr. John Henderson, who was appointed foreman of the cordite factory at Kynochtown in April 1906, stated that in July it became part of his duties to weigh the 25 grains of mercuric chloride for incorporation with the cordite charges. The practice was discontinued on November 10, 1906 under orders from Mr. Helcke.

Mr. Horatio Ballantyne, F.I.C., F.C.S., said he had been personally familiar with the manufacture of cordite for 17 years. The heat test is a rough test in the sense that considerable variations are found in making duplicate tests of the same material, variations of several minutes. Cordite has been made for this case of various sizes and containing varying proportions of mercuric chloride. The effect on the heat test is shown in Table V. in the opposite column.

A definite quantity of mercury is required in the cordite to produce an appreciable masking effect, and the quantities that must be added to leave this amount in the cordite increase as the size gets larger. In size 4¼ the addition of nine parts per million has an effect, but in size 45 there appears to be no effect with 24 parts per million. He thought this was due to two reasons, viz., the larger sizes are longer in the stoves, and thus more mercury is volatilized, and secondly, this longer drying gives a greater hardening of the cord whereby the mercury is more effectually imprisoned during the heat test. If the amount of mercury is sufficient to mask the heat test the spectroscope would be capable of showing the mercury vapour rising from the heated cordite. The solubility in ether is not a test for mercuric chloride, because, as applied in the spectroscopic test, sulphate of mercury, which might arise from the sulphuric acid used in manufacture, is also soluble in ether. In the Dupré spectroscopic test the cordite is given a preliminary extraction for two hours with ether, and this extract is not used. A second extract of ten hours is made, and this is used for the test in the spectroscope. Consequently the mercury salt which comes out in the first extract is lost. If the amount present is small, mercury will not be found, and this in his opinion explained why Dr. Dupré did not find mercury in Waltham Abbey cordite.

Dr. Hehner, past President of the Society of Public Analysts, etc., etc., etc., explained a method which he had devised for estimating mercury compounds in cordite to the accuracy of one part of mercury in one million parts of cordite. This is one grain in 143lbs., in fact "a needle in a haystack." For this test 100grms. of cordite are dissolved in acetone. To this is added a water solution of potassium iodide, and iodine which has been made slightly acid. The three ingredients of cordite are thus precipitated, and the solution contains the whole of any mercury compounds which have been present in the cordite. In this way about two litres of solution are obtained. The solution is passed through a tube containing a bulb filled with finely precipitated copper, and the copper takes all the mercury out of that solution. After washing the copper in the bulb, and drying it at ordinary temperature, a little iodine is introduced in an extremity of the tube, and the mercury is driven on to it, when it combines and forms the yellow iodine which later turns red. This change of colour is characteristic of mercury iodide, and besides being a qualitative test gives some indication of the amount collected. To determine the actual quantity the mercury iodide is dissolved in a solution of potassium iodide and added to a sulphuretted hydrogen solution. The black mercury sulphide so produced, and hence the mercury itself, is estimated colorimetrically by comparing with similar tubes of sulphuretted hydrogen solution containing known quantities of mercury sulphide. Tests with solution of mercury compounds of known strength and also cordite doughs, to which have been added known amounts of mercuric chloride, have proved that this method of testing is accurate to one part of mercury to a million parts of cordite.

TABLE V.—*Influence of Mercuric Chloride upon the Heat Test.*

NOTE:—*Batches made from the same stock of Cordite dough, and therefore comparable inter se, are marked off by horisontal lines.*

Size of Cordite.	No. of Batch.	Mercuric Chloride added (parts per million).	Heat Test. Minutes.
4¼	1	nil	17
	2	0·71	17
	3	2·2	18
	4	3·4	18½
	5	4·4	19
	6	7·15	18
	7	8·8	22
	8	11·15	28
	15	55·75	60B = N.A.
4¼	9 (bottom)	nil	22
	9 (top)	nil	24
	10	15	34
	11	17	60B
	12	20	60B
	13	22	58
	14	24	50½
8	1 (bottom)	nil	22
	1 (top)	nil	18½
	2	0·71	14
	4	3·4	17
	5	4·4	21
	6	7·15	20
	8	11·15	20
8	9 (bottom)	nil	26
	9 (top)	nil	26
	10	15	31
	11	17	33
	12	20	35
	13	22	34
	14	24	34½
16	1 (bottom)	nil	19
	1 (top)	nil	21
	2	0·71	19
	5	4·4	19
	7	8·8	18
37	9 (bottom)	nil	33
	9 (top)	nil	30
	10	15	32
	11	17	25½
	12	20	29
	13	22	32
	14	24	26½
45	9 (bottom)	nil	30
	9 (top)	nil	30
	10	15	19½
	11	17	28½
	12	20	31
	13	22	30½
	14	24	32

No matter what form of mercury compound is added to, or finds its way into cordite, it is always converted into the compound mercury carbonate, because all cordites contain sufficient sodium carbonate to transform 100 parts of mercury per million

of cordite into the carbonate. There is, therefore, only one compound to consider, and although according to the publications mercury carbonate is not soluble in ether, nevertheless under the conditions of the Dupré spectroscopic test all mercury compounds are soluble in ether—"in the traces we have to deal with here *everything* is soluble in ether."

Samples of cordite of various sizes have been prepared with known amounts of mercuric chloride added, and, after drying, these were analysed for mercury. The following table shows the mercury added and found :—

TABLE VI.—*Loss of Mercury during Manufacture.*

NOTE:—*The "mercuric chloride left" as recorded in column 4, was ascertained by analysis of the Cordite.*

Size of Cordite.	No. of Batch.	Mercuric Chloride added (parts per million).	Mercuric Chloride left (parts per million).
4¼	3	2·2	2·2
	4	3·4	3·9
	5	4·4	2·6
	6	7·15	3·3
	7	8·8	8·0
	8	11·15	8·7
	15	55·75	slightly over 24·4
8	3	2·2	1·6
	4	3·4	3·0
	5	4·4	4·6
	6	7·15	3·1
	7	8·8	4·0
16	3	2·2	2·0
	4	3·4	2·3
	5	4·4	4·0
	6	7·15	2·4
	7	8·8	4·0
	8	11·15	8·5

Mercury and all its compounds are volatile. Thus the amounts found after the drying operation were less than those added. This volatilization goes on until about four parts per million remain, which seems to be the irreducible minimum, *e.g.*, size 4¼ batch 7, the 8·8 parts added became 8·0 parts after 132 hours drying. In the course of further drying it was found that 434 hours left only 3·0 parts, whilst after 753 hours 3·3 parts were still found, which is the same thing, as near as one can go. The rate of loss in the larger sizes was slower than in the smaller, and the loss was the more rapid the greater the amount present. Table VII. gives the amounts found in the cordites under dispute, and also the amounts ascertained from the details of manufacture, of the maximum quantity that could be present. The greatest part found is four per million and this could not have affected the heat test.

TABLE VII.—*Cordites in dispute in the action.*

(1). *Lots in dispute against which the Government have bought.*

No. of Contract.	Lot in Question.	Size.	Mercuric Chloride present, as found by analysis (parts per million).	Greatest possible average quantity of Hg Cl_2 inserted in the lots (parts per million).
2802	1260	45	4·0	13·6
2816	1251	37	2·6	6·7
,,	1241	37	4·0	8·5
2817	1244	8	0·5	0·9
,,	1245	8	2·0	2·0
,,	1252	8	1·3	2·0
,,	1253	8	1·3	0·9
,,	1255	8	1·3	0·7
,,	1256	8	2·6	2·0
2821	1235	37	2·6	11·9
2830	1246	16	1·2	6·7
,,	1261	16	1·0	2·9
2839	1254	4¼	1·0	—

(2). *Lots accepted in August, 1907.*

No. of Contract.	Lot in Question.	Size.	Mercuric Chloride present, as found by analysis (parts per million).	Greatest possible average quantity of Hg Cl_2 inserted in the lots (parts per million).
2816	1250	11	2·6	12·2
,,	1258	11	2·3	1·8
,,	1262	37	2·0	2·2
2817	1248	8	3·0	1·6
2839	1249	4¼	1·6	0·7
,,	1257	4¼	1·3	—
,,	1259	4¼	1·0	—

This having completed the case for Messrs. Kynoch, Counsel proceeded to deal with the various points shown in evidence by the witnesses on behalf of the firm. In the first place he lodged a complaint that Kynoch's, even if they were proved to be in the wrong, had been specially selected for punishment though others, including the Waltham Abbey factory, were in the same position. He emphasized the fact that the essential ballistic properties of the cordite were not affected by the presence of mercury, nor also, so far as was known, were the storage capabilities of the explosive. The cordite in dispute had been wholly made during a time when the use of mercury had ceased, and its presence was only to be accounted for by the blending with new manufacture of a small proportion of old material. Whereas one part in 50,000 was the amount the Government supposed was present, in actual fact the amount surviving from the old practice was as low as ·7 of a part per million, and therefore so small as not to be describable as an ingredient. There were other questions of a highly technical legal nature which concerned the status of the various conditions in the contract, and which the judge himself described as presenting the greatest difficulties in the case.

Mr. Rowlatt for the War Office laid down most emphatically that the contract was given on the basis of the heat test, and that no material could possibly be added which might mask the heat test, even though an innocent motive for so doing could be advanced. If used as a sterilizer it also had the other effect. Mr. Seip's evidence as to why the material was introduced six years ago must be accepted as absolutely unshaken in respect to the point as to what did occur in those times. The addition of the mercury to the acetone in the process of manufacture was plainly the addition of an unauthorized material whether it be regarded as an addition to the acetone or to the explosive as a whole. He maintained that even if the War Office admitted other cases of deliberate addition of mercury, or discovery by chemical examination where none had been knowingly introduced, that did not alter the breach of contract which Kynoch's had committed.

His Lordship in delivering judgment said that the real and substantial question in both cases was whether the Crown was entitled to reject certain deliveries of cordite because of the presence in it of a substance known as mercuric chloride. That question depended on the facts and specifications contained in the contract. The material clauses were as followed. Clause 1 said that the articles required should be equal in all respects to the specifications, drawings, and samples, and should be delivered as specified in the schedule—namely, at the rate of one lot per month. Clause 2 was as followed :—"The articles, previous to their being received into store, shall be examined ; and if found inferior in quality to or differing in form or material from the pattern, etc., specified in the schedule, may be rejected, and the contractor shall remove the same at his own expense within eight days of the date of the notification of the rejection ; and if such articles are not so removed, the Secretary of State for War may cause them to be returned carriage forward by such mode of transit as he may select, and such rejected articles shall not be considered as having been received under the contract, but the contractor shall replace the same at his own expense without any allowance being made to him." Clause 3 provided that notification of rejection would be sent within 40 days from delivery. Clause 6 provided :—"Should the articles or any portion thereof not be supplied within the period or periods stipulated for the delivery, the contractor shall be liable to a fine . . . . and in addition thereto, if and whenever there may be any articles or any portion thereof deficient, the Secretary of State for War shall be at liberty to purchase other articles of the same or similar description from other persons to supply such deficiency." The clause went on to

provide for the recovery of the excess cost of doing this, and conferred power on the Secretary of State, in the above case, to terminate the contract. There was what he might call a general specification and then detailed specifications relating to the various articles to be used in the manufacture. The general specification, so far as it was necessary to read it, was as follows: Clause 1 prescribed the percentages of nitroglycerine, guncotton, and mineral jelly. By clause 2 the whole of the ingredients and materials were to be of the description and must comply with the tests laid down in the specifications in the appendices. By clause 7 it was specified that the cordite was to stand the heat test, which was a material thing to consider in this matter.

There was a specification for every article used in the manufacture of cordite except the water which was necessarily used in the washing processes, etc., and possibly of the salt which might also be used for some purposes. But it was necessary to read Appendix F, containing the specification of acetone, because the mercuric chloride found its way into the cordite through its presence in the acetone.

" The liquid is to be genuine acetone and must contain no other ingredients except small quantities of substances which are normal by products of the manufacture of acetone. It must be colourless and absolutely transparent when mixed with distilled water in any proportions, and must show no turbidity. It must leave no residue when evaporated upon a boiling water bath."

After referring to Mr. Seip's evidence he pointed out that it at any rate proved that Kynoch's were aware at that date of the effect of mercury chloride on the heat test. From his point of view it was immaterial whether the mercury existed in the cordite in sufficient quantities to prolong the heat test. The question which he had to consider was this—Under these circumstances, did the acetone, one of the ingredients, comply with the detailed specification for acetone? In his Lordship's opinion the cordite was not in accordance with the specification because it was made with acetone which was not in accordance with its specification. Even if this were not so, the question remained whether the cordite complied with the specification in clause 7, viz., that it must fulfil the tests specified.

Even assuming that the acetone and the mercuric chloride were two different substances, still the mercuric chloride would be a material used in the manufacture. He could not conceive how it could be said that a distinct substance put in to produce a distinct result was not a material used in the manufacture. He thought that in all probability the War Office were entitled to say, " This mercuric chloride does affect the heat test, and we are not certain how much does affect the test, and there is no method for ascertaining the exact quantity actually present, and we are not going to be put to the trouble and expense of carrying out experiments to find out." In fact, no such method did exist until the one was invented which had been explained in Court. He thought the War Office was right in saying that they declined to make long experiments to ascertain the quantity present, and were justified in saying that they would have none at all, and in rejecting the deliveries. He did not think that the possibility of mercuric chloride being unavoidably present affected the question at all. If Kynoch's had taken up the position that they were perfectly ready to supply other cordite a different question with regard to purchasing elsewhere might have arisen. But their position was that they would not supply any, and he did not think that their allegation that they were ready and willing to do so was proved. Therefore he did not think there was anything in the contract to deprive the War Office of their right to buy cordite in the best way they could to supply the place of that rejected. On the whole he had come to the conclusion that the facts did not justify the application of the powers reserved by Clause 6 as quoted above. This dealt with non-delivery and Clause 2 with wrong delivery. If, for example, a lot were delivered on January 1st the War Office need not decide until some time in March, so that Kynoch's could not possibly replace the wrong January delivery within the same month. He thought that Clause 6 did not apply to this case, and that, therefore, the War Office was not entitled to set up this claim in deduction of the suppliant's claim. He did not think it made any difference, except perhaps as to costs, as the Crown got the relief claimed under the information. The proper judgment was for the suppliants on the claim with costs up to the admission of liability, and judgment for the Crown on the information for the amount of damages claimed; and as the contest was chiefly on matters in which the Crown was successful, it was to have the costs after the time of the admission of liability. A stay of execution was granted with a view to appeal.

AMERICAN TESTS OF REVOLVERS AND AUTOMATIC PISTOLS.

The American Government has always been noted for the masterly reports which the officers of the army have been in the habit of compiling when called upon to examine any new arm or item of equipment. This is not to say that our own officers are less expert on the journalistic side of their profession, but the fact remains that the American reports are published and make extremely interesting reading, whilst our own Government seizes every excuse for withholding from circulation documents which there is no justification for regarding as secret.

Among the 1907 reports coming from America is one by the Chief of Ordnance which contains a record of the experiments and recommendations of a committee of officers which was appointed to examine various types of revolver and automatic pistol, with a view to deciding which is best suited for military service, and whether the selected model shows sufficient advance on the ·38 revolver to justify its adoption. The letter of instruction was dated December 28, 1906, the first meeting was held on January 15, 1907, and in due course various revolvers and automatic pistols were exhaustively tested. Their relative merits and demerits were duly tabulated, and the following definite recommendation of the automatic system was put forward in the month of May :—" The advantages of the automatic pistol and the disadvantages of the double-action revolver are deemed by the board of such importance that it desires to state its conviction that the principle of the automatic hand firearm should be adopted for the military service, and that the adoption of a specific arm should be contingent only upon the question of whether it is mechanically satisfactory in service." The calibre ·45 was finally accepted as best suited for military purposes, and arrangements were rapidly put in hand for securing a trial lot of automatic pistols of this calibre, the same to be practically employed by selected units for exactly the same service that would be given to the existing revolvers. Special stress was, however, laid on the far greater scientific value of the tests conducted by the committee, as compared with the reports of commanding officers as a result of the pistols being used under what is described as garrison conditions.

APPLICATIONS FOR PATENTS.

NOVEMBER 16—DECEMBER 12, 1908.

24,554.	Backsights for Small Arms. Birmingham Small Arms Co., Ld., and G. Norman.
24,563.	Double Barrel Small Arms. A. B. Williams & Co., Ld., and J. Rawlings.
24,573.	Igniting and Explosive Compositions. J. E. Gillon.
24,657.	Sights. W. S. Freeman.
24,720.*	Report Silencer for Guns. W. Kristandt.
24,875.*	Automatic Pistols. H. Rosier.
24,905.	Adjusting Small-Arm Sights for Windage. J. C. Walker.
24,912.	Field Firing on Surprise Targets. R. T. Gates.
24,953.	Rifle Sight Mountings. L. R. and J. Tippins
25,052.	Explosives. M. B. Lloyd and Curtis's & Harvey, Ld.
25,078.	Rifle Sight. R. J. Kirwan.
25,094.	Rifles. T. R. R. Ashton.
25,116.	Firearms. H. W. Gabbett-Fairfax.
25,222.	Attaching Stocks of Small Arms. R. Wake.
25,269.	Lessening Sound of Discharge. H. P. Maxim.
25,358.	Automatic Target. P. J. McGinn.
25,393.*	Sights. Fried Krupp.
25,406.	Controlling Gun Turrets. A. F. Petch.
25,432.*	Greasing Ammunition. R. Frommer.
25,487.	Machine Guns. E. Jones & Kynoch Ld.
25,527.	Targets. J. Paterson and J. T. Musgrave.
25,633.	Bullets. T. Noble.

25,894. Small Arms. W. C. F. Cook.
25,913. Windgauge Backsight. F. Cantelo.
25,924. Range Finders. G. Forbes.
25,966.* Shooting Gallery Targets. C. B. Winder.
25,975. Small Arm Backsights. L. G. Proctor.
25,980. Safety Mechanism of Automatic Small Arms. W. J. Whiting.
26,059. Target Practice Apparatus. F. Mitchell.
26,062. Air-Pistols. F. S. Eves.
26,077. Air-Guns. R. B. Gilbert.
26,112. Ejector for Firearms. D. W. Wilson and G. F. Whitby.
26,158. Ordnance Sighting Apparatus. A. T. Dawson and G. T. Buckham.
26,187. Bolt Rifle Backsights. R. E. Fenby and A. T. C. Hale.
26,395. Rifle Sight Mountings. L. R. Tippins.
26,579. Ammunition Loading Apparatus. A. T. Dawson and J. Horne.
26,582.* Rifle Breech Action. W. Fairweather.
26,653. Rifle Backsight. F. Cantelo.
26,670. Rifle Sights. J. E. Martin.
26,679.* Projectiles. Fried Krupp.
26,791. Backsight. H. J. Harriss.
26,943. Breech-Loading Small Arms. H. W. Holland and T. Woodward.
27,003. Elbow Pad for Shooting. N. H. Nixon.
27,004.* Ordnance Sighting Apparatus. Fried Krupp.
27,028.* Machine Guns. W. J. Teufel.
27,039. Rifles. T. R. R. Ashton.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

NOVEMBER 26—DECEMBER 17, 1908.

COMPILED BY HENRY TARRANT.

17,835 (1907). **Shrapnel Shell.** G. G. M. Hardingham, London. (Agent for *P. K. Georgiev, St. Petersburg*). A large number of bullets or projectiles are confined in two compartments running parallel with the axis of the shell whose cross section is oblong or oblong-ovate. The bursting charge is so confined that when it explodes the pressure of gases tends to drive the shrapnel elements outward at right angles to the axis of the shell. Accepted November 6, 1908.

25,191 (1907). **Firing Naval Ordnance.** Capt. O. Runge, Berlin. The improved devices described in this patent are designed to bring about the automatic discharge of naval ordnance at the moment when the ship in its rolling returns to the position in which the gun is directed correctly to the target. A combined pendulum and gyroscope is made use of, the rotating swinging mass being arranged on a universally suspended bar-like body which carries the firing contact. Accepted Nov. 13, 1908.

25,395 (1907). **Automatic Rifle Mechanism.** Sir C. H. A. F. L. Ross, Bt., Ross-shire. (*See Selected Patents*).

26,141 (1907). **Range Keepers for Ordnance.** Lt. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. In patent No. 9,461, 1904, these inventors described a range keeper, *i.e.*, an automatic indicator of the change of range between a moving target and the gun, in which a clockwork driven disc conveyed movement to the roller for actuating the range indicator. To prevent slipping between the rotary disc and the friction roller a " true couple drive " is now instituted by introducing a pair of discs which are forced by springs against the friction roller lying between them and which revolve at equal velocities in opposite directions. Accepted November 19, 1908.

26,491 (1907). **Spring Guns.** D. Marshall, Cheltenham. This patent relates to a method of cocking the spring in toy guns. A lever is fulcrumed behind the trigger and is pulled backwards to compress the spring. Accepted Nov. 26, 1908.

3,078 (1908). **Dismountable Ordnance.** Lt. A. T. Dawson, and G. T. Buckham, London. Several methods are in existence for attaching ordnance, having a buffer cylinder for checking recoil and returning the gun, to the buffer piston rod. The patentees describe the combination of a handle with a pivoted safety catch which operate together to prevent the gun being closed or opened should the connection of barrel and piston rod not be secure. Accepted November 12, 1908.

3,102 (1908). **Rifle Aiming Apparatus.** A. M. Faulkner, York. A tube containing an electric lamp is attached to the under side of a rifle so that a spot of light is thrown on to the target at the place where the bullet would strike. The pulling of the trigger closes the circuit. Accepted November 12, 1908.

5,211 (1908). **Firing Mechanism of Ordnance.** Lt. A. T. Dawson and G. T. Buckham, London. The type of ordnance which has a swinging carrier and a vent sealing tube or primer is dealt with in this specification. Means are provided for preventing the tube retainer from being displaced by the shock of slamming the breech home. They consist of a floating stud on the breech screw co-operating with a lever on the carrier. Accepted November 12, 1908.

9,067 (1908). **Bayonet Attachments for Rifles.** W. O. Barnes, Quebec. Bayonet joints of the usual type are modified to allow the bayonet to be fixed very quickly and to allow for the taking up of looseness due to variations in manufacture or wear. When making the first connection between the top of the bayonet grip and the projection below the barrel a little latitude is allowed so that the front joint between ring and barrel may easily be made. Accepted November 26, 1908.

10,129 (1908). **Preventing Spontaneous Combustion of Nitrated Explosives.** J. C. E. Bouchaud-Praceig, Paris. (*See Selected Patents*).

10,947 (1908). **Ramming Apparatus for Ordnance.** E. Schneider, France. A reciprocating ramming rod is fitted up with a series of hinged tappets adapted to engage successively with the projectile, and the powder charges. The rod is pushed forward by means of projections on an endless chain and is forced back again by a spring. The rod is guided in the walls of the loading tray. Accepted Nov, 12, 1908.

10,965 (1908). **Indicating Decomposition in Explosives.** J. E. Bouchaud-Praceig, Paris. (*See Selected Patents*).

12,188 (1908). **Elimination of Flash on Discharge.** The Anglo-French F. & S. Co., Ld., and Lieut.-Gen. Sir J. B. Edwards, London. (*See Selected Patents*).

13,180 (1908). **Transport Vehicles for Ordnance.** Fried. Krupp, Germany. To enable travelling ordnance to be loaded quickly on to a speedy waggon such as an automotobile, a special vehicle is constructed. It is provided with beams which in one position form ramps for the gun and its carriage to be run up on to the vehicle and in another position they serve to secure the gun in place on the vehicle. Accepted Nov. 12, 1908.

12,843 (1908). **Preventing Erosion in Ordnance.** B. C. Winslow, U.S.A. (*See Selected Patents.*)

13,538 (1908). **Automatic Small Bore Ordnance.** Lt. A. T. Dawson, London. (Agent for *Deutsche Waffen und M.F. Berlin*). The point of connection of the fuzee chain with the fuzee in a Maxim gun is made capable of movement relatively to the fuzee during the working of the gun. During recoil the rate of stretching of the fuzee spring is diminished and its resistance reduced so that the opening of the breech is hastened. During the return, the fuzee spring causes the barrel to outrun the lock and to reach the firing position before the lock closes the breech. Accepted November 5, 1908.

13,546 (1908). **Line Carrying Projectiles.** Lt. Col. W. T. Unge, Stockholm. A cable is attached to a projectile, capable of rotation, by means of a loose ring which abuts against a flange on the rear part of the projectile. A swivel is mounted between the free ring and the line. Escaping hot gas cannot destroy the connection of ring and life line. Accepted November 12, 1908.

14,310 (1908). **Lessening the Sound of Discharge.** H. S. Maxim, U.S.A. (*See Selected Patents*).

16,079 (1908). **Time Fuses for Ordnance.** W. Fritsch, Austria. At the cocking of the striker of ordnance an adjusting piece is turned. The rotation of this piece adjusts the setting disc of the fuse arranged in the base of the loaded shell. The amount of rotation corresponds to the desired range and is determined by a timing scale, and, of course, by the regulation of the stroke of the striker. Accepted November 12, 1908.

16,370 (1908). **Machine Guns.** Lt. A. T. Dawson, London, (Agent for *The Deutsche Waffen und M.F., Berlin*). The hinged handle block of rifle calibre machine guns and the trigger lever and sliding trigger bar are combined with a device for connecting the trigger to the lever so that the handle block can be moved about its hinge into the open and closed positions without disconnecting the trigger bar from the lever. Accepted November 5, 1908.

16,495 (1908). **Barrel Recoil Ordnance.** Fried. Krupp, A.-G., Germany. In barrel recoil ordnance with an upper carriage capable of being swung relatively to an under carriage the slide carrier is arranged so that it can be coupled to the upper carriage independently of the elevating gear and the upper carriage can be coupled to the under carriage independently of the traversing gear. The weight is by these means taken off both laying gears. The patentees state that they are aware of Patent No. 10,015, 1905. Accepted November 12, 1908.

19,269 (1908). **Range Finders.** A. W. Erdman, U.S.A. This invention aims to improve the construction of tangent screw range finders in which the angular adjustment given to a vertically tilting telescope in finding the range is caused to affect a corresponding actuation of a range scale. The instrument is adapted for measuring from various altitudes and to compensate automatically variations in effect of the earth's curvature and for abnormal atmospheric refractions.

SELECTED PATENTS.

INDICATING DECOMPOSITION IN EXPLOSIVES.

10,965 (1908). J. C. E. Bouchand-Praceig, Paris. In order to prevent the accidental explosion of charges used in big guns, it is proposed to provide an indicator with each charge. This indicator consists of a tube or bulb of glass (similar to an ordinary test tube) filled with a porous granulated material such as sawdust, treated with a colouring matter like litmus or certain aniline dyes which undergo a change of colour when exposed to nitrous fumes. These observation bulbs communicate with the atmosphere at one end and at the other by means of a small metallic tube with the explosive containing chamber. The patent described above also deals with this subject. Accepted November 19, 1908.

ELIMINATION OF FLASH ON DISCHARGE.

12,188 (1908). Anglo-French F. & S., Ld., and Lieut.-Gen. Sir J. B. Edwards, K.C.M.G., London. The object of the patentees is to produce an ordnance explosive charge with a nitroglycerine basis, and to combine mechanical and chemical means to obtain both regularity of combustion and an absence of flashes. In the patentee's words :—Whatever the ingredients used in the manufacture to form the explosive there are added in the course of manufacture non-nitrate products which, during the combustion, act as a sure preventative of the production of flame ; it has long been suggested that this result can be obtained by adding alkaline salts to the explosive in paste form, but these salts have an undesirable tendency to decompose under the influence of hygrometric variations and to become deliquescent inside the substance of the explosive itself in which they have been embodied and consequently to bring about the more or less rapid and more or less dangerous decomposition of the explosive itself.

" It became necessary therefore, to find a means of giving stability, as it were, to these alkaline salts and the following composition has been arrived at :—Beeswax, 5%, bicarbonate of soda, 2%, benzine, 5%.

" Beeswax plays its part as a stabilizer very effectively, inasmuch as the particles of wax during the rolling enwrap as it were the particles of alkaline salts which are thus protected from the air and which only enter into action when liberated by the deflagration of the explosives. Also the density of the charge is reduced. We are aware that wax and bicarbonates have previously been employed in explosives of a similar nature."

The benzine in decomposing sets free hydrogen which combines with oxygen of the air, forms watery vapour and so has a great bearing on the extinction of the flash. The paste is subjected to the shaping process described in patent No. 24,025, 1907. Accepted November 19, 1908.

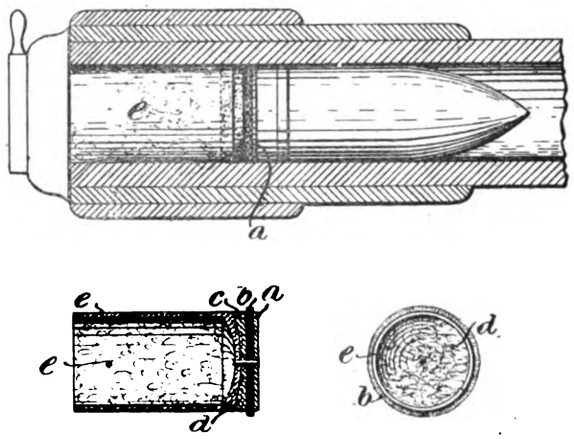
PREVENTING SPONTANEOUS COMBUSTION OF NITRATED EXPLOSIVES.

10,129 (1908). J. C. E. Bonchaud-Praceig, Paris. The recent catastrophies on certain men-of-war have prompted the patentee to invent the method described of stopping spontaneous combustion of such explosive charges as are used for propelling projectiles. He fully describes the reaction which occurs in decomposing explosives and lays himself out to stop the gradual increase of heat which finally explodes the mass. In getting at this end decomposition is held up.

The patented process consists in surrounding or packing the explosive with a porous and permeable matter so as to fill every possible interstice and absorb any heat evolved within the explosive and more especially to neutralize any acid fumes as soon as they appear. Suitable matters for this purpose in their order of merit are as follows :—bicarbonates, sesqui-carbonates and carbonates of alkalies in a crystalline state. These normally hold some water and they evolve " extinguishing " gases when contacted with nitrous fumes. It is advantageous to mix such protecting substances with moss, sawdust, wood fibre, or paper pulp. The wood of the storing boxes might also be impregnated. A colouring matter may also be incorporated with this safety filling matter so that visual indication is given immediately decomposition sets in, the action of acid fumes changing the colour of such as litmus, certain aniline dyes, etc. Accepted November 19, 1908.

PREVENTING EROSION IN ORDNANCE.

12,843 (1908). B. C. Winslow, U.S.A. This invention has application to big guns and is intended as a medium to prevent erosion of the bore and thus increase the life of these pieces. The explosive charge is placed inside a " thimble " of nonconducting lubricating material such as a combination of graphite and borax whilst to the head of this thimble is attached a pad of asbestos containing a lubricant composition such as graphite and tallow, and copper discs larger in diameter than the bore.



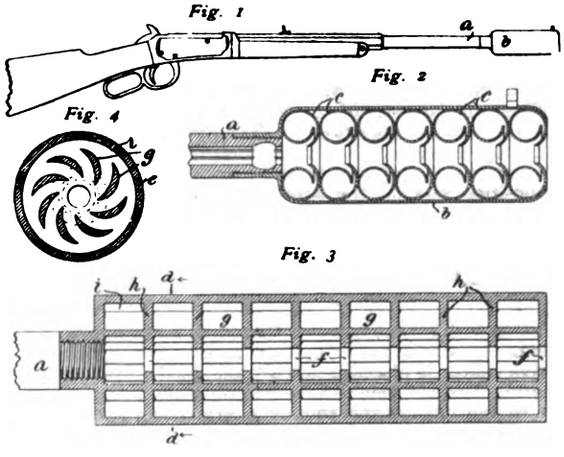
The drawings illustrating this short description show how this gas check and lubricator is built up and arranged in the gun, immediately behind the projectile. The plate *a* of copper ·125in. to ·25in. thick forms the base on which is arranged several copper fringe discs *b* larger in diameter than either the base plate or the bore and about as thick as the former. At the back of these metal elements the pad *c* is fixed. It is formed of tightly compacted fibrous asbestos 85%, graphite 10%, and tallow or paraffin wax, 5%. A second composition pad *a* backing the pad *b* is composed of graphite 80%, borax, 15%, and tallow or paraffin wax, 5% on a ground of silk. These pads are about one to three inches in thickness and of about the same diameter as the bore of the gun. The second pad is extended in thimble form *e* rearwards to accommodate the powder charge.

The arrangement of the whole device, riveted together as at *f* is illustrated as it is put into the gun. It is claimed that the built up head forms a perfect gas check, that the bore is well lubricated and that the chamber is efficiently protected by the thimble in which the charge is burnt. Accepted November 19, 1908.

LESSENING THE SOUND OF DISCHARGE.

14,310 (1908). H. P. Maxim, U.S.A. The following verbatim reproduction from this specification fully describes the scope of the invention :—" Various attempts have been made heretofore to render noiseless the discharge of firearms by preventing the sudden release of the powder gases at the muzzle of the firearm. An example of this is shewn in Specification No. 6701 of 1899.

" In the present invention it has been discovered that the noise of the discharge of the firearm can be entirely overcome if the gases, following the projectile, are made to dissipate their energy by being given a rotary or whirling movement in a suitable chamber, the velocity being so great that the gases are held by centrifugal action against the circumferential wall of the chamber until by friction against such wall the velocity is gradually re-



tarded and the gases are permitted to escape gradually through an axial or substantially axial opening. Such movement of the rotation of the body of the gas may take place about an axis coincident with the axis of the bore of the firearm or otherwise, and while theoretically the entire body of the gases of a single discharge might receive the desired rotary or whirling movement in a single chamber, practically, on account of the considerable size which a single chamber would necessarily have, it is desirable to provide a succession of chambers among which the gases of a single discharge are distributed and from one to another of which the gases may pass in succession as their velocity is successively reduced, the direction of movement of the gases being preferably reversed in the passage from one chamber to the next and an oscillation of the gases being thus produced, whereby their energy is the more quickly dissipated. Such chambers, moreover, might be made to communicate with the bore of the firearm at different points along its length, but are preferably located at the true muzzle of the firearm, that is, at the point where the projectile has already received its maximum impetus, and constitute an extension of the barrel."

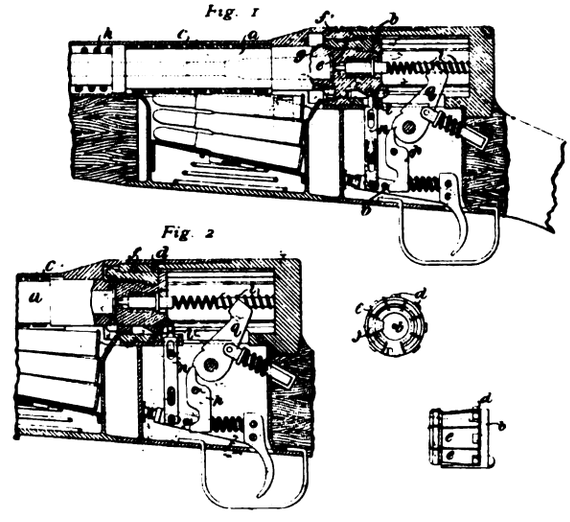
The illustration accompanying this description should be referred to. At the muzzle end of the rifle barrel *a* (Fig. 1) is fitted the casing *b* which is substantially circular in cross section. Inside the casing (Fig. 2) the series of annular cells *c* are arranged. The narrow openings of each cell are as is shown directed towards the breech of the rifle so that when the bullet passes through the longitudinal opening in the casing *d* the gases which follow it expand or diverge into the cells *c* through the narrow openings. A whirling movement is given to the gases and their velocity is stated to be gradually decreased until their energy is dissipated. The rotary movement gradually ceases and the gases find their way out of the casing into the open air. The number of cells can of course be varied with the character of the firearm to which the casing is to be attached, and in order to keep the length of the casing down as low as possible the chamber *f* might be formed near the muzzle of the barrel to influence a more rapid divergence of the gases.

Another " silencer " is illustrated in Figs. 3 and 4, the latter representing a section of the device on the lines *d–d*. The interior of the casing *e* is divided up by the partitions *h* which have the axial hole *f* for the passage of the bullet. A series of turbine-like fixed blades *g* are arranged in each chamber between the partitions *h*. These terminate before they reach the casing *g* so that the annular space *i* is left. The gases of combustion enter the various chambers after the bullet has left and are given a strong rotary movement around the casing in the space *i* by the vanes *g*. Friction overcomes their energy and they escape quietly from the casing. Accepted November 5, 1908.

AUTOMATIC RIFLE MECHANISM.

25,395 (1907). Sir C. H. A. F. L. Ross, Bt., Ross-shire. The patentee has designed an automatic rifle which contrary to custom contains what he calls a short breech " plug " instead of the usual long reciprocating breech bolt. The body is to a great extent eliminated and weight and bulk so reduced. A heavy coil spring stores up the energy of recoil and forces the barrel, still locked to the breech plug, forward after its backward travel following the discharge. The forward movement is continued beyond the normal position of the barrel, a second and lighter spring taking up the momentum of the moving barrel so as to return it and lock it to the breech which has meantime been unlocked and left behind.

The illustrations reproduced are necessarily a small selection only of those which appear in the specification, but it is hoped that they will be sufficient to enable the reader to obtain an idea of the principal of construction and the working of the component parts of this automatic rifle.



It must be assumed that the parts are in the position shown in Fig. 1, and that both the barrel and magazine are loaded. When the trigger is pulled and the cartridge discharged the recoil drives the barrel *a* and the breech plug *b* backwards against the resistance of the heavy spring *c*. The breech and barrel are returned together when this spring gives out its stored up energy. When the barrel and breech have reached a position a little forward of the normal the projections *d* on the cocking dogs *e* impinge against the cam ring *f*, so opening the dogs and disengaging the barrel and breech locking teeth *g* (Fig. 2). The barrel, free from the breech, continues its forward movement until the lighter spring *h* arrests it and returns it to the breech plug *b*. Meantime the latter has been held in its forward position by the springs *i*, and the spent cartridge has been pulled out of the barrel by the extractor *j* and ejected from the arm. In arresting the forward movement of the barrel the light spring *h* acquires some energy which is given out in returning the barrel to the breech plug, a fresh cartridge being picked up from the magazine during this movement. The breech and barrel come together, the breech is forced back to its normal position, and the cam ring *f* forces the dogs *e* down into locking engagement again with the teeth. The dogs *e* entirely surround the barrel except where the extractor interrupts. During the reciprocating movement the incline *l* acts upon the " safety plunger " *n* in such a way that the pin *o* through which the sear *p* is moved out of the bent on the hammer *q* when the trigger is pulled, is shifted into a safety position (Fig. 2) so that the sear cannot be operated. When the parts resume the normal positions the pin is dropped again into engagement with the sear toe. Accepted November 16, 1908.

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CONTENTS.

CURRENT TOPICS.

War Office Text Books. — Suggestions for improving War Office administration are unpopular at the present time, because improvements as a rule cost money, at any rate in the initial stages. To discuss desirable changes is a more innocuous proceeding, and it may, therefore, not be out of place to emphasise the very great need that exists for placing the preparation and issue of War Office text books under the control of a permanent department. Practically speaking the next edition of a book needs to be kept in consideration commencing with the day when the current edition is published. Such hints as can be obtained from reviews and correspondence would then be properly recorded and filed. Information concerning fresh developments in the subject matter treated should be garnered, the progress of sales should be carefully watched, and at the right moment the next edition should be put in hand. No permanent staff could undertake the whole of the duties of authorship, but a War Office publication is more essentially a question of editing than original writing. However competent the officer or professor may be, who is charged with the preparation of a new edition of one of the handbooks, the drudgery of editorship is not a proper burden to place on his unaccustomed shoulders. The editing of text books, and their preparation for the press, is an expert trade of itself, for which the civilian staff at the War Office is far more competent than the technical officers who make a hobby of authorship. The historical case of the officer who put through a 300-page text book and received a fee of £50, with income tax deducted, emphasises the wrong spirit in which literary labours are estimated. At the present moment the *Text Book of Small Arms*, 1904 edition, is sadly in need of revision. The trajectory tables are wholly based on the blunt-nose form of bullet, and all the fallacies associated therewith remain uncontradicted. The old Metford table of angles, with its out-of-date foundations, remains there with its stupid assertion that to construct a consistent curve it is absolutely necessary to give seven places of decimals of a minute of angle. The explosives handbook, 1907 edition, is also full of anomalies. On page 99 there is for instance the statement that the composition of cordite for small arms and for all natures of ordnance is the same, a blunder which is further corroborated by a much displayed comparative statement of the composition of "cordites," containing for M.D. cordite the same ingredients and the same proportions as for ordinary cordite. In the appendix a good deal of information is given concerning stability tests, but the student is not assisted in distinguishing between two alternative forms of apparatus by the interchanging of the illustrations, whereby the description of A is illustrated by B and *vice versa*. Skilled editing is an absolute necessity for books of this description, and the extra sales would no doubt help pay for the extra cost involved in doing the work properly. The young officer in search of sound technical information should not be hindered by unfair obstacles.

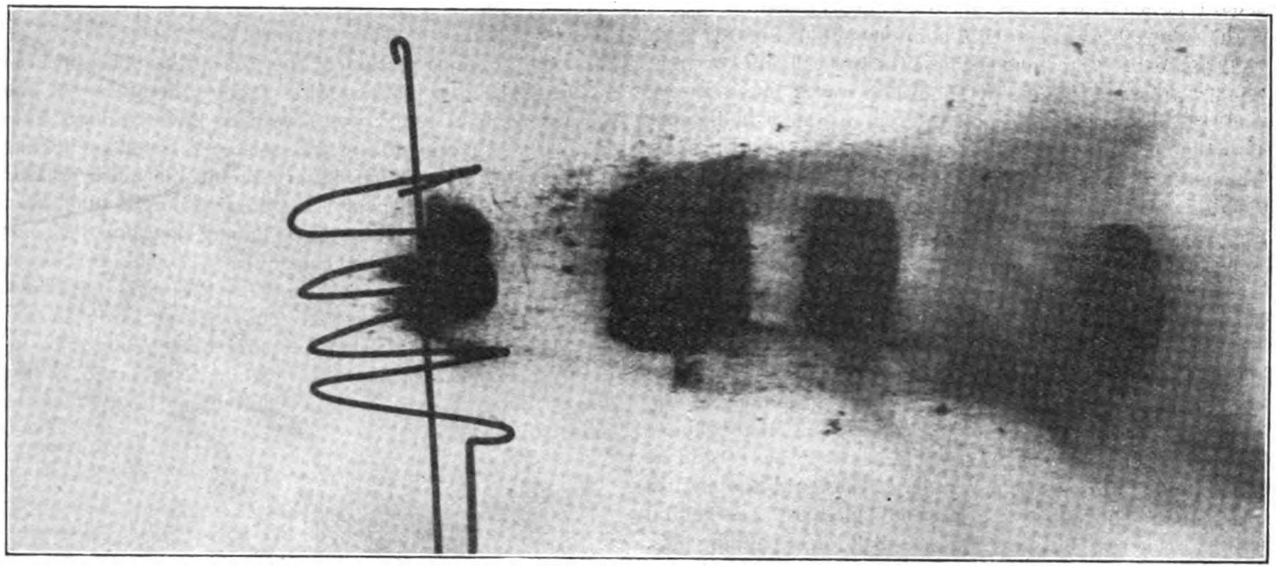
Notes on Dynamics.—That a War Office publication is capable of great success as a piece of book work is proved when the author is a sufficiently gifted individual to combine knowledge of the subject with power of expression, and a general power of editorship. This somewhat exceptional

praise can certainly be accorded to Sir G. Greenhill for his lately issued second edition of *Notes on Dynamics*. The usual reproach against the writing of great mathematicians is that they disdain the familiar illustration, seeking only to make themselves understood by those conversant with the special language and mode of thought associated with abstruse science. The result is to repel outside enquirers, and, therefore, to widen the breach between scientific accuracy of thought and the rough and ready approximations of the ordinary mortal. Sir G. Greenhill, on the other hand, writes more in the manner of a lecture to young gunmakers than as one who having gone far himself, assumes that others are equally keen of perception. The special merit of Sir G. Greenhill's simplicity is that he has schooled himself to write clearly on subjects which have been familiar to him since boyhood, which is a far more difficult task than to teach others the lesson which has only just been learnt, and, therefore, of which the difficulties of comprehension are still fresh in mind. Even though these *Notes on Dynamics* contain an immense and wondrous assortment of mathematical formulæ, which it is positively necessary for the student to analyse, there is also for the student of ballistics a large amount of special information which could not in ordinary circumstances come within the purview of writers on dynamics. Altogether the book constitutes an interesting monument of personal labour, such as is given to very few to achieve.

Foreign ·22 Ammunition.—The constant complaints by the newspaper press at the immense purchases by rifle clubs of Rheinisch ·22 cartridges is justifiable on the grounds that so important an article of consumption should be supplied by the home manufacturer. The accounts are not clear as to whether the foreigner's business has been achieved by good quality or cheap prices. The accuracy of the R. ammunition is certainly very high, and the makers of it must have worked very hard to overcome the well-known difficulties of manufacture. On the other hand it is possible to paraphrase all these favourable comments in the case of the King's Norton Metal Company, whose ·22 cartridges afford extraordinary evidence of the success of British manufacture when a difficult task is vigorously undertaken. Years ago the U.M.C. Company held almost undisputed possession of the trade in ·22 cartridges, when most of the British consumption was short length cases for promiscuous shooting by boys and others. Rifle clubs introduced a new standard of demand which smokeless powder in the long cartridge alone fulfilled. Then followed the struggle which still goes on, a struggle where wholesale selling prices seem to be the most important factor. The general sentiment that British goods should if possible be used does not dominate the decisions actually arrived at, the fight turning upon the combined issues of price and efficiency. Each side can produce evidence of notable achievements, and there is the further element of other firms whose manufactures are daily approaching closer and closer to the very high standard which the specialist in miniature rifles has set up. The shooter is consistently fickle in his patronage. He deals with the firm who for the time being best serves his purpose, and cheap as is the price which he pays for his ammunition there are a good many people who live out of the small margin of profit which selling prices allow. Primarily there are the outgoings of the shooting organisations and the rifle clubs, and the cartridge seems to provide a suitable basis for a kind of capitation fee, out of which expenses are met. The general tendency is to collect this tax from the producer, and of course the amount that can be squeezed out of the price paid for one hundred of the best cartridges, is not considerable. Manufacturers must live notwithstanding arguments to the contrary.

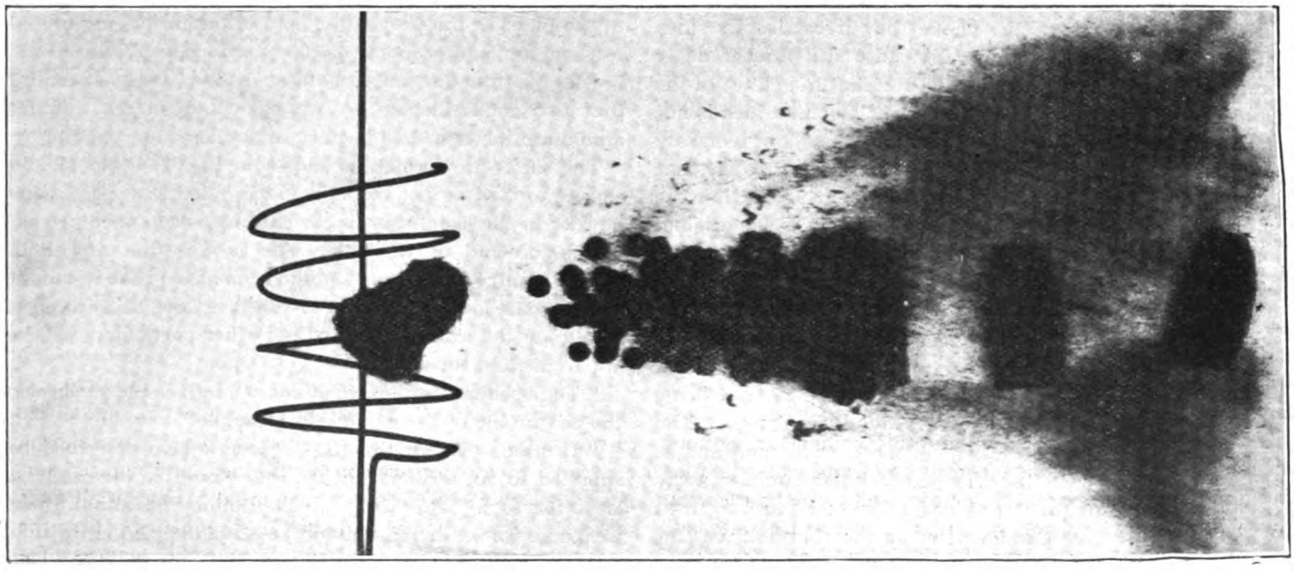
Continental Demand for English Guns.—As time goes on the special position of the English maker of high class double-barrel sporting guns becomes increasingly emphasised. The competition of the typical machine-made edition of a double-barrelled gun shows more clearly than ever that the tastes of the rich sportsman are not successfully satisfied by the output of a factory. The handworker in guns can show a useful result for the extra price of his labour in the form of smooth working and fine handling properties. The gap may be narrowed by the extension of machine processes, but taking things as they stand competition with the higher grades is not very severe, because the machine factory necessarily limits its efforts to the grades for which there is a large demand. A correspondent has recently forwarded to this office an interesting statement of the position as regards Germany. He points out that it is not the cheap English gun which will find a sale in that country, since they can make that grade quite as well as the English article. It is the first-class hand-finished gun for which it is considered that an increasing sale will be found. Just what grade is meant is not clear, but the general truth seems obvious enough that according to the class of buyer the English style is likely to meet with appreciation—the very best gun for the best class of customers, and others in their respective grades, the same as happens in this country. In Germany, shooting is said to be a much more generally followed sport than in England, and the German is a thorough sportsman in the high appreciation and regard in which he holds his gun or rifle. These men have an eye for a good gun, and it is amongst such as they that the London and Birmingham maker has already found a remedy for the lack of home demand which set in about seven years ago. It is the custom throughout the Continent to carry a gun much in the manner of a walking stick, occasional shots in the course of a ramble supplementing the more serious kind of day which represents almost the exclusive form which shooting takes in this country. In other words the proportion of odd days is much greater on the Continent than here in England, and this use of a gun is specially provided for by the fitting of sling swivels on the butt and half-way down the under rib of the barrels. A colonial, to whom such a gun was shown, expressed great appreciation of the idea, and evinced surprise that swivels were not a recognised fitting on all guns sent out to the Colonies and such like countries, where the distances tramped are considerable and the chances of a shot few and far between.

SOME FURTHER SHOT PHOTOGRAPHS.



EMERGENCE OF A CHARGE OF NO. 4 SHOT FROM A CYLINDER BARREL.

IN continuation of the series of photographs of shot charges emerging from the muzzle of a sporting gun, two more examples are given this month which differ from those shown in the previous issue solely as regards the size of shot used for loading the cartridges. No reference to this point was made in connection with the photographs then published, but the size depicted was No. 6, whereas the present pictures show how slight is the difference of arrangement when the larger No. 4 size is used. The representations are of course new in one other important respect, viz. the very obvious one that they refer to different rounds, and, therefore, show the kind of variation which may exist between the behaviour of one cartridge and another when the important conditions are practically identical. In both instances a better picture has been obtained, in that more of the rear disturbance has been brought into the area of view. The choke picture is especially interesting as showing two forces acting in opposition. The streaky horizontal arrangement of the material such as paper fragments and so forth suggest the forward movement of the ejected materials now carrying on by their own momentum, and the curly waves of smoke pressing forward from the rear, suggest the expanding globe of gas which assumes a ball or mushroom shaped formation as a result of its expansion



EMERGENCE OF A CHARGE OF NO. 4 SHOT FROM A CHOKE BORE.

the moment it gets clear of the muzzle. The shot has a muzzle velocity of about 1300 f.s. as against 1100 f.s. for sound. The sound wave is, therefore, in contact so to speak with the charge until a point some 8 or 9 yards from the muzzle has been reached where the two velocities become equal. Beyond that point the sound waves move ahead, and in due course a noticeable interval of time would elapse between the sound of discharge and the arrival of the shot. The gases coming up behind the shot have a velocity which for calculation purposes is computed to have a mean value of 1700 f.s. in the case of E.C. powder with which these experiments were made. In the cylinder picture the tailing out of the wads is just as marked as with the choke gun. Therefore it seems reasonable to suppose that whatever may be the penetrative capacity of the gas blast the present pictures are taken so far forward of the muzzle that they only suggest the existence of this disturbing element at the extreme rear. The expanded diameter of the cylinder charge presents evidence of the forces that have been at work, but at this particular stage of the flight the greater mass of the shot and wads has enabled it to leave behind the more active but less massive ball of expanding gas. Mr. Tarrant, whose interest in gunnery is shown by the careful attention with which each month's patents are digested has put forward the following alternative theory to account for the marked differences between the cylinder and choke pictures

" When the over-shot wad leaves the barrel, the shot and wads follow in the ordinary way, with the exception that the field and felt wads are held by the choke so that they cannot follow so quickly as they can from a cylinder bore barrel. This momentary check holds the gas back until the shot has got, more or less, clear away."

The idea is that the shot charge can jump the choke by virtue of its considerable momentum, but that the wads with their less weight encounter a resistance in excess of the gas pressure acting from behind. This explanation does not deny that delay or rather loss of velocity occurs when the shot passes the choke, but it carries the idea further by saying that the wads cause still further delay and are the real means of allowing the shot to get out of the muzzle undisturbed by back pressure. Such an idea is not inconsistent with what the photographs show, but it hardly fits in with the known power of the muzzle gases to say that they can be held back as by a closed door during the time the shot is travelling a distance of several inches. The original suggestion was that the delay due to the charge passing the choke causes the gases to pile up in a kind of ball, the high density producing a rearward tendency of movement, the net result being that time is occupied whilst the gases are re-establishing their forward motion. This minute check enables the charge to get clear of the muzzle without being wedged into the shape shown in the cylinder picture. The large diameter must be taken as more than mere shape, that is to say it provides evidence of lateral motion away from the line of flight. The lateral spread must occur at practically the precise moment when the charge leaves the barrel. Recess choke produces the same effects as ordinary choke, and a complete theory must take both forms into reckoning.

II.—THE PIONEER OF POINTED PROJECTILES.

IN the previous section of this reprint, which appeared in the December issue, Major Jacob's discovery of the pointed form of bullet was shown to have resulted from exhaustive experiments of air resistance based on testing the angle of elevation necessary to hit the mark at long ranges. At the point where the break occurred the author was referring to percussion shells having the same design as No. 6 in Plate 1. He then continued :—" These percussion rifle shells, No. 7, Plate 1, constitute the *most formidable missile ever invented by man*. They are perfectly simple, and safe in use ; and when properly made, cannot be injured by time, weather, etc. ; while they range to the longest distance, with accuracy quite equal to that of the solid balls.

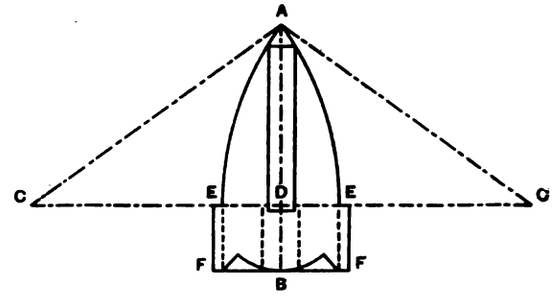


Plate I. No. 7. Rifle Shell formed exactly as Ball No. 6, Plate I., but cast with a deep hole at the smaller end in which is fixed a copper tube filled with detonating powder.

The great reduction of the resistance of the air to projectiles of this shape, enables us, with the usual initial velocity, to reduce the elevation required for long ranges so much, that the ground between the rifleman and his mark becomes no longer so safe by reason of the high curve of the flight of the projectile ; and errors in judging of distance become, in proportion, of less serious importance.

Judging from our practice at Jacobabad, it seems certain, that two good riflemen so armed, could, in ten minutes annihilate the best field battery of artillery now existing.

The shells are formed as shown in Fig. 1, Plate II. ; a copper tube of proper size and shape, filled with percussion powder in the usual way, is thrust into a deep opening cast in the fore-end of the ball. The tube is first dipped in melted resin, " kitt," or such like cement, so that it cannot ever become loose ; the ramrod-end is hollow, so as to press wholly on the lead in loading ; all other particulars will be apparent from the figure.

" The peculiar form of the hinder end gives the shells also the advantage of the expansion principle.

" It seems evident that if the arms above described be supplied to our soldiers, their power would be increased at least fourfold. The army which should first adopt these weapons, would thereby obtain an advantage equal to that of the exclusive possession of firearms a century ago. One effect of these would be that the whole of our field artillery must become *totally useless*.

PARTICULARS OF SHELL PRACTICE WITH 8-GAUGE RIFLES. *Jacobabad*, 1853–4.

GUN. Nature of Gun.	Length of Barrel.	Distance of Sight from Muzzle.	Height of Sight.	Weight.	Range. Yards.	Weight of Shell.	Charge of Powder. Drachm.	Angle of Elevation.	Time of Flight. Seconds.	REMARKS.
	Inches.	Inches.	Inches.	Lbs. Ozs.		Ozs. Drs.				
Double 8-gauge charge.	20	16	·75	13 8	400	3 12	2½	2° 42′	1·89	Two guns of this size used, both made by John Manton. The grooves take one whole turn in 24 inches.
			·92		500			3° 19′	2·3	
			1·1		600			3° 57′	2·8	
			1·3		700			4° 40′	3·25	
			1·5		800			5° 24′	3·75	
			1·7		900			6° 7′	4·38	
			1·9		1,000			6° 50′	4·71	
			2·1		1,100			7° 33′	5·2	
			2·3		1,200			8° 16′	5·68	
Single 8-gauge four grooved	24	19½	·85	14 8	400	3 12	2½	2° 33′	1·82	Two guns of this size used, both made by John Manton. The grooves take one complete turn in 24 inches. NOTE.—With a charge of 3 drachms these guns make excellent practice at 1,600 yards, and shells never fail to burst at that range.
			1·03		500			3° 5′	2·23	
			1·22		600			3° 39′	2·47	
			1·42		700			4° 15′	3·1	
			1·63		800			4° 53′	3·56	
			1·8		900			5° 24′	3·96	
			2·1		1,000			6° 18′	4·52	
			2·4		1,100			7° 12′	5·05	
			2·7		1,200			8° 6′	5·61	

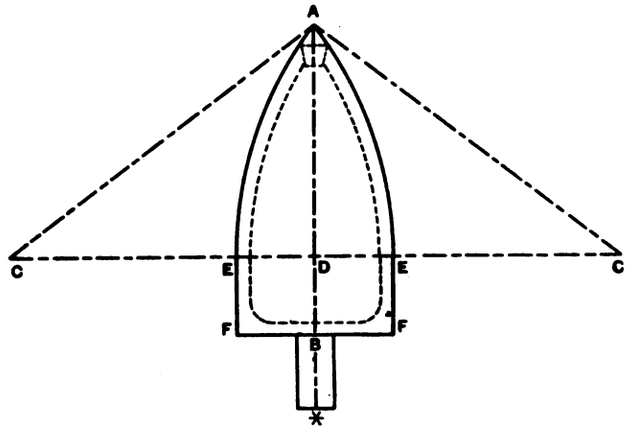


*Plate II. Fig. 1. *Square iron tenon, cast in one with the shot or shell, side of the square equal to one-fourth of the diameter. The dotted interior line shows the shape of the inside of a shrapnel shell of this construction. From E to F the shot is cylindrical. From A to E it is defined by circular arcs described from the centres C C with the radius C A.*
A B = 2 diameters. D B = ½. C D = 2. C A = 2½.
Note.—The weight of these shot will be more than double that of the common round shot of the same calibre; the weight of the gun must be proportioned to that of the shot, not to its diameter.

Plate II. Fig. 2. Hard wood bottom with square mortice in the centre to fit on to the tail tenon of the shot, to which it is to be wedged fast. An iron ring is driven on to each end of the bottom to secure it from splitting. Thickness of bottom exclusive of iron rings, equal to half the diameter.

"The guns must be rifled also. In which case shrapnel shells, of the shape of figure No. 6, would be fully effective at distances of 5,000* yards, or more.

"For cannon shot the hold on the rifle grooves could be given by a wooden bottom (Fig. 2, Plate II.), formed with proper projections to fit the grooves, and fixed to the shot by a square tenon cast on the latter, and a mortice through the wood. The twist of the grooves might be one whole turn in forty-five diameters.

"This plan is, it is understood, being tried at Woolwich, on the suggestion of the author of this paper. The thing was freely offered to the Indian Service; but no notice has as yet been taken of it. The subject, however, appears to be one of vast importance; and, with regard to it, wonderful ignorance appears generally to exist. The exact description of rifle recommended for use throughout the army is the same as has been already given above. The charge of powder mentioned is the quantity of good sporting powder, which is found most convenient. If the musket powder be of less strength, the charge should, of course, be slightly increased in proportion; and probably two and a half drachms may be found to be best.

(Signed) JOHN JACOB, Major."

"The annexed table of times of flight, etc. is curious. The initial velocity appears to be but little reduced in the long ranges. The numbers in the table are the mean of hundreds of experiments."

"This paper was forwarded to the military authorities, and a committee of artillery officers was assembled to report on its subject. This committee conducted its proceedings, no doubt, with the greatest fairness; but, owing possibly in some measure to imperfect explanation on my part, and to other causes not necessary to detail, fell into several mistakes, which rendered the enquiry totally useless for the object in view.

* *From subsequent experiments with Minié pointed balls, it seems that three times this range may be accomplished.*

"The pattern rifle proposed by me for the army was described in the above memoranda; but at that time I had no rifles of proper pattern for the army ready, and the four-grooved rifle forwarded by me with the paper on the subject, was of construction altogether different. The rifle forwarded was made for me purposely, exactly resembling the two-grooved rifles in use with the army, with all their defects; with the sole exception of its having four grooves instead of two. This piece was made for me many years ago, with the sole object of obviating the difficulty in loading the two-grooved rifle. All this is set forth in the first part of the above memorandum, and was explained to the military authorities, etc. in 1846, as therein mentioned.

"The only trial, then, between this piece and the common two-grooved rifle which could have been of any practical use, should have been made with round balls with the one, and two bands respectively. It would then have been found that, with the usual tight fitting balls of the two-grooved rifle, the number of shots capable of being fired with accuracy in a given time, would have been about ten to one in favour of the four-grooved piece.

"The circumstance of easy or difficult loading is of the greatest practical importance; the committee, however, did not even allude to it. Yet with a view to easy loading alone, was the piece forwarded by me made. In making it exactly like the rifles in use, I had this object in view: namely, to show how the great defect of the two-grooved rifles, difficult loading, could be at once obviated, by adding two more grooves to the pieces then in use, and using the two-banded ball.

"Two additional grooves could easily have been made in the two-grooved rifles by any ordinary armourer, or even by the soldiers themselves; thus. Take a cylindrical piece of hard wood about two inches long, of size to fit the bore of the piece; through this drive a peg, to be left projecting a little at each end to fit into the two grooves of the barrel; at right angles to this, in the wooden cylinder insert a steel cutter, with its edge of the breadth of the required grooves; screw the ramrod into the wooden cylinder, and thrust it up and down inside the barrel; the pegs give the lead for the twist of the new groove, which must thus be exactly parallel to the old ones. To make the cut of the proper depth, insert pieces of paper, card, or spills of wood, between the cylinder, on the side opposite the cutter, and the barrel. When one groove has been cut thus, take the tool out of the barrel, turn it half round, and cut the other in like manner. I have found this simple method perfectly effective. Thus the improvement proposed could at once have been adopted into the service, without additional expense. Easy loading alone was what this piece was intended to effect; in other respects it was neither better nor worse than the rifles then in use in the army. All other improvements referred to the shape of the *ball* only, and of course equally affected both rifles; save that the conical ball No. 2 of the memorandum, or of other such like shapes, cannot be used with effect from the two-grooved barrel, by reason of their being at liberty to lean over to one side in the direction of the grooves, so that the axis of the ball may not coincide with the axis of the gun.

"The committee, however, apparently not knowing the object with which the piece was made, nor that it was of old date, seemed to imagine that the four-grooved rifle before them was of the pattern recommended by me, and proceeded to try it against one of the two-grooved rifles, using *the same balls for each*; when of course, it was found that the differences between the pieces were merely accidental, such as might have occurred between two individual muskets of similar pattern. The result, therefore, of the enquiry was of no practical use whatever; but, on the contrary, with the best possible intention, the proceedings tended only to mislead.

"The rifles used were of the old musket bore, and much too light in proportion to the diameter of their bore, to enable a properly shaped ball to be used with a proper charge of powder; so that no great accuracy nor penetration at long ranges could be expected; and their practice at 800 yards seems to have been inferior to contemporary practice at Jacobabad (with leaden balls only) at 1200.

"Little practical advantage was to be expected from the proceedings of a committee, however ably and honestly composed, unless the members had some previous practical acquaintance with the particular matter in hand, and the proposer of the improved weapons, etc. had been present to explain matters personally.

"As an example, the committee fired the rifles "fixed almost immoveably" in a species of carriage; naturally thinking thereby to ensure accuracy of practice. Experience shows, however, that by far better practice can be made by firing from the shoulder, than by fixing the barrel in any vice or carriage. It was not long before this was discovered, and numerous trials placed the fact beyond doubt, and led to the discovery of the cause.

"I had made several apparently excellent carriages for rifles, very strong and heavy, with screw adjustments both for altitude and azimuth; yet, to my amazement, no practice nearly equal to that from the shoulder could be made with them. The reason I discovered by grasping the barrel while being fired. The metal appeared in a state of strong vibration, like the ringing of a bell; and the whole matter was at once accounted for. The vibration was not perceptible to the eye, and the barrel, when examined after firing, appeared to be in the same position as before; but the velocity of its vibration when fired probably bore considerable ratio to that of fired gunpowder, and necessarily threw the ball quitting its muzzle upwards, downwards, right or left, in an irregular and quite uncertain manner. Take a stiff steel spring, hold it in the hand, and it can be made to vibrate only with great difficulty, or not at all. Screw it fast in a vice, and the least touch makes it vibrate rapidly. In like manner the gun fired from the shoulder gives way, moves, and alters its position much, probably; but this motion is slow, and does not affect the flight of the ball in a degree approaching to the effect of the rapid *vibrations of the metal itself*, which do not take place when the gun is not fixed immoveably. This at first seems curious; but however it be, there is no doubt of the fact as stated above.

(To be continued.)

ROUND THE TRADE.

The works, goodwill and patents of Henrite Explosives Ld. were sold by auction on the 7th ult., and the Syndicate who have purchased them desire to make it known that the business will be carried on under new management. Mr. Lorenzo Henry, who retired from the board of the late company about two years ago, will be managing director. Mr. Robertson is not in any way connected with the present Syndicate.

The Birmingham Small Arms Co., Ld. have forwarded an advance copy of their new catalogue which contains compendious details of the several forms of Lee-Enfield rifle, military, miniature and sporting, target sights, air-rifles, the War Office miniature rifle, together with sundry tools and gauges for use by riflemen. The catalogue will naturally occupy an important position amongst those kept for reference by the retail trade.

The Wilkinson Sword Company have set up at their premises in Pall Mall rifle range apparatus which has been especially devised for training shooters in rapid fire practice. The targets consist of sundry figures and shapes moving across natural scenery. The various scoring sections of the targets are recessed in such a way as to deflect the bullet to a position where it operates electric signalling apparatus, thereby communicating to the firing point the value of each hit. An immensity of care and ingenuity has been devoted to the perfecting of the various devices employed.

Considerable surprise was everywhere expressed when the South British Trading Co., Ld. called a meeting of creditors on the 15th ult., for it had always been taken for granted that the financial status of this company was sufficiently guaranteed by the standing and reputation of the firms for whom it acted. These included the Stevens Arms and Tools Company, Savage Arms Company, Peter's Cartridge Company, and the Lyman Gun Sight Corporation. During the last year they even succeeded in securing the representation of the Ross Rifle Company. Letter headings belonging to these firms were commonly used for the transaction of business, but orders were as a rule given in the name of the defaulting company. The statement of affairs showed that the Company owed creditors the sum of £10,745, the assets consisting mainly of stock entrusted to them for sale, and book debts of the estimated net value of £4,653, the net result being a deficit of £6,092. That the Company, with its £1,858 capital, has never been in a paying condition was shown by the following statement submitted to the meeting:—

Year.	Sales and Commission.	Gross Profit.	Net Loss.	Net Profit.
1899	£2,146	£ 385	£ 851	—
1900	6,535	963	1,147	—
1901	12,434	2,443	605	—
1902	16,621	2,504	162	—
1903	20,350	4,259	—	£740
1904	22,654	3,388	2,452	—
1905	23,973	5,526	—	624
1906	27,674	5,882	—	215
1907	30,762	5,900	2,541	—

The net loss on these years trading, that is the difference between the net loss and the net profit of the several years, amounts to £6,254, which represents about the amount of deficiency shown in the above statement. Mr. Friedenstein, as managing director, seems to have drawn £800 a year, and Mr. Pollitt at the same rate during the nine months or so of his connection with the Company. Mr. Harold J. Snowden had acted as liquidator on behalf of the shareholders, and the creditors nominated Mr. Corfield to act on their behalf.

The British Explosives Syndicate Ld., 124 St. Vincent Street, Glasgow, have forwarded samples of a pocket diary (size 4ins. by 3ins.) leather bound and with back loop pencil, the whole get-up being in remarkably good style and containing an absolute minimum of advertisement matter. Those submitted are intended for the home trade, but special editions of the diary have been prepared for the firm's Australian and South America Agencies.

The Schultze Gunpowder Co., Ld. have issued a circular informing the trade that their "Popular" powder will be supplied at the reduced price of 1s. 6d. per pound, subject to the proviso that the amount so sold shall at no time be more than half the amount of ordinary Schultze which has been purchased. The arrangement commences as from the 1st inst., and will be carried on till the 31st of January next year. The "Popular" powder supplied under this arrangement will be the same as that now listed at 2s. 10d. per pound. The idea is to enable the Company's trade customers to compete successfully with the demand for a cheap cartridge.

According to the *Western Morning News* of the 7th ult. Nobel's Explosives Co., Ld. had received news that the Home Secretary had granted the amending licence for the storage of cordite at their Perranporth factory. It will be remembered that the inhabitants of Perranporth and neighbourhood were much against the new licence being granted, and at the hearing before the local authority a majority of the magistrates refused to grant the application, giving as their reason that it was to the general disadvantage "to the interests of the neighbourhood." The company appealed to the Home Office, and an inquiry was held at Truro by Major Cooper Key in August relative to the reasons for opposing the licence.

Mr. F. Marten Hale has written as follows:—"With reference to the paragraph on page 6 of your current issue, your correspondent, Mr. Pedersen, is ignorant of facts, and somewhat premature in his comments upon my rifle grenade. He wrote under a similar strain to the Company who is interested with me in the exploitation of my grenade, and the Company submitted the letter to their patent agent, Mr. R. Core Gardner, of 173 Fleet Street, E.C., who wrote the Company on the 25th November as follows:—'I have seen the letter addressed to you by Mr. Pedersen of Belgium, drawing attention to his patent No. 20,238, 1905, and claiming that Mr. Hale's invention in grenades is an infringement. I have also examined Mr. Pedersen's patent, and compared same with Mr. Hale's invention, and can assure you that Mr. Hale does not infringe Mr. Pedersen's invention in any way whatever, the two inventions being totally distinct from one another.'"

Messrs. Kynoch Ld. have sent the following communication. "In reference to the paragraph appearing on page 6 of your January issue, with regard to our new issue of ·22 R.F. long rifle ammunition. The particulars given in this paragraph are, in the main, correct, but the cartridges are not loaded with Cordite Mark I., but with 1·3 grains of our 'Axite.' The bullets weigh 40 grains and the muzzle velocity is 1050 ft.-per-second." The differences between measured velocity and weight of bullet and the nominal standards of the company are easy to understand, but with regard to the composition of the powder it happened that an analysis was made which showed a complete resemblance to cordite in respect to the proportions of nitroglycerine and nitrocellulose, whereas Axite more nearly resembles M.D. Cordite as regards these ingredients. The analysed sample was admittedly unlike cordite in that it contained a small percentage of saltpetre. Under the circumstances it would perhaps have been better not to have described the material as cordite. The mistake arose from the saltpetre having escaped notice in the first examination that was made.

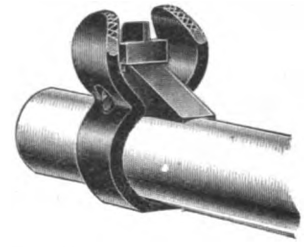
THE growth of rifle clubs and trade in connection therewith, has resulted in a large increase of the illegal practice of forwarding sample and other cartridges through the post-office, and dealers are being warned to avoid a practice for which a heavy penalty can be imposed. *The Field* meets the same difficulty by including the following in their notice to correspondents :—" Cartridges sent for test should be packed in wooden cases, and despatched per passenger train, labelled : Safety Cartridges, Class VI., Division 1."

Though aëronautics have but little direct connection with explosives, at any rate for the time being, a brief mention may nevertheless be accorded to an interesting reprint from the Journal of the American Society of Mechanical Engineers which has been received at this office. It is entitled *The Present Status of Military Aëronautics* and the author is Major George O. Squier, whose name is associated with experiments with the photo-chronograph, which he worked upon in conjunction with Professor Crehore. The illustrations are extraordinarily numerous and life-like, and a bibliography on the subject contains a list of sixteen pages of books and papers concerning the navigation of what is aptly described as the universal highway.

The Birmingham Proof House continues its vigorous prosecution of all persons selling Belgian proved guns which bear English names without having been reproved in this country as required under the Act. The latest case was against Davis and Company, pawnbrokers of Camberwell, London, S.E. in respect to guns advertised at 29s. 6d. each which were represented to be seven-guinea guns with Government proof. They cost a sovereign each, and one which had gone out of repair was sent to Birmingham with the result that the Proof House received information, and proceedings were instituted. The defendant pleaded ignorance, and that the offence committed was of a technical description, but the Guardians had asked for a substantial penalty, and £20 was the amount of the fine, £5 of which was allocated to the Guardians of the Proof House.

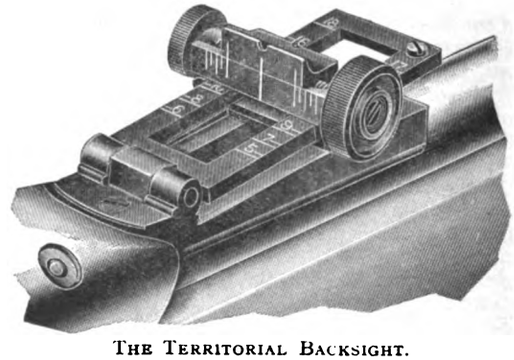
Instructions for the transport of Government explosives by road in vehicles drawn by mechanical motors have been issued. Ammunition or explosives will not (according to the *Western Morning News*) be transported in steam or internal combustion lorries. When packed in metal-lined packages, also filled shells, plugged, it may be carried in wagons drawn by steam tractors burning oil or coal, or by internal combustion tractors, provided that the steam tractors burning coal or wood are fitted with efficient spark arresters. When so carried the ammunition or explosive boxes must be efficiently covered by tarpaulins or fire-proof covers. Explosives not packed in metal-lined packages may only be carried in special fire-proof vans or wagons, which must be used for this purpose only. Fuzed filled shells, except Q.F. ammunition packed in metal-lined packages, must not be transported by mechanical transport, except under special authority. Wagons loaded with explosives should display a red flag by day and a blue lamp by night, to indicate the contents. These instructions are issued in view of the fact that large quantities of loaded shell are now transported by road to the artillery camps at Okehampton and on Salisbury Plain the authorities finding it cheaper than sending explosives by rail.

One of the long Lee-Enfield rifles which have been converted into the territorial model recently came into our hands, and although most of its features have already been made familiar by frequent references in the newspaper press, at the same time the number of persons who have actually handled the rifle and examined it in detail is probably still very limited. The removal of the bolt cover, and the addition of a bridge over the bolt way to form a guide for the charger clip constitute between them the only important changes in the mechanism. In order to effect these alterations the rifles have to be stripped to allow for machining the recesses in the body, into which the charger bridge is soldered. At the same time the lugs on the bolt, by which the discarded cover was attached, are ground flush with the cylindrical surface. Radically new sights have been fitted, as the accompanying illustrations, kindly loaned by the Birmingham Small Arms Co., Ld. will show. The changes in the foresight comprise the cutting of a dove-tail slot in the old block, and the fitting therein of an adjustable knife-blade tip. The protecting wings on either side of the foresight constitute a regrettable but necessary



THE TERRITORIAL FORESIGHT.

accompaniment to the moveable foresight. The backsight consists primarily of a semi-circular notch, in place of the older shaped V. This alteration in the shape of the sights certainly introduces a difference, but it is not necessarily an improvement, being in all probability the reverse. The mechanism of the backsight is a vast improvement on anything which has before been seen on the service rifle. That is to say the windgauge apparatus is complete, though elevation is still given on the old system of sliding the bar up and down the leaf. Fine adjustments for range shooting have necessarily to be effected by means of a vernier, the mechanical feature of which is that it supplements the absence of a screw upon the backsight. These changes in the sighting of the volunteer, now the territorial rifle, would have been welcomed years ago, especially for the occasions



THE TERRITORIAL BACKSIGHT.

when teams of British riflemen were pitted against foreign teams armed with weapons having a refined system of sighting. One peculiarity of the new design will strike everyone who examines the rifle. The function of the large milled head screw on the right is to lock the bar to the leaf at the required elevation adjustment. The screw on the left traverses the bar for the purpose of wind adjustment. The natural assumption would be that the windgauge screw should have been placed conveniently for the right hand to operate. The intention of the existing arrangement is obvious and exceedingly sound, viz. that whilst in position for shooting the finger and thumb of the left hand can control the adjustment for wind up to the very moment of pulling the trigger. The clicking sound which accompanies each quarter turn makes it quite simple to apply any required correction without observing the scale.

THE BRITISH ASSOCIATION COMMITTEE ON GUNCOTTON (1863).

By GEORGE W. MACDONALD, M.Sc.

AFTER the discovery of guncotton by Schönbein in 1846, the thoughts of many were directed to its application to warlike purposes. Many trials and experiments were made, especially by the French Government; but such serious difficulties and objections presented themselves, that the idea seemed to have been abandoned in every country but one. That country was Austria. From time to time accounts reached England of its partial adoption in the Austrian Service, though no explanation was afforded of the mode in which the difficulties had been overcome, or the extent to which these attempts had been successful.

This was the state of the case, when a Committee was appointed in 1862, by the British Association for the Advancement of Science to report upon the matter. The Committee contained some ten of the best known scientists of that time. It was put in possession of the fullest information on the subject, mainly from two sources. (1) A report by Abel by permission of the Secretary of State for War, containing the information given by the Austrian Government to the English Government, of the method of manufacture in the Austrian Factory. (2) General von Lenk on the invitation of the Committee and by permission of the Emperor of Austria, paid a visit to England, with the object of answering any inquiries the Committee might make, and explaining his system of manufacture thoroughly, and for this purpose he brought over drawings and samples from the Imperial Factory. In addition to these principal sources of information, special services were also rendered by two of the members of the Committee. Frankland was able to corroborate by his own experiments, most of the statements made in the earlier communications of Abel. Whitworth made experiments on the application of guncotton in mines, and sent over to Austria, rifles and ammunition to be experimented with by von Lenk, with a view of obtaining results, which he communicated to the Committee. The following are the conclusions arrived at by the Committee after their investigation.

Chemical Considerations. Under this head are included the manufacture of the guncotton itself, and the answers to such inquiries as those which refer to its liability, or non-liability, to deterioration by keeping; the possibility of its spontaneous decomposition; and the nature and effects of the products into which it is resolved on explosion.

As to the chemical nature of the material itself, Baron Lenk's guncotton differs from the guncotton generally made, in its complete conversion into a uniform chemical compound. It is well known to chemists that, when cotton is treated with mixtures of strong nitric and sulphuric acids, compounds may be obtained varying considerably in composition, though they all contain the elements of the nitric acid, and are all explosive. The most complete combination, or product of substitution, is that described by Hadow as $C_{36}H_{21}(NO_4)_9O_{30}$, which is identical with that termed by the Austrian chemists Trinitrocellulose, $C_{12}H_y(NO_4)_3O_{10}$ This is of no use whatever for making collodion, but it is Baron Lenk's guncotton, and he secures its production by several precautions. Of these the most important are:

(1) The cleansing and perfect desiccation of the cotton, as a preliminary to its immersion in the acids.

(2) The employment of the strongest acids attainable in commerce.

(3) The steeping of the cotton in a fresh strong mixture of acids, after its first immersion and partial conversion into guncotton.

(4) The continuance of the steeping for forty-eight hours.

(5) The thorough purification of the guncotton so produced, from every trace of free acid. This is secured by its being washed in a stream of water for several weeks. Subsequently a weak solution of potash may be used, but this is not essential.

The prolonged continuance of these processes appears at first sight superfluous, but it is really essential; for each cotton-fibre is a long narrow tube, often twisted and even doubled up, and the acid has first to penetrate into the very furthest depths of these tubes, and afterwards has to be soaked out of them. Hence the necessity of time. It seems to have been mainly from want of these precautions that the guncotton experimented on by the French Commission gave irregular and unsatisfactory results.

From the evidence before the Committee, it appears that this highest nitro-compound, when thoroughly free from acid, is not liable to some of the objections which have been urged against the mixture of compounds which has been usually employed for experiments on guncotton.

These advantages may be classed as follows:—

(1) It is of uniform composition, and thus the force of the gases generated on explosion may be accurately estimated.

(2) It will not ignite till raised to a temperature of at least 136 degrees C. (277 degrees F.), a heat which does not occur unless artificially produced by means which would render gunpowder itself liable to ignition.

(3) It is almost absolutely free from ash when exploded in a confined space.

(4) It has a very marked superiority in stability over other forms of guncotton. It has been kept unaltered for fifteen years, and is not liable to that spontaneous slow decomposition which is known to render lower products worthless after a short time. Yet there are still some reasons for suspecting that even the guncotton produced at the Imperial works suffers some gradual deterioration, especially when exposed to the sunlight.

There is one part of the process not yet alluded to, and the value of which is more open to doubt, namely, the treatment of the guncotton with a solution of silicate of potash, commonly called water-glass. Abel and the Austrian chemists think lightly of it; but Baron Lenk considers that the amount of silica set free on the cotton by the carbonic acid of the atmosphere is really of service in retarding the combustion. He adds that some of the guncotton made at the Austrian Imperial Works has not been silicated at all, and some but imperfectly; but when the process has been thoroughly performed, he finds that

the guncotton has increased permanently about 3 per cent. in weight. A piece of one of the samples left by the General was indeed found to contain 2.33 per cent. of mineral matter, consisting chiefly of silica.

Much apprehension has been felt about the effect of the gases produced by the explosion of guncotton. It has been stated that both nitrous fumes and prussic acid are among these gases, and that the one would corrode the gun, and the other poison the artilleryman. Now, though it is true that from some kinds of guncotton, or by some methods of decomposition, one or both of these gases may be produced, the results of the explosion of the Austrian guncotton, without access of air, are found by Karolyi to contain neither of these, but to consist of nitrogen, carbonic acid, carbonic oxide, water, and a little hydrogen, and light carburetted hydrogen. These are comparatively innocuous; and it is distinctly in evidence that practically the gun is less injured by repeated charges of guncotton than of gunpowder, and that the men in casemates suffer less from its fumes. The importance of this latter property in a fortress, or a ship, will be at once apparent.

It seems a disadvantage of this material as compared with gunpowder that it explodes at a lower temperature, possibly at 136 degrees C. (277 degrees F.); but against the greater liability to accident arising from this cause may be set the greatly diminished risk of explosion during the process of manufacture, since the guncotton is always immersed in liquid, except in the final drying; and that may be performed, if desirable, at the ordinary temperature of the air. Again, if it should be considered advisable at any time, it may be stored in water, and only dried in small quantities when required for use.

The fact that guncotton is not injured by damp like gunpowder, is indeed one of its recommendations. It is not even so liable to absorb moisture from the atmosphere, 2 per cent. being the usual amount of hygroscopic moisture found in it; and should that quantity be increased through any extraordinary conditions of the air, the guncotton speedily parts with its excess of moisture when the air returns to its ordinary state of dryness.

But a still more important chemical advantage which guncotton possesses, arises from its being perfectly resolved into gases on explosion, so that there is no smoke to obscure the sight of the soldier who is firing, or to point out his position to the enemy; and no residue left in the gun to be got rid of before another charge can be introduced.

Practical Applications. Guncotton is used for artillery in the form of thread or spun yarn. In this simple form it will conduct combustion slowly in the open air at a rate of not more than 1 foot per second. This thread is woven into a texture or circular web. These webs are made of various diameters; and it is but of these webs that common rifle cartridges are made, merely by cutting them into the proper lengths, and enclosing them in stiff cylinders of paste-board, which form the cartridge. In this shape its combustion in the open air takes place at a speed of 10 feet per second. In these cylindrical webs it is also used to fill explosive shells, as it can be conveniently employed in this shape to pass in through the neck of the shell. Guncotton thread is spun into ropes in the usual way, up to 2 inches diameter, hollow in the centre. This is the form used for blasting and mining purposes; it combines great density with speedy explosion, and in this form it is conveniently coiled in casks and stowed in boxes. The guncotton yarn is used directly to form cartridges for large guns, by being wound round a bobbin, so as to form a spindle like that used in spinning mills. The bobbin is a hollow tube of paper or wood. The object of the wooden rod is to secure in all cases the necessary length of chamber in the gun required for the most effective explosion. The guncotton circular web is enclosed in tubes of indiarubber cloth to form a match-line, in which form it is most convenient, and travels wtih speed and certainty.

Conveyance and Storage of Guncotton.—It results from the foregoing facts that 1lb. of guncotton produces the effect of more than 3lbs. of gunpowder in artillery. This is a material advantage, whether it be carried by men, by horses, or in wagons. It may be placed in store and preserved with great safety. The danger from explosion does not arise until it is confined, as it simply burns intensely in the open air. It may become damp, and even perfectly wet without injury, and may be dried by mere exposure to the air. This is of great value in ships of war; and in case of danger from fire, the magazine may be submerged without injury.

Practical use in Artillery.—It is easy to gather from the foregoing general facts how guncotton keeps the gun clean, and requires less windage, and therefore performs much better in continuous firing. In gunpowder there is 68 per cent. of refuse, or the matter of fouling. In guncotton there is no residuum, and therefore no fouling.

Experiments made by the Austrian Committee proved that 100 rounds could be fired with guncotton against 30 rounds of gunpowder.

In firing ordnance with guncotton, the gun does not heat to any important extent. Experiments showed that 100 rounds were fired with a 6-pounder in 34 minutes, and the gun was raised by guncotton to only 122 degrees Fahrenheit, whilst 100 rounds with gunpowder took 100 minutes, and raised the temperature to such a degree that water was instantly evaporated. The firing with the gunpowder was therefore discontinued; but the rapid firing with the guncotton was continued up to 180 rounds without any inconvenience. The absence of fouling allows all the mechanism of a gun to have more exactness than where allowance is made for fouling. The absence of smoke promotes rapid firing and exact aim.

The fact of smaller recoil from a gun charged with guncotton is established by direct experiment; its value is two-thirds of the recoil from gunpowder—the projectile effect being equal. To understand this may not be easy. The waste of the solids of gunpowder accounts for one part of the saving, as in 100lbs. of gunpowder 68lbs. have to be projected in addition to the shot, and at much higher speed. The remainder General von Lenk attributes to the different law of combustion; but the fact is established.

Advantage in weight of gun.—The fact of the recoil being less, in the ratio of 2:3, enables a less weight of gun to be

employed as well as a shorter gun, without the disadvantage to practice arising from lightness of gun.

Endurance of gun.—Bronze and cast iron guns have been fired 1,000 rounds without in the least affecting the endurance of the gun.

Under water.—Two tiers of piles 10 inches thick, in water 13 feet deep, with stones between them, were blown up by a barrel of 100lbs. guncotton placed 3 feet from the face, and 8 feet under water. It made a clean sweep through a radius of 15 feet, and raised the water 200 feet. In Venice, a barrel of 400lbs. placed near a sloop in 10 feet water at 18 feet distance, shattered it to pieces and threw the fragments to a height of 400 feet.

The Committee desire to put upon record their conviction that the subject has neither chemically nor mechanically received the thorough investigation which it deserves. There remain many exact measures still to be made, and many important data to be obtained. The phenomena attending the explosion of both guncotton and gunpowder have to be investigated, both as to the temperatures generated in the act of explosion, and the nature of the compounds which result from them under circumstances strictly analogous to those which occur in artillery practice; and until these are accurately ascertained, it is impossible to reconcile the apparent contradictions between the mechanical phenomena which result from the employment of guncotton gases and gunpowder gases, when employed to do the same kind of mechanical work.

SOUTH AUSTRALIAN EXPLOSIVES REPORT FOR 1907.

THIS report arrived last December, but pressure of other matter has prevented the giving of a notice until now. The report deals with the various departments of chemical work requiring attention from the government laboratory. Explosives naturally occupy a leading position in the list of chemical examinations made. The section of the report which deals particularly with explosives contains several important references to the mercury question, and though these are necessarily out of date, some of them may be reproduced as having historical importance coming from an official quarter. Particular mention is made of a shipment of gelignite of German manufacture which arrived in the month of May of the year under review. It gave a heat test of 90 minutes, but in consequence of advice from H.M. Inspector in England a careful test for mercury was made, and later on a re-test under conditions which removed the masking effect of the added mercury. As a consequence of the results then obtained the whole stock, amounting to 52,150lbs. was condemned and destroyed by being thrown on September 15th "into the deep sea of the Southern Ocean beyond the continental shelf." The report then goes on to state:—"A careful examination of the other brands of explosives imported showed that all explosives of German manufacture were adulterated with mercuric chloride, and that they were all of low heat test, indicating dangerous instability. All these explosives were condemned, and 6,200lbs. of explosive (blasting gelatine, gelatine dynamite, and gelignite) were destroyed by burning in October. In all 58,350lbs. of explosives had to be destroyed owing to being of dangerous character, although when tested by the official heat test they appeared to be safe for transport, storage, and use. All the explosives of British manufacture imported to this State were found to be free from mercuric chloride, and were passed as safe for use. It is interesting in this connection to note that subsequent shipments of German explosives from which mercury was omitted failed to pass the heat test."

"Experiments were made with Monobel powder to determine whether in this comparatively dry country the waterproof cartridges could be dispensed with and the material packed in bags, each containing 25lbs. The results were not satisfactory, and it was decided to keep to the use of waterproof cartridges."

"A series of tests on safety fuses showed that when two pieces of fuse are intertwined together, and one piece is fired first and burnt through before the other is fired, then in most cases the first piece will have a quicker burning rate than the second. On 6ft. lengths of fuse the second piece took from seven seconds to 15 seconds longer to burn than the first, whereas when 6ft. lengths were burned separately the difference in burning time did not vary more than five seconds. This phenomenon is probably due to parts of the first piece giving off sparks, or more heat than usual at points of close contact with the second piece, and thus softening the pitch at these places. This causes a slight interference with the powder core, and tends to increase the time of burning of the second piece."

APPLICATIONS FOR PATENTS.

DECEMBER 14, 1908—JANUARY 16, 1909.

27,101. Ammunition Rammers. A. T. Dawson and J. Horne.
27,105. Time Fuses. A. T. Dawson and G. T. Buckham.
27,109. Anchoring Device for Gun Carriages. A. T. Dawson and G. T. Buckham.
27,110. Backsights for Small Arms. Birmingham Small Arms Co., Ld. and G. Norman.
27,112. Brake Apparatus of Recoiling Guns. A. T. Dawson and G. T. Buckham.
27,166.* Rimless Cartridges. L. B. Taylor.
27,195. Range Finders. G. A. Spratt and Houghtons, Ld.
27,286. Explosives. B. E. D. Kilburn.
27,332. Rifle Sight. W. McCubbin.
27,366.* Holding Cartridge Cases. R. B. Ransford.
27,368. Automatic Small Arms. J. Eastwick.
27,388.* Ordnance Sighting. F. Wigley, F. Duncan, and T. A. Petrie.
27,500. Backsights for Small Arms. Birmingham Small Arms Co., Ld., and G. Norman.
27,513. Disappearing Target. W. S. Freeman.
27,528. Clay Bird Traps. W. Erskine and J. Johnston.
27,533. Target. J. M. Proctor.
27,584. Discharge Silencer. A. Thompson.
27,602. Measuring the Paths of Projectiles. C. W. Wallace.
27,627. Small Arms. R. J. Petersen.
27,643.* Ammunition Conveying Device. Fried Krupp.
27,672.* Ordnance Sighting Apparatus. E. Schneider.
27,765. Target Practice Apparatus. J. H. Faulkner.
27,886. Sighting Attachment for Rifles. J. E. Martin.
27,958. Backsight of Rifles. J. Beveridge.
27,979. Sights. A. L. Tisdall and W. J. Robinson.
28,012. Explosives. E. H. Harris.
28,122.* Sword Handle. J. O. Magrini.
28,195. Sights. E. H. Parsons and L. B. Taylor.
28,275. Safety Attachment for Firearms. C. Kolbe.
28,330. Aperture Sights. D. M. Fraser and H. Ommundsen.
28,341. Ordnance Elevating Gear. Armstrong, Whitworth & Co., Ld., and F. G. D. Johnston.
28,391.* Projectiles. D. M. Fraser.

28,518. Loading Appliances for Small Arms. C. J. Feeny.
28,534.* Loading Apparatus for Ordnance. Schneider et Cie.
28,544.* Explosives. W. A. Andersen.
64.* Firearms. G. V. Haeghen.
100. Magazine Rifles. L. B. Taylor.
187. Sporting Rifle Attachment. F. H. Harrison, J. W. B. Ross and H. Bebbington.
325.* Rifle Cleaning Rods. J. H. Blair.
437. Ordnance Sights. Armstrong, Whitworth & Co., Ld., C. H. Murray and F. G. D. Johnston.
455.* Discharge Silencer. H. P. Maxim.
594. Coin-freed Shooting Apparatus. J. Lewthwaite.
680. Securing Side Locks to Small Arms. H. White.
690. Hang-fire Device for Ordnance. A. T. Dawson and T. Buckham.
701.* Toy Rifles. G. Schrödel.
707.* Gun Sighting Devices. P. M. Justice.
864. Ordnance Firing Mechanism. Armstrong, Whitworth and Co., Ld., and A. G. Hadcock.
865. Bringing Gun to Loading Position. Armstrong, Whitworth and Co., Ld., E. W. Lloyd and F. G. D. Johnston.
957.* Automatically Operated Guns. E. C. R. Marks.
961. Ordnance Sighting Apparatus. A. T. Dawson and G. T. Buckham.
965. Range Finders. S. Case. J. Goldberg and A. Scicluna.
984. Controlling Sighting of Guns. A. T. Dawson and G. T. Buckham.
985. Ordnance Sighting Apparatus. W. A. Burns.
1.177. Gun Mountings. A. Smith.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

DECEMBER 24, 1908—JANUARY 14, 1909.

COMPILED BY HENRY TARRANT.

20,440 (1907). **Automatic Rifle Firing Mechanism.** R. Frommer, Hungary. In this firing mechanism an additional sear is automatically released by a cam piece on the breech block at the end of the closing movement. The trigger is provided with selective means by which continuous or single firing is secured. Accepted Dec. 14, 1908.

21,414 (1907). **Electrical Sighting of Ordnance.** Lieut. A. T. Dawson, and G. T. Buckham, London. Electrical transmitting apparatus such as is dealt with in patent No. 4,404, 1906, is modified. A calibrating device similar to that set out in patent No. 673 ,1907, is combined with this apparatus to enable corrections to be made from the transmitting station to compensate more particularly for errors of the day affecting range. Accepted December 28, 1908.

25,549 (1907). **Ammunition Hoists for Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. Instead of employing a separately moveable loading cage to which the powder and projectile are transferred from the hoist before they are rammed into the gun, the hoist is adapted to be brought to such a position as to allow the charge, etc. to be transferred readily to a receiving cage connected with the gun mounting. Accepted December 18, 1908.

26,635 (1907). **Rifle Sights.** E. R. Tufts, U.S.A. A "non-view obstructing" or hair line back sight of approximately triangular shape co-operates with a vertical foresight relatively arranged as a bisector of the base of the triangular backsight. The triangle is open at the apex. The object may be fully seen when these sights are used. Accepted Dec. 2, 1908.

26,823 (1907). **Ammonium Nitrate Explosive.** The South African Explosives Syn., Ld., and H. C. L. Bloxam, Cape Colony. An explosive, the principal constituents of which are ammonium nitrate and dinitrobenzine, was described in Patent No. 3,005, 1906. The present patentees remove certain objections said to attend the method of mixing (by melting), by first fusing the ammonium nitrate, then allowing it to solidify and afterwards powdering it ready for amalgamation with the dinitrobenzine. Accepted Dec. 3, 1908.

27,000 (1907). **Electrical Target Improvements.** G. Schupp and G. Weingärtner, Germany. In patents Nos. 4,909, 1894, 10,342, 1891, and 4,641, 1881, targets and electrical indicators are described. The patentees improve this apparatus, their object being to eliminate possibility of false indication. Besides the usual indication at the firing point a strip of paper is punctured by a falling member so that the exact value of the shot is recorded permanently. Accepted Dec. 7, 1908.

27,960 (1907). **Box Lock Gun Manufacture.** C. Ryland, Birmingham. To facilitate manufacture of break-down sporting guns the action body is simply made flat-sided (i.e., without any mechanism housing slots). The mechanism works on these flat sides and the whole is covered in by a detachable box. The parts are readily accessible. Accepted Dec. 17, 1908.

28,105 (1907). **Loading Mechanism for Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. Rammer gear forms the subject of this patent. Various ways have been adopted for carrying the rammer, one referred to particularly being described in patent No. 18,442, 1904.The new form of rammer is of the flexible or chain type,and although it is mounted on the loading cage it may be moved into or out of the gun independently of the mechanism used for operating the cage. Both sets of mechanism are inter-connected however. Accepted Dec. 17, 1908.

28,587 (1907). **Automatic Rifle Mechanism.** M. G. Farquhar, Aboyne, and A. H. Hill, Birmnigham. Improvements are described in automatic arms of the type set out in patent No. 7,969, 1906. The energy of the recoiling barrel is stored, and the breech is opened only after the barrel has been returned to its normal position. Accepted December 30, 1908.

208 (1908). **Loading Apparatus for Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. This improvement relates to loading apparatus of the type set out in patent No. 25,549, 1907. The hinged loading tray is actuated by gearing which receives its motion from a cylinder. The gearing is arranged so that its action is timed to take place in proper sequence with respect to the loading cage. Accepted December 31, 1908.

1,299 (1908). **Coincidence Telemeters.** O. Eppenstein, Germany. The object of this invention is to render reading with coincidence telemeters as simple as with the stereoscopic instrument with a fixed scale. The improvements are fully and technically described in the Specification. Accepted Dec. 3, 1908.

2,447 (1908). **Device for Slaughtering Animals.** Capt. C. Playfair, Birmingham. (*See Selected Patents*).

2,985 (1908). **Ammunition Hoist for Ordnance.** P. M. Justice, London. (Agent for *The Otis Elevator Co., U.S.A.*). Means for controlling the starting and stopping of electrically operated ordnance without shock or jar are set out in this patent. The high speed of the hoist is first reduced and the hoist is then stopped at any point according to the elevation of the gun. Accepted Dec. 3, 1908.

3,092 (1908). **Machine Guns.** Lieut. A. T. Dawson and G. T. Buckham, London. In order to condense the steam generated in the steam space of the water jacket by the heat of the barrel of a machine gun, during firing, the steam is led through a flexible tube to a portable water tank in which a large cooling area of water is exposed. Accepted Dec. 17, 1908.

3,306 (1908). **Improvements in Underlever Air Rifles.** The Birmingham Small Arms Co., Ld., A. H. M. Driver, and G. Norman, Birmingham. (*See Selected Patents*).

3,326 (1908). **Orthoptic Spectacles for Shooting.** A. G. Downie, St. Andrews. The tubular "sighting" device is adjustable on a frame and may be set at any convenient angle to suit the eye of the shooter. The frame on which the tubular part slides is attached to a second wire construction which forms the spectacle frame. Accepted Dec. 3, 1908.

3,555 (1908). **Cartridge Making Machinery.** W. B. Challen, Birmingham. The machine described in this Specification is designed to improve the method for heading sporting cartridge cases, i.e., forming the flange of the head the correct shape, accurately sizing the cap chamber, and pressing the wad securely in the proper position into the chamber mentioned. Accepted December 31, 1908.

4,254 (1908). **Loading High Angle Ordnance.** E. Schneider, France. A spring controlled member for retaining ammunition in ordnance when being loaded at high angles is usually arranged to project from a recess in the body of gun. The patentee places it in a longitudinal recess formed parallel with the axis of the gun in a smooth sector of the breech nut. Accepted Dec. 3, 1908.

4,913 (1908). **Miniature Range Target Apparatus.** L. Jeffrey. This apparatus embodies stationary, running and disappearing targets. The moving and disappearing targets are manipulated by ropes from the firing point. Accepted Dec. 3, 1908.

5,889 (1908). **Ramming Device for Ordnance.** A. F. Petch and F. Duncan, London. A ramming device more especially for inserting fhe explosive charge consists of three links. The lower ends of two of these are pivoted and the upper ends are jointed to a third link. The arrangement is such that when one link is rotated about its pivot the end of the third link is made to travel approximately in a straight line parallel to the axis of the bore, so that it pushes the charge before it into the gun. Accepted Dec. 3, 1908.

5,992 (1908). **Rifle Back Sights.** J. E. Martin, Glasgow. In order to obtain delicate, as well as coarse adjustments for the slide of a back sight of the tangent leaf form a supplementary frame is arranged around the outside of the usual leaf. The slide works on this and many be pushed up and down for coarse adjustments, or by means of a screw the whole frame and the slide may be delicately moved relatively to the leaf. Accepted Dec. 17, 1908.

6,944 (1908). **Armour Piercing Projectiles.** Sir R. A. Hadfield and A. G. McK. Jack, Sheffield. A sheet metal " charge container " is secured in the bursting chamber of a projectile by first passing it through a hole in the base adapted to be closed by a plug of about the same diameter as the largest part of the chamber. The container is forced into close contact with the walls of the chamber by inserting a body of elastic material such as rubber under pressure. Patent No. 15,837, 1906 is mentioned in connection with this device. Accepted Dec. 17, 1908.

10,205 (1908). **Small-Arm Back Sights.** M. Blood, London In order to bring an aperture sight fitted to the ordinary leaf of the open back sight of a military rifle nearer to the eye a cap is provided on the head of the leaf so that when the latter is turned backwards (instead of forwards), the aperture is presented to the eye. A slide on the leaf rests on the barrel, and controls the elevation of the aperture cap. Accepted December 31, 1908.

10,229 (1908). **Torpedo Shaped Projectiles.** Major R. Naglo, Germany. In order to guide a projectile of this shape properly through the bore a copper casing is arranged on its point. extending backwards over half the length of the shell. Accepted Dec. 17, 1908.

12,958 (1908). **Ramming Device for Ordnance.** E. Schneider, France. Manual operations in the manipulation of rammers for heavy ordnance are eliminated by this invention. All the ramming operations are accomplished automatically by means of an endless chain and are completed during one single revolution of this chain. Accepted Dec. 10, 1908.

14,442 (1908). **Firing Naval Ordnance.** O. Angeline and G. Ascoli, Italy. Separate time adjusting devices for firing ordnance at the right moment during the roll of a ship have hitherto been needed for each gun. The patentees provide a device capable of controlling the firing of all the guns on board. The diametrically opposed members of a plurality of contact points situated above a mercury surface are connected to the separate circuits containing the detonators of the different guns. Accepted Dec. 10, 1908.

14,776 (1908). **Projectile Fuse Construction.** P. Schwenke, Germany. Automatic electric firing devices operated by the admission of water are improved. The " battery " and the detonator are arranged close together. Accepted Dec. 10, 1908.

16,587 (1908). **Fluid Pressure Brakes for Ordnance.** Fried. Krupp, A.-G., Germany. In fluid pressure brakes in which the piston has a part capable of rotation engaging with the brake cylinder, a ring of balls is inserted between the rotary part and that surface which serves as an abutment for it during recoil. The brake is of the type dealt with in patent No. 26,252, 1905. Accepted Dec. 17, 1908.

16,588 (1908). **Incendiary Projectiles.** Fried. Krupp, A.-G., Germany. Projectiles designed to burn and evolve smoke during flight, and to set fire to the object they strike are described in this patent. The fuse can be adjusted for igniting the burning composition after different periods of flight. The projectile is intended principally for bombarding balloons. Accepted December 31, 1908.

17,359 (1908). **Ammunition Hoists.** Sir W. G. Armstrong, Whitworth & Co., Ld., and C. H. Murray, Newcastle-on-Tyne. Hoists of the differential type adapted for use with naval guns are simplified and improved. By the rotation of an operative member mounted to one cage relative movement is secured between one cage and another. Accepted Dec. 17, 1908.

17,623 (1908). **Cartridge Pockets.** W. C. Fisher, U.S.A. Pockets of the type dealt with in patent No. 23,336, 1907 are improved. The tube is fixed midway between the back and front walls of the pocket so that three compartments are formed. Accepted December 31, 1908.

19,102 (1908). **Detachable Lock Mechanism for Small Arms.** R. Hill and T. V. Smith, Birmingham. (*This patent will be fully described in the next issue of Arms and Explosives*).

19,345 (1908). **Illuminating Projectiles.** Fried. Krupp, A.-G., Germany. Illuminating or incendiary projectiles usually have the head containing the bursting charge larger than the bore of the gun and therefore have a fixed stem to take the bore. This fixed stem is said to have an unfavourable effect on the flight of the projectile and therefore the patentees provide that it shall fall away from the shell shortly after leaving the gun. Accepted Dec. 3, 1908.

20,261 (1908). **Sight Shields for Ordnance.** Fried. Krupp, A.-G., Germany. A protective shield is provided with a pivoted screen to cover the sighting opening. When the screen is turned upwards to uncover the sighting opening, side walls attached to the screen are automatically brought up to form a lateral protection. Accepted Dec. 10, 1908.

20,279 (1908). **Potassium Chlorate Explosives.** F. W. Bawden, Johannesburg. In patent No. 4,046, 1908, the patentee covered the addition of molasses to impart plasticity to nitrate or chlorate explosives. He now states that such molasses compositions, whilst fully plastic and safe to use when fresh, have a tendency to deteriorate if stored for any length of time. The molasses are, therefore, incorporated with a certain amount of lamp black, the relative proportions being by weight between equality and one part of lamp black to four of molasses. Explosives to which this mixture is added are said to retain their plasticity permanently. An example of such a compound is as follows. By weight—Potassium chlorate 75%, colza oil 11½%, cane sugar 10%, molasses 2%, and lamp black 1½%. This is suitable for general mining purposes. Accepted Dec. 17, 1908.

20,574 (1908). **A New Potassium Chlorate Explosive.** H. D. Farris and A. C. Jex, Canada. (*See Selected Patents*).

20,981 (1908). **Ordnance with Recoiling Barrels.** E. Olsson, Sweden. In ordnance in which the recoil brake is arranged on one side of the gun only a counterpoise is placed on the recoiling system so that the centre of gravity of the system is moved nearer to the axis of the barrel. Strain on sighting appliances is obviated. Accepted December 31, 1908.

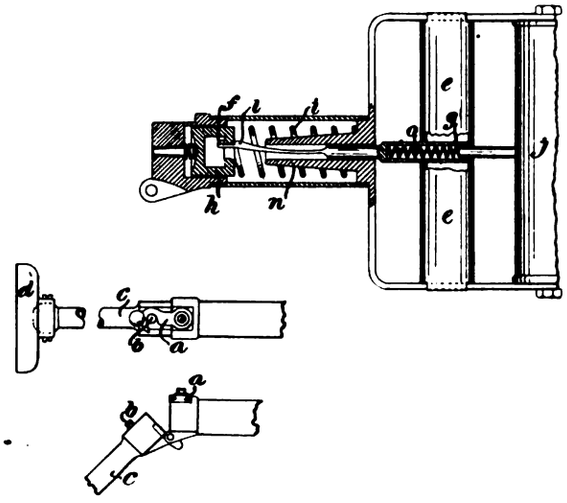
23,173 (1908). **Telemeters.** Optische Anstalt C. P. Goerz, A.-G., Germany. The ocular prism in range finders having one ocular and two objectives is improved. The

instrument is made less sensitive to vibrations. Slight displacements are rendered practically harmless, because the displacement of one reflecting surface is neutralized by the displacement of the other reflecting surface of the ocular. Other improvements are mentioned. Accepted Dec. 17, 1908.

SELECTED PATENTS.

DEVICE FOR SLAUGHTERING ANIMALS.

2,447 (1908). Capt. C. Playfair, Birmingham. The instrument described in this patent is intended to facilitate the slaughtering of animals. The break-down principle of an ordinary gun is introduced so that a cartridge may easily be inserted and the case extracted after firing.



Reference to the drawings will at once give some idea of the construction of the "gun" The hook connection *a* and *b* holds the barrel-like part *c* (which receives the cartridge) to the rear part carrying the firing mechanism. The front of the barrel is fitted with a capped plate *d* which is placed against the part of the animal into which the cartridge is to be fired.

The firing mechanism consists of the handle bar *e*, the spring catch *f* attached to the spring containing tube *g*, the "hammer" and striker *h*, and the mainspring *i*. To fire the apparatus after it has been loaded, the handle *e* is drawn backwards towards the fixed bar *j* against the resistance of the spring *i*. The shaft of the catch *f* is so shaped at *l* that at a certain point in its backward travel it is caused to impinge against the inside of the tube *n* and to be forced downward and out of engagement with the lip of the hammer *h*. Immediately the hammer is released in this way the spring *i* drives it forward and causes the striker point to fire the cartridge in the barrel *c*. The handle bar *e* and consequently the hook *f* are returned to their normal positions after firing by the spring *o*. Accepted December 10, 1908.

A NEW POTASSIUM CHLORATE EXPLOSIVE.

20,574 (1908). H. D. Farris, and A. C. Jex, Canada. A new blasting powder claimed to be of great strength is made up as follows:—Chlorate of potash, 53%, potassium nitrate 5%, slacked lime 6%, wheat flour 33%, compound of picric acid and chlorate of potash 2%, and lamp black 1%.

The whole of the ingredients are thoroughly mixed together, sufficient water then being added to make the mass into a stiff dough. The dough is afterwards granulated and dried. A water proof coating is applied. It consists of one gallon of oil of tar added to two ounces of nitric acid. This mixture is allowed to stand until bubbles appear on the surface. Two ounces of muriatic acid are then added and the whole compound is set by until all working has ceased. The waterproof coating consists of the liquid part of the mixture which is poured off without disturbing the sediment.

The compound of picric acid and chlorate of potash are specially prepared. Six pounds of picric acid are dissolved in an iron vessel in eight gallons of hot water. Four pounds of chlorate of potash are dissolved in one gallon of cold water and this solution is slowly added to that of picric acid, the admixture being stirred meanwhile with a wooden ladle. The liquid is set aside for ten hours and the precipitate after that time is used for incorporation with the explosive.

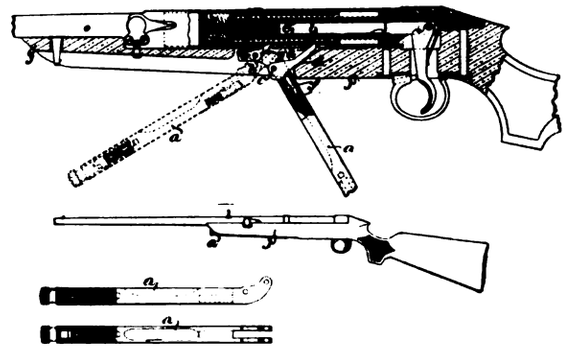
The potassium nitrate in the compound is added to create rapid ignition, the principal constituents being the potassium chlorate and the compound mentioned above. The lime is used for hardening purposes, the flour for binding and the lamp black for colouring the explosive. Accepted December 31, 1908.

IMPROVEMENTS IN UNDERLEVER AIR RIFLES.

3,306 (1908). The Birmingham Small Arms Co., Ld., A. H. M. Driver and G. Norman, Birmingham. Certain minor objections are said to be attached to the use of the long forward cocking lever generally used in the air rifle of the kind known as the "B.S.A." The lever is somewhat ugly, it adds weight to the forward part of the rifle, and so far as the cocking operation itself is concerned there is fear that failure of the sear to engage the bent on the piston will result in driving the lever back to its nominal position in a speedy and dangerous manner.

These objections it is sought to remove by the introduction of a short lever lying nominally neatly within a fore-end much of the usual shape and a safety catch designed to hold the piston at any stage during the compression of the spring. This safety catch is necessary because the parts are "cocked" by two strokes of the lever instead of one as heretofore.

The essential parts are shown in the drawings here reproduced and the operation of them will be explained as clearly as possible. The cocking lever *a* is fulcrummed to a lug at *b*, and has pivoted to it at *c* the ratchet lever *d* through which the piston *e* is forced backwards when the cocking lever is pulled back towards the trigger. The spring and pin *f* are arranged to keep this lever up to its work. The safety catch *g* is also fulcrummed at *b* and its nose is always spring-pushed into engagement with the bottom of the piston *e*.



When the cocking lever is pulled backwards the nose *h* of the ratchet lever *d* is forced into engagement with one of the notches *i* in the piston, and the latter is consequently forced backwards against the resistance of the piston spring. Half the rearward journey only of the piston is made by the first backward stroke of the cocking lever *a* and whilst the lever is being carried forward again so that the cocking operation may be completed by a second stroke, the spring pushed piston is held prisoner against forward movement by the safety lever *g* the nose of which is forced up into engagement with another of the notches in the piston underside.

The second backward stroke of the cocking lever completes the cocking operation and when the lever is returned to its proper position, i.e., snugged up in the fore end *j*, the safety lever *g* is turned by the ratchet lever *d* so that its nose is pressed downwards away from the notches *i* in the piston. When the rifle is ready for firing the piston has an unobstructed path before it. The method of holding the lever in its normal position is of the spring plunger type described in another patent. No. 25,830, 1906. Accepted December 10, 1908.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

The Maxim Report Silencer.—A curious change has come over Mr. Hiram Percy Maxim since an article was written in this column in the April issue of last year regretting that the father's example of experimenting first and talking afterwards had not been followed. The preliminary puffs of the device for silencing firearms described an arrangement hostile to common sense and contrary to the well-known scientific laws. Confirmation of the unsound principles on which Mr. Maxim was working came in due course in the form of patent No. 6,845 (1908), in which a crude valve arrangement was put forward as a remedy for the noise produced by discharging firearms. A later patent, No. 14,310 of the same year, and published in the last January issue, shows unquestionable evidence that Mr. Maxim has learned something about firearms which he did not know before; and he is accordingly working on lines which, on a theoretical basis at any rate, are not unsound. An American newspaper of the 9th ult. gives a popular illustrated description of the later device, and it may be said at once that a case has clearly been made out for suspending unfavourable judgments until practical tests can be made. The repudiation in the American report of the much criticised valve arrangement is curiously associated with the grudging admission a few lines lower down that the inventor did take out a patent on this construction. Had he admitted frankly that he commenced by working on wrong lines, and had since attained wisdom, the present mechanism would be received with less distrust. Nevertheless, it is quite feasible to suppose that the attachment of a piece to the muzzle, containing a number of recesses whilst leaving a clear central passage for the bullet, may actually provide a practical means of checking the violent outburst which takes place at the moment when the bullet leaves the muzzle, the gases being then free to pass into the open air with full liberty for lateral expansion. The point to be decided is whether the gas can be so caught and interrupted in its expansion without creating such resistance as would unship apparatus of reasonable weight and dimensions, and secondly, whether Maxim's arrangement for so doing as a fact diminishes the noise produced. Whilst, therefore, the original assertion that a particular problem had been solved in a certain manner was received with amused contempt, the later claims justify more serious consideration, because they suggest that scientific advice has been obtained. The present attitude is therefore, more favourable than the first, but the mantle of caution must be maintained until facilities are provided for practical experiment.

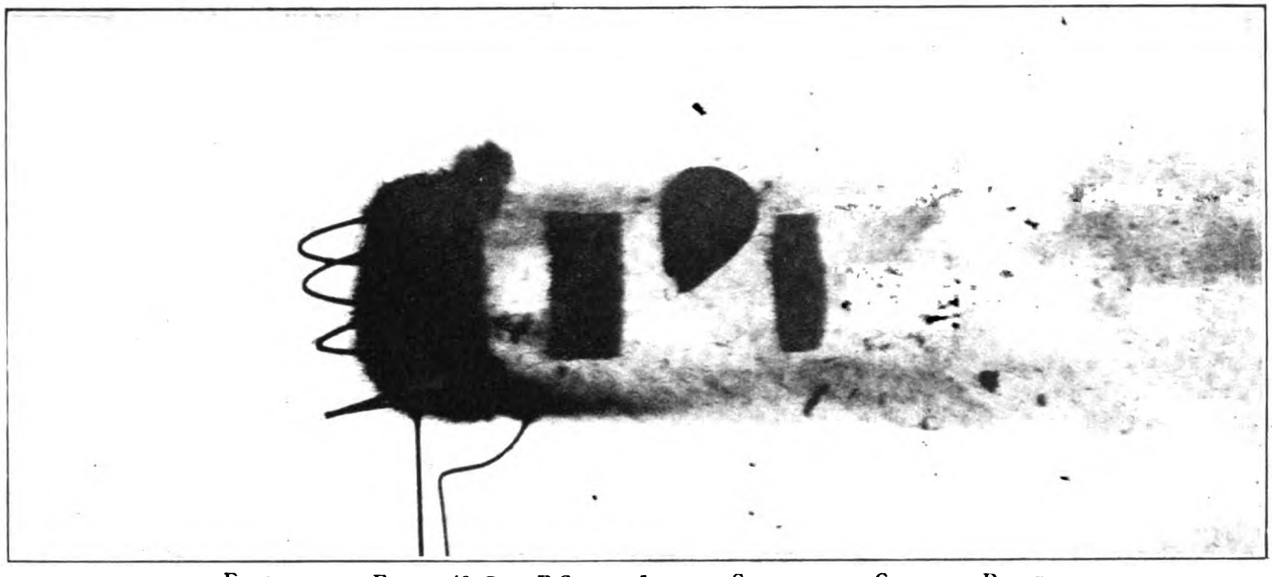
Afforestation in Relation to Sport.—Those who have gone further than merely to read the newspaper references to the Royal Commission's report on the subject of afforestation will be interested in the observations put forward according to their particular activities and occupations. The shooting man, whether he be gunmaker or practical exponent, will naturally be most concerned to ascertain whether the proposed planting of forests in the unoccupied quarters of the country will favourably or adversely affect the head of game and the sport it provides. Regarded from the sporting point of view the Commission's report is in most respects a disappointing document. Considering that the laying out of forest land represents a capital ex-

penditure which will produce no dividend for the present or the succeeding generation, the crop being necessarily of slow growth, it would have been thought that the only immediate benefit, viz. the sporting value of even recently installed coverts, would have received consideration. In point of fact sport is, as a rule, mentioned only in order that its methods may be criticised. The ideal pheasant covert is planted far too open to comply with the requirements of modern arboriculture. The trees throw out too many vigorous side branches which create knots, and diminish the length of parallel trunk. The growth is too rapid and the quality of timber inferior, except as regards oak and ash which thrive when planted in an open fashion. Pheasant covert must contain a plentiful assortment of dense undergrowth. Here again the Commission falls foul of the shooting man, failing meanwhile to point out that the barest of woods can be made useful for sport by planting its margins with rhododendron and other vigorous low-growing shrubs. The deer forests, which contribute a large proportion of the land recommended for afforestation, would apparently be turned to other uses, and the gamekeepers would be employed as foresters. The castles and mansions which form the summer headquarters of the shooting tenant and his family, being also the off-season home of the actual owner, would presumably form barracks for the afforestation staff. The document as a whole shows far too little regard for the need to conciliate the sporting interest, which, when all is said and done, possesses both the capital and the influence to have an important voice in whatever scheme may be discussed.

The Cult of Fancy Targets. Mr. Solano has just received from the War Office a testimonial expressing the most unqualified approval of what he termed his battle practice target. The idea which has received this unprecedented approval is a fancy system of miniature rifle range, in which the objects to be aimed at are set out amidst a species of stage scenery reproducing the conditions of a landscape. The enthusiasts who honestly believe that shooting becomes more practical when the simplicity of the bullseye is departed from in favour of some other kind of mark are very difficult to combat now that they have made converts of some of the most important War Office officials. Admittedly, the man who has learnt all that the rifle range can teach him would find his previous experience largely discounted if he were asked to make a good bag of rabbits stalking them with a rifle, or to bring down his deer if good fortune took him to a Scottish forest. Abroad, in the haunts of big game, the same disability would be manifest. Likewise the clay bird shot has much to learn before he can apply on fur and feather the personal skill which may have been thoroughly acquired at a modern shooting school. Clay bird shooting on a well-arranged basis comes much nearer to the genuine article than target shooting does to the employment of a military rifle under campaign conditions. On these matters there can be no opening for doubt, but there is unfortunately a strong tendency to discount the importance of range shooting in the futile attempt to make a man a practical shot by a direct route. Those who know are most emphatically of the opinion that the highest theoretical knowledge of the rifle and its behaviour is the best preparation for overcoming the peculiar difficulties which occur when shooting over strange country. The actual process of education is mainly mental, and consists in the shooter convincing himself that although the result may be an approximation, there is no limit to the amount of care that can be taken in diminishing the liability of error. Just what curriculum will carry the knowledge of shooting beyond the stage which range shooting achieves is exceedingly difficult to define. To shoot without knowing the result of each shot is a waste of time and ammunition which could not be sanctioned. Safety conditions have also to be considered on rather an elaborate scale. In fact the more the subject is threshed out the more necessary it seems to fall back on the rifle range for the actual shooting practice, and to develop range estimation as a separate exercise entirely independent from the inconveniences of actual shooting; The difficulty in fact occurs in incorporating with the ability to shoot the scouting instinct which at present is only properly developed in certain types of sportsmen and pioneers. Civilisation has obliterated the craft of the hunter, and battle practice targets and such like contrivances constitute the remedy put forward by the War Office. Baden-Powell's creation of the boy scout idea brings us much nearer the achievement of a practical solution.

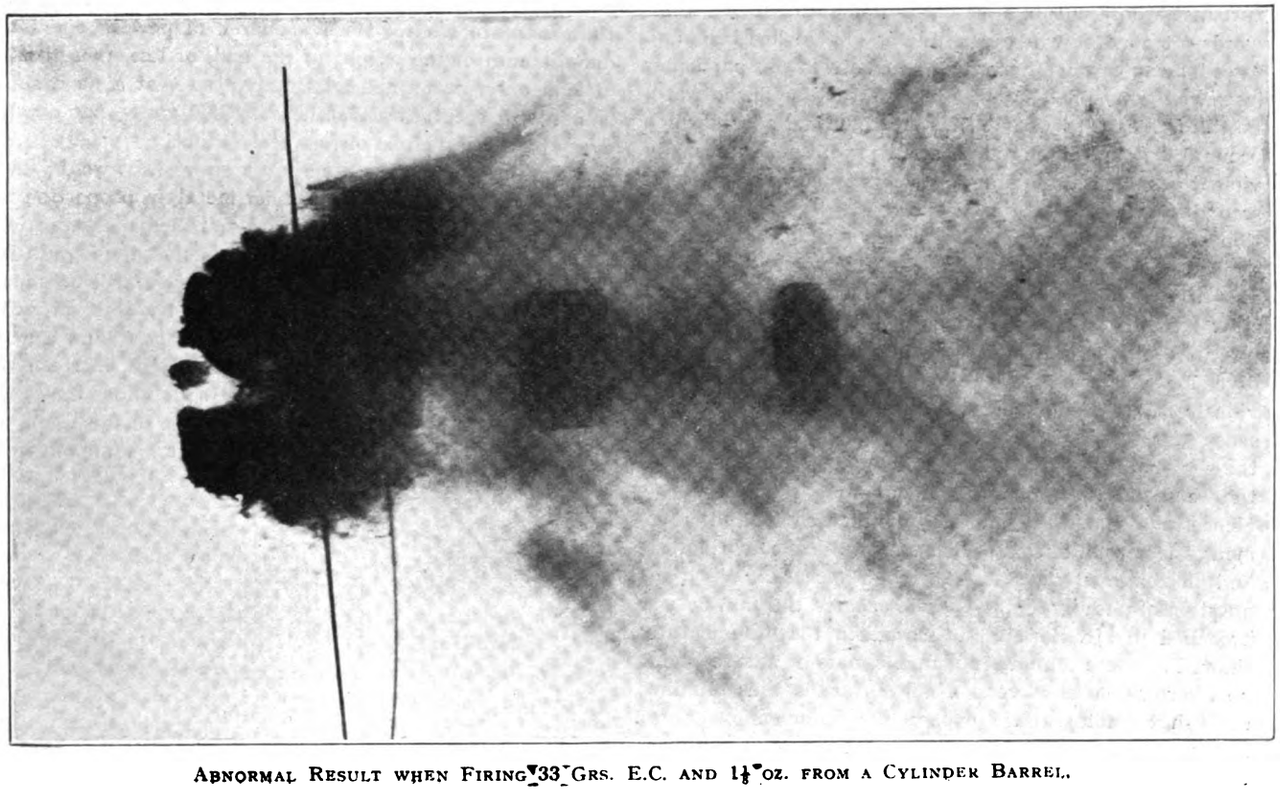
The Jacob Pamphlet.—The conclusion of the reprint of Major Jacob's pamphlet of fifty years ago teaches the modern student of ballistics a lesson of painstaking research which should not be wasted. It inferentially shows that the match rifle was then and remains to-day the most exact instrument of small arms research. Notwithstanding the achievements of electrical science there is no instrument which resolves the properties of a bullet to their exact mathematical components with the same exactitude as the measurement of its angle at long ranges. So important is this principle of working that trajectory observations will henceforward occupy an ever increasing ratio of prominence in research work, whether the weapon tested be the humble air-gun, the ·22 rifle or the latest creation of a Sir Charles Ross. The fact that Jacob lived fifty years before his time need not discount the value of his researches to-day. The natural impulse in all these matters is to believe that this particular orange has been squeezed dry. The pointed bullet certainly exhausts the visible opportunities of diminishing air resistance, but that does not alter the central fact that match rifle shooting enables a man to get on terms of close intimacy with his weapon in a manner that the less scientific forms of marksmanship seem unable to emulate. Much of the instruction which might otherwise be derived from miniature rifle practice is inaccessible in the absence of any mode of sighting which enables shooting to be conducted with true zero elevation. With the rear sight fixed on the butt of the rifle this disability would cease, and there can be little doubt that the advanced miniature shot would soon learn to appreciate the virtues of the back position of shooting.

SHOT PHOTOGRAPHS—THIRD SERIES.



EFFECT WHEN FIRING 40 GRS. E.C. AND ⅞ OZ. OF SHOT FROM A CYLINDER BARREL.

IT is difficult to decide just what theory or preconception is illustrated in the accompanying shot photographs. The upper one shows the appearance resulting from the use of 40grs. of E.C. powder and ⅞oz. of No. 6 shot in a cylinder gun. The degree of lateral spread seems certainly to be enhanced in the presence of conditions whose accepted result is exceptional scattering of the charge on the target. This picture again affords evidence that the truly interesting things have already happened. The elongated effect produced by the streaks of gas and case fragments suggests the sorting out effect which occurs when bodies of different density are projected into air with the same initial velocity.



ABNORMAL RESULT WHEN FIRING 33 GRS. E.C. AND 1⅛ OZ. FROM A CYLINDER BARREL.

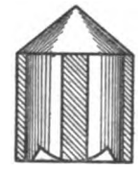
The heavy shot charge carries on, taking the top wad along with it, whilst the wads behind the shot show that the impeding effect of the air has already begun to tell its tale. The solid-looking object which shows up between the wads may consist of a fragment of paper which has become detached from the cartridge case or even from one of the wads. It tells no obvious tale, not so obvious at any rate as the clear definition of the under side of the charge. The sharp line of demarcation between the shot and all its satellites on the one hand and the free air space on the other, clearly implies that the charge is forcing its way by sheer momentum through air undisturbed by gas blast from the gun. The lower picture depicts something so entirely different as to throw an important ray of light on a curious phenomonen. Readers of shooting literature were not informed till about five years ago that about one pattern in ten showed a degree of scatter entirely inharmonious with the other rounds of the series. Every one knew that these things occurred, but their existence was ignored by deleting them from the record as a kind of experimental mishap or error. Anyhow this photograph shows the same degree of abnormality near the muzzle as is correspondingly found on the 40 yards plate. The forefront of the charge seems to be split asunder, and the bisection by a curious coincidence gives the impression of a monkey cracking a nut. Assuming for the moment that it is really one of the one-in-ten scatter patterns, the curious forward split is here associated with an extraordinarily large area of disturbed material behind the charge. The lateral expansion of the gases is unusually great, and presupposes some kind of disturbance whose effects have only just subsided. In other words, at a point where usually the charge has begun to force its way through uncontaminated air, in this particular instance the troubled area has been carried further forward. Is it in fact rash to assume that the abnormal effects which occur about once in ten rounds are the result of an unusually violent gas blast resembling in its consequences a species of secondary explosion at the muzzle of the gun ? The formation of every cylinder pattern which has so far been examined suggests that the gases, at the moment when the rear of the shot charge leaves the muzzle, find their first clear vent in the annulus which is created by the relative positions of the shot charge and muzzle orifice. Their diversion from the forward direction which they had previously taken inside the barrel, naturally implies the presence of a resisting and deflecting body, viz., the base of the shot charge. The resisting medium is itself plastic in the sense that it consists of numerous separate parts. Hence the pellets of the charge take on a compound movement, the normal form of which is shown in the first picture, and an abnormal one in the second picture. When the question of photographing the shot nearer the muzzle was broached to Mr. Borland, he explained that the pictures showed no more than an indefinable mass of smoke giving no information whatever. Confirmation is thus obtained that shot photographs display the happenings at the moment when the charge draws clear of the cloud mass near the muzzle. Possibly a means may some day be found for taking a photograph before the cloud mass has formed.

III.—THE PIONEER OF POINTED PROJECTILES.

THE third and final instalment of Major Jacob's pamphlet of 1855 is now presented. At the conclusion of the last division of his matter he was discussing the reasons why rifles do not display their best shooting when fired from a fixed rest. He particularly referred to the state of vibration to which the barrel becomes subject the moment any part of it is firmly grasped. The knowledge he so carefully conveyed has since been reacquired. Having thus explained the comparative failure of the War Office experiments as a test of accuracy, his next criticism was directed at the methods employed for judging elevation :—" In these experiments by the committee, also, the rifles were laid with a gunner's quadrant ; which does not seem to be a workmanlike or effective method for small arms. A long folding sight with slide, is by far the best method of elevating the piece, whether in actual use in war or for experimental practice. These sights should be made with springs, both to the sight itself and to the slide, to prevent their working loose and falling down of themselves.

" Since the date of these proceedings, the experiments of Jacobabad have been continued with a great many new rifles, and with curious and important results ; such, that the progress made throws all former proposals for improved balls for rifles for the army, in the background. The ball No. 6 of the foregoing memorandum, there described as of perfect shape, is indeed so, so long as it retains that shape in front. With a charge of powder equal to one-fifteenth of the weight of the ball, or less, these balls, of lead only, performed admirably ; so that a good shot could, with them, at a distance of 1,000 yards, put nearly every ball into a circle of four feet radius.

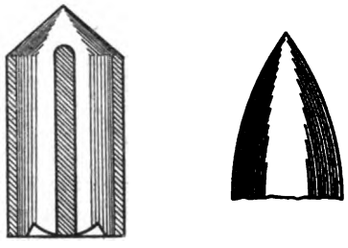
" Nothing could have been better so far as it went ; but rifles were now procured of heavier metal, in proportion to the bore of 16 and 24 and 32 gauge, and the balls were tried with larger charges ; it being supposed that they could be used with advantage with an initial velocity at least equal to that used with the ordinary round ball. It proved, however, on trial, that such was not the case, and a new law was at once developed. A very slight increase of charge caused the lead to change its shape under the pressure of the gunpowder ; so that the balls of the shape of the ball No. 6 when inserted into the barrel, came out in a form resembling the annexed sketch.



Shape after Firing.

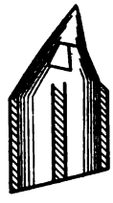
" It was in vain attempted to remedy this by lengthening the ball, which was increased to two-and-a-half and three

diameters ; and, by making holes in the afterpart, as in the Minié ball. Wads also of all manner of kinds, loose, and attached to the balls in various ways, were employed ; but without avail. The lead was found totally incapable of preserving any resemblance to its original form, under the pressure of a charge of powder equal to one-eighth of the weight of the ball. The balls of three diameters in length, from the 24-gauge guns, whose fore-part was shaped as that of the ball No. 6, came out of the rifle in the form here shown.



Shape after Firing. *Shape of the Fore part of these Balls before Firing.*

" These proved the best of all the lead balls, and ranged, with deadly force and considerable accuracy, up to 1,600 yards, or further ; but of course all advantage of the peculiar form adapted to overcome the resistance of the air was lost. Manton's steel points were tried with these balls ; but these were worse than the others ; the lead was squeezed forward by one side of the point in an irregular manner ; the ball assumed this shape, and would not fly truly.

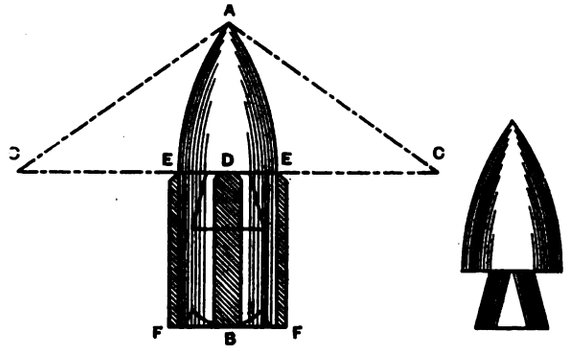


" The limit of the powers of leaden balls had thus been attained ; and to proceed further, it became necessary to find a method of constructing rifle balls so that the fore-part should be capable of sustaining the pressure of large charges of fired gunpowder without change of form, and thereby retain that shape best adapted for overcoming the resistance of the air, on which all accurate distance practice depends ; and at the same time having the part of the ball next the powder sufficienty soft and yielding to spread out under its pressure, so as to fill the barrel and grooves perfectly air tight. This problem was speedily solved ; the fore part of the ball was cast of zinc, in a separate mould, of the shape of the annexed sketch ; (*see opposite*).

" These points were placed in the full sized mould, and the lead cast on to them, the complete ball being formed as shown in the diagram. I was, at first, doubtful whether the small specific gravity of the zinc would not prove of disadvantage so great as to overcome the benefit of its hardness ; but, on trial, nothing could have proved more perfectly effective. The 24-gauge balls of the increased length of two-and-a-half and three diameters—especially the latter—proved admirably effective at ranges up to 2,000 yards, which had never before been attained.

" No change whatever took place in the form of the zinc fore-part of the balls with the largest charges, while their penetration was found enormous, being not less than four inches at 2,000, and nearly three times that depth at 1,000 yards, into very hard dry Cutcha brick. At the same time the accuracy of the flight of these balls was truly wonderful.

" It may be here remarked that in the published reports of the Enfield rifle practice, it is stated that the twist of the rifle grooves throws the ball to the right or left, according as a right or left handed screw may be employed. This seems to be wholly erroneous ; no such effect is observed in my practice. There may be some such *tendency* to deviation from such cause, but it must be of small amount, and is not perceptible.



Rifle Ball complete, with the Fore Part of Zinc or Iron. *Zinc or Iron Point.*

AB = 1½ diameters. DB = ditto. DC = 2. AC = 2½.
From E to F the Ball is cylindrical.
From E to A its sides are defined by arcs of circles described from the centres C with the radius CA.

" The real facts of the matter seem to be these : considering the person of the rifleman as a cylindrical column, the recoil of a gun fired from the right shoulder is a force acting at a distance from the axis of that column, and therefore tending not only to drive it back, but to run it round on its axis. The muzzle of the gun, therefore, must receive a certain degree of motion to the right hand when fired. It was found here, in many thousands of trials, that on a calm day the balls of the guns which recoiled with the greatest force, fired from the right shoulder, always deviated to the right hand ; this deviation amounting to about twenty feet at 800 yards.

" That the cause of this is correctly assigned above is thus proved. The same gun fired from the *left* shoulder *threw* the ball to the *left*. With the guns recoiling most, such as the 8-gauge rifles, used with a four-ounce ball and three-drachm charge, the deviation was very great ; with the 32-gauge rifles, of which the recoil was slight, this regular deviation did not occur at all. These effects were observed *always* to occur, without any respect whatever to the amount of twist given to the grooves of the rifle. In

practice a perfect remedy was found for this deviation, or for any other similar errors caused by the action of wind or anything else. When taking aim, leaning the gun over a little to the left perfectly counteracted the deviation to the right; and by practice the habit is formed of instinctively adjusting the amount of the lateral indication(*sic*) thus given to the sight, so as correctly to compensate the error. Thus the matter stands at present. The limit of the powers of these missiles has, I am certain, not yet even been approached.

"The points for such balls could probably be made wholesale of cast iron; when the ammunition could be prepared at no more cost than the common musket cartridges; while the power of this weapon would be about three times that of the best Minié rifles. I have tried every expedient I could think of as a substitute for the greased patch for rifle balls, but always had to return to this. Any species of wad, however attached to the ball, retards its flight so much as to render distant practice impossible, whatever may be the initial velocity used.

"The best method I am acquainted with of preparing military rifle ammunition, is to stitch slightly to the balls, patches of thin cotton cloth completely deprived of starch (or conjee), and then to dip them in melted tallow. The fore-part of the ball being hard, cannot be injured by any maltreatment by the ramrod, nor by knocking about against each other, and are best carried loose in a pouch; the powder being in blank cartridges in a separate partition. Such arms would be found worthy of our noble English soldiers. Their use implies skilful workmen in our ranks, instead of pipe-clayed automatons. The proper use of such arms implies an entire change in our tactics, so as to give full scope not only to the bodily, but to the high moral and intellectual powers of our men." (The author at this point becomes somewhat discursive on the subject of the selection and training of the British soldier.—ED).

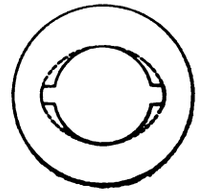
* * * *

"With such infantry, so armed, our artillery must be abolished, or *improved*. For cannon, especially field pieces, similar shot to these found so effective for small arms might be used, perhaps, with advantage, instead of the shot with wooden bottoms formerly proposed by me. The only objection seems to be the cost of the lead; which, however would not probably be very great, as the quantity may be much reduced by making the dove-tailed tenon of the iron larger. Shot, partly of lead, for rifled cannon, have been, I understand, not long ago tried and found to fail at Woolwich; but these proposed by me are of entirely different construction, and seem free from the defects of the others.

"Nothing but actual trial can decide the merits of these things; and if such trials be made, it should be borne in mind that great weight is essential to the correct performance of rifled cannon. The observations on the vibrations of the barrels of small arms tell here with redoubled force. Strength to resist the bursting force of the powder is by no means sufficient; weight and mass are required; and, whatever the strength may be, the rifled cannon should not be of less weight than one hundred and twenty times that of its shot.

"Judging from experiments made, as an old artillery officer as well as a rifleman and practical mechanic, I am deliberately of opinion that a four-grooved rifled iron gun, of a bore of four inches in diameter, weighing *not less* than twenty-four hundredweight, could be made to throw shot to a distance of ten miles, and more, with force and accuracy.

"The 'Lancaster' guns *must*, I think, fail. The mode of rifling adopted in them is the very worst possible. It is only the two-grooved rifle in disguise—thus:



"Let the shoulders of the grooves of a two-grooved rifle be removed, as shown by the dotted line in the sketch, and you have the Lancaster rifle. But by the removal of these shoulders, the friction, if the twist be considerable, becomes *enormous*: the ball and the bore are not quite round, but nearly so, wherefore, as the ball is compelled to follow the twist of the bore, it acts like a "cam," and endeavours to burst the gun; or the dotted part in the sketch becomes a very acute wedge, which the spiral motion causes to be driven with great force into the bore as the ball is driven out.

"The heat developed by the friction must be very great, and the tendency of the gun to burst, or the shell to crush, also very great. It would be far better than this to use a 4-grooved rifle with projections on the ball, *even of iron*, with a greased leather patch.

"One more remark appears requisite. The experimenters at Enfield have published the opinion that great twist to the grooves of a rifle is of no advantage. This does not accord with my experience; or at least does not apply to the balls used by me. The twist I use, and which I find best, is one turn in twenty-four inches, or more than double that recommended by the Enfield gentlemen. This I find necessary to maintain the spiral motion of the ball quite up to the last, in the long ranges attained by my rifles; and a rapid spiral motion is necessary to preserve the light end of the ball truly foremost throughout its long flight; which it is perfectly successful in doing.

"I have now little time for carrying on further experiments with rifles, being more than fully occupied with public duties: but when opportunity occurs I purpose continuing them: and meanwhile, enough has been done here to aid, perhaps, in pointing out the way and smoothing the path for others."—*Jacobabad, on the Desert of Upper Sinde, March 20th*, 1855.

The report by the Liquidator of the Colt Gun and Carriage Company states that the claims in front of the ordinary shareholders comprise, in addition to the costs of liquidation, about £15,000, which at present there seems very little prospect of obtaining. It is proposed to offer by auction the whole of the assets of the Company, in view of the failure to dispose by private treaty of the patent rights and stock.

ROUND THE TRADE.

The four days ending April 17th next have been fixed for the International Pigeon Shooting Meeting at Florence.

The Russian Powder Manufacturing Company, St. Petersburg, made a profit of 435,268 roubles, and declared a dividend of six per cent for its twenty-third (1907) working year.

A further demonstration of Hale's patent grenade took place at the Cotton Powder Company's works on the 10th ult. in the presence of attachés and other experts interested in military equipment.

Mr. H. M. Chapman, whose name has for so long been associated with the manufacture of smokeless powders, has for private reasons, resigned the important managerial position he has held at the Tonbridge powder works since he succeeded Mr. André.

The firm of Cogswell and Harrison Ld. have been successful in securing from the holders of the British patents, a contract for manufacturing the Sjogren automatic shotgun. The guns will be made on an interchangeable basis at the Gillingham Street factory of this Company, which is equipped with a complete outfit of repeat machinery.

Holloway and Naughton Ld. is the name of a private company which has been registered with £6,000 capital to acquire the business of Holloway and Company, gunmakers of Vesey Street, Birmingham. The formation of the Company follows the sale of the business, (which previously belonged to Mr. H. L. England), to Mr. T. Naughton, who has acted as manager for some time past.

The report and balance sheet of Messrs. Eley Bros. Ld. shows a welcome improvement on the previous year's trading results. The profit for the year is £18,680, as against £11,263 a year ago. Directors' fees and interest on debentures absorb £4,250. The following depreciations are then written off:—Angel Road Estate £1,712, Leaseholds £150, Machinery and Plant £5,195. The balance then remaining is £8,920. The directors recommend a dividend at the rate of 6s, per share free of income tax, which is at the rate of three per cent. These appropriations leave £1,420 to be carried forward, as against £1,047 brought into the account.

The N.R.A. report for the past year is an exceptionally bulky volume due to the inclusion of a detailed report of the tour of the British rifle team through Canada and Australia. The rifle clubs also require an increasing share of space. The Boys' Bisley is another comparatively new development which occupies its own section of the annual report. The financial statement is practically the only portion of the volume which represents essentially new information. The swing of the pendulum has unfortunately thrown the accounts into a state of deficit, the loss on the year being £916 odd. Diminished entries is the suggested explanation. The sustained and progressive loss under this heading is found to be very serious when for statistical exactitude the large number of side show competitions, which have developed enormously during recent years, are excluded from the comparison. The present activity in the territorial movement, coupled with this year being the fiftieth anniversary of the Association, will no doubt cause a momentary check in the decline. The underlying cause is not so much the result of diminished interest in shooting, for this is undoubtedly on the increase, as to the ever-growing skill of the band of Bisley experts who practise assiduously through the spring and monopolise the prize list when the big meeting comes along. The small man coming from a a distance suffers a considerable disadvantage, and the Association shows wisdom in developing the side shows.

The South Russian Powder Factory and Explosives Company, Kieff, made a loss of 16,409 roubles in its fifth (1907) working year.

MESSRS. Curtis's and Harvey show justifiable pride in the success which has accompanied their one departure from ordinary routine manufacture. Their "Ironclad" incandescent mantle has just received an independent testimonial in the *Municipal Journal* in the form of an expert article by a road surveyor in an important district to the effect that he has tried every other make of mantle and finds the "Ironclad" the most economical.

Dr. T. R. R. Ashton, whose promising career on the engineering staff at Woolwich Arsenal culminated in his appointment in 1905 as superintendent of the Enfield rifle factory extraordinarily early in life for such an important position, has been forced to resign as the result of ill-health. Great things were justifiably expected of him, but fate willed otherwise. In proof of the extraordinary importance which is attached to having a first-class man in charge at Enfield, Sir Frederick Nathan of the Royal Gunpowder Factory has been appointed to the vacant position. The efficient methods which have been the keynote of his administration provide the only possible excuse for depriving Waltham Abbey of his services. The natural assumption is that the gunpowder factory must now get along without him in view of Enfield's greater need.

The Chamberlin Cartridge and Target Company of Cleveland, Ohio, have forwarded a catalogue, accompanied by a letter, drawing special attention to a new clay bird trap they are putting on the market, the same being adapted to throw a special round ball with a relatively slow curved flight, adapting it for small rifle practice. The opportunities for rifle shooting of this promiscuous character are so few in this country compared with America as to restrict the demand, but there is no doubt that Messrs. Eley Brothers, who act as agents for the Chamberlin Company's "Expert" traps and birds, would arrange the necessary importation of a trial consignment if serious interest were shown in the idea. The ball trap might prove on test to be specially adapted for teaching boys to shoot. Those who have had experience in this direction will have noticed the disheartening effects of the ordinary clay bird in the very early stages of tuition.

A correspondent writes:—Notwithstanding the very strict import regulations with regard to arms in Russia, the deliveries of sporting guns have steadily increased, and after making allowances for all kinds of revolvers smaller guns, etc., this business amounts to about £80,000 a year. England, Belgium, Germany, and the United States are the principal sources of supply. Inferior quality guns are made in the country itself, Thula being the centre of the industry. The retail prices of sporting guns range from £2 12s. to £32 5s. Belgium supplies most of the cheaper guns and is far ahead of Germany, United States and Austria. Practically only the more expensive qualities are bought from England, and the English gun enjoys a very good reputation throughout the whole country. The Russian sportsman of the better class is favourably disposed towards the more expensive article, and this explains his partiality for the English-made weapon. English guns are principally bought by the retailer through the agents of London houses, and the business is nearly always a cash on delivery one, but German and Belgian firms of manufacturers, who as a rule have agencies in Russia, have begun during the last few years to give credit, extending in some cases to over half a year. English firms would undoubtedly enlarge their turnover with Russia, by paying more attention to the requirements of the market and by occasionally sending a representative to call upon the better-known dealers.

(*Continued on next page*).

Mr. Peddie's connection with the Vickers-Maxim Company has produced various evidences of their new sphere of activity. A circular descriptive of windgauge rifle sights, and offering the same for sale, has been issued. The sight comprises a folding leaf interchangeable with the present fitting, and carrying mechanism for vertical as well as lateral adjustment by means of screws. Each bar carries two alternative modes of alignment, including a notch and an aperture, a slit and an aperture and two apertures. The son of Sir F. W. J. Barker, Superintendent of the late Government factory at Sparkbrook, who was employed in the office of the B.S.A. Company, has now joined the staff assisting Mr. Peddie.

Mr. Jesse Collings will again introduce his bill for extending to Scotland and Ireland the provisions of the Proof Act so far as they at present apply to England only. The Birmingham Chamber of Commerce, who have taken the initiative in getting the bill brought forward, are especially anxious that it shall be so well understood by all concerned as to be free from the risk of opposition at the last moment by some misunderstanding gunmaker or dealer. Such a mishap would wreck the chances of the bill passing into law this session. The bill, as presented at the last Parliament. has been freely circulated, and it stands as an entirely independent measure from the Proof Act, containing as it does its own definitions, penalties and so forth. Its sum and substance is that firearms sold etc. in Scotland and Ireland must have been properly proved beforehand.

A case having been stated for the High Court in the matter of Mr. Robert Gray's prosecution to elucidate a disputed reading of the Pistols Act, the gun trade section of the London Chamber of Commerce have issued an appeal for subscriptions to a guarantee fund for fighting the case. The point at issue was fully explained in the summary of the considered judgment, delivered by the Clerkenwell magistrate, which appeared in the last December issue. Briefly it refers to the right of householders to purchase pistols for the purpose of house protection without the necessity to comply with the much more stringent regulations which apply to persons going abroad. The police authorities endeavoured in the action against Mr. Gray to substantiate a reading of the Act different from that which had previously been recognised by everyone concerned. The magistrate, whilst criticising the grammatical construction of the clause under dispute, gave judgment most emphatically in favour of the accepted rendering. In such circumstances it is vitally important that the arguments in favour of the less onerous reading of the Act should be advanced by counsel instructed on behalf of a body representative of the trade.

The B.S.A. Company have just issued the earliest models of their new ·22 bolt rifle for examination by the press and other persons specially interested. The retail selling price has been fixed at 30s., and the weapon represents a higher standard of value for money than can be called to mind in any other rifle, wheresoever made the world over. Its chief point of merit is ingenious and efficient design combined with high class manufacture. There have been many attempts to apply the bolt system of action to the ·22 rim-fire cartridge; but few, if any, of these rifles can be passed as entirely satisfactory. The reasons are various, but the chief stumbling block is the difficulty of completely protecting the thin metal case from the liability to burst under high pressure. The unpleasant consequences are too numerous to mention, but shooters emphasise their opinions on the subject by mostly using non-bolt systems of action, and putting up with the inconveniences of inefficient or non-existent ejection. In the rifle under notice altogether exceptional pains appear to have been taken to consummate the bolt action ·22 rifle. The weight is a trifle over 6lbs., total length 41 inches, length of barrel 24 inches. The body and the barrel are framed from one bar of metal.

The firm of Dan. Fraser and Company, gunmakers of Edinburgh, have opened a London office at 48 Dover Street, Piccadilly, the same having been placed in the charge of Sergt. H. Ommundsen, one of the most brilliant of Bisley's younger shots. He is admittedly a veteran in the sense of having first shot at Bisley in 1897, winning the King's Prize in 1901 and sundry other important successes before and since. The law originally claimed his attention during working hours, but like the great Lord Armstrong he has deserted law for guns, and everyone will heartily wish him success in the new undertaking.

Mr. Oscar Guttmann has achieved lasting reputation by the issue in book form of his recent lectures before the Royal Society of Arts detailing the progress of explosives during the past twenty years. In discarding the bubble reputation to be gained by delivering a popular lecture he has laid the foundations for a more lasting effect. The statistics and records which sounded dry and uninteresting as they came pattering off the tongue acquire a new life and vigour now that they can be studied in library book form. The author's power, peculiar to himself, of amassing and classifying the developments of all nations on the subject of explosives, coupled with real first-hand information and creative power of his own, constitute the most valuable equipment with which to write contemporary history. Therefore there is no hesitation in advising everyone interested in explosives, directly or indirectly, to order the three-shilling volume entitled *The Manufacture of Explosives; Twenty Years' Progress*, which Messrs. Whittaker & Co. have issued.

The newspapers which have taken up the subject of foreign manufactured rim ammunition have been especially eloquent on the rank injustice of Home Office regulations which deny facilities to the home manufacturer, thereby crippling his power to compete with the foreigner. Great as is the currency which has been given to this statement it is curious that it is based on an entire misapprehension of the working of the Explosives Act. Certain things are classed as percussion caps and others as detonators, and there exists between the two a kind of no man's land which the newspapers, no doubt under inspiration, have assumed must be regarded as the territory of the detonator. For ·22 cartridge cases to be so classified, and therefore to be subject to the exceptional precautions which are ordained, would clearly introduce difficulties of manufacture, but in point of fact the definition is on a footing with that of safety cartridges. The manufacturer adopts his own view of the situation, and the onus rests on him, and not on the Home Office, of proving in case of accident that he is in the right.

The cartridge makers in this country might grant one concession to their customers in return for the general increase of price which has come into force within the past year. It is well known that a large surplus of named cases remains over after the round number orders given by gunmakers and other loaders have been executed. These should not be jumbled up with positively defective cases, rejected in the course of manufacture, and be roughly loaded for sale as inferior grade goods. It is a libel on any well-known gunmaker or powder manufacturer that cartridges bearing his name, but not his "goods or merchandise," should be used in a manner calculated to damage his reputation. The right course would be to destroy scrap absolutely, and for ever abandon the foolish policy of putting on the market cartridges which have no business outside the breaking-up house. Gunmakers might assist by removing the only legitimate justification which exists for the sale of "job" cartridges by accepting as a trade custom that all orders for named cases or cartridges should be given for a specific number plus or minus some arranged percentage to cover the manufacturer's margin.

THE AMERICAN SPORTSMAN AND HIS RIFLE.

By EDWARD C. CROSSMAN.

FOR the past forty years, the American sportsman has bought his arms by a strange plan. While admitting the necessity for the expenditure of a reasonable amount of money to obtain a really good fowling piece, and while he has proved his readiness to pay for a good double gun, yet the tendency has been to be satisfied with, and even to insist upon, the cheapest rifle that could be turned out by machinery and still be safe.

It is the rule, not the exception, to find an American sportsman equipped with a good double gun costing at least $150.00, but for the rifle end of his outfit, shooting a Winchester or a Marlin or a Savage costing anywhere from $14.50 to $19.00. It seems to be more a matter of habit than any other reason, the first American repeating rifles were made by machinery at a low price and the public has been educated to paying just about so much for its rifles, and no more. No one has ever advanced the argument that the American rifles cannot be much improved, both in design, material and finish, their cheapness and perhaps their accuracy in some calibres is about the only point in their favour. A good many cheap shotguns are sold, of course, in the United States, and it is easy to understand that if a man cannot afford to pay more than $30.00 for a double hammerless gun, he would object to paying more than $20.00 for his rifle. This does not explain, however, the reason why wealthy sportsmen, able to pay almost any price for their rifles, should buy expensive imported English, or German, or French, double guns, costing perhaps from $150.00 to $500.00, to kill birds or break clay pigeons, and yet will walk into a gun shop and be satisfied with a roughly made and roughly finished machine-made rifle, retailing for $15.00 and costing perhaps $8.00 to make. The breaking or the getting out of order of the shotgun would mean nothing more serious than the loss of a day's sport, perhaps. The breaking or jamming of a rifle might mean getting to close quarters with some maddened beast, and the consequent carrying of scars to his death-bed, if not the loss of his life from the teeth and claws of the animal. It seems to be more of a habit than any other reason and the American manufacturers have encouraged the idea. If a man happens to be a rifle lover and wants something better than the average run of the American rifles, all his money will not get him anything better than the regular stock rifle, except for the superior wood in the stocks, a little engraving on the outside of the rifle and a little gold inlaying on the receiver. The finish of the parts and the care with which the rifle is made will not be a whit better if $200.00 be spent instead of $20.00 and the material will be the same.

This is not on account of the rifles being made of perfect materials as they are turned out, or that they are finished nearly to perfection in the regular stock grades. Far from it, for most of them are finished in a way that would not be tolerated for a moment in a shotgun, the parts rough and poorly fitting and the insides of the receivers and locks left almost as they were when taken from the drop forging machine, except for the necessary milling to bring them to the requisite size and shape. The majority of the rifles are clumsily put together, having a multitude of screws and pins which must be taken out if the rifle is to be dismounted and cleaned. The accuracy of the smaller bored American rifles is nearly perfect, more attention being paid to the barrels than to any other part. A small-bore Stevens make rifle is equal to practically any rifle made for accuracy, regardless of its price, but it is a poor weapon to look at and one in which the gun lover cannot take much pride. In the high power rifles, however, such as the ·30–30 and other calibres, using high pressure powder and metal cased bullets, the accuracy is not nearly so good. The barrels are bored too large, gas cutting takes place, the ammunition is not made any too carefully—in the purely sporting cartridges at least, and the resulting combination is a rifle which is soon gas cut from the poor fit of the bullet and which never, even when new, gives the accuracy which it should give were a little more care used. One cannot blame the ammunition makers, there is but little use making sporting ammunition with the utmost care, when the rifles in which it is to be shot are not bored accurately. The ammunition companies *can* make ammunition as good as any in the world, they have proved this in their stuff turned out for military target shooting.

As it becomes necessary to go further and further from home every year to get the big game shooting, and the gunsmiths are left back with civilisation, scores or hundreds of miles away from the hunting fields, an increasing demand has arisen among the American sportsmen for rifles that can be taken apart without a full set of tools or a half a day's time, in case of a dirty rifle or a jam within the receiver. They are beginning to demand rifles which have not the thousand and one parts of the ordinary American repeater, the small pins, and springs and dogs and rockers, and other things liable to go wrong at the critical moment or break when there is not a man within fifty miles able to replace them.

They are beginning to see the beauty of a rifle which has practically no small parts to break or get out of order, a rifle which carries its cartridges one above the other in a magazine in the receiver, not strung out in a long tube under the barrel, to destroy the balance of the rifle and to batter the points of the bullets until accuracy is lost, and jams take place when the deformed ammunition arrives at the chamber.

The bolt action is becoming more and more popular in the States, as the sportsmen realize its advantages. That it is not more popular than it is, is because the bolt action is not used by a single American maker at present. The Lee action was used by the Remington factory up to a short time ago, but this factory has discontinued its manufacture in favour of the automatic rifle which the Remington concern is at present making. The Winchester com-

pany no longer make their Lee Straight Pull, although a few of both the Lee Remington rifles and of the Lee Straight Pulls may be bought around the country from the stocks of the larger dealers. This is no loss, as the Lee action as used by the Remington was a poor one, and the Lee of the Winchester was worse. Probably nineteen out of twenty of the bolt action rifles used in the States at present, are by German makers, Sauer-Mausers, Waffenfabrik-Mausers, Sauer-Mannlichers, Haenel-Mannlichers and Mannlicher-Schoenauers being the most commonly used.

While a great many of theser ifles are semi-machine made, as the American has not been educated up to paying the price for a rifle, necessary were it hand-made, yet the finish on these arms much surpasses that of the American arms, the balance of the German arms comes nearer that of a fine shotgun than any rifle sold in the States, and made there, and last but not least, they are of the cliploading, bolt action type that is to eventually drive the older, lever action repeaters out of the market. These arms range in price, in the States from $20.00 to $75.00, the cheaper ones being by Haenel or Schilling, and the rifle selling for $75.00 being the Mannlicher-Schoenaur, made by a German concern. The price of $75.00 seems like an enormous sum to pay for a rifle to the sportsman who has been in the habit of getting his shooting iron for $15.00, but the difference in the arms is beginning to be appreciated, so that the price is forgotten in the quality of the weapon.

The Germans have the market to themselves as far as imported rifles are concerned and the importers are advertising far and wide. The demand for the fine foreign rifles is just about commencing and the impossibility of getting the bolt action, either Mauser or Mannlicher, in any rifle except a foreign one, is increasing the sales of these arms.

The English makers appear to have forgotten or overlooked the market offered in the States by the changing demand for rifles. Not a single English rifle is advertised in any of the American sporting publications, although double guns made by Scott, Greener, Westley-Richards, Purdey and Jos. Lang are well known in America.

It costs a great sum of money to put in machinery necessary to turn out bolt action rifles, and, until they are forced to do so, the American makers will not use their capital in this way. It looks as though the foreign rifle makers, turning out bolt action rifles at a reasonable price, should find a good market in the States, as the simplicity, strength, durability and reliability of this style of action become known as it should be.

That there exists a good market, even at the present time, is shown by the constant advertising that is done by the importers, or manufacturer's agents, handling these German bolt action rifles. While of course, steady hammering, year after year will create a demand for any good article, still this is not the campaign that is being carried on by these sellers of German rifles. They cannot afford to spend much money in advertising in the hopes that the far distant future may bring in results justifying this expense. They must see sales each day or they would soon discontinue their extensive advertising.

(To be continued).

THE MANUFACTURE OF GUN-COTTON IN AUSTRIA (1863).

By GEORGE W. MACDONALD, M.Sc.

The Committee of the British Association had before them details of the method of manufacture of guncotton in Austria, and also submitted to Baron von Lenk a great number of questions, to which he replied in detail. In addition, there was also a report, by three of the foremost Austrian chemists of that time, upon von Lenk's guncotton, and the system of manufacture. Extracts from all these sources have been embodied in the present paper.

System of manufacture of guncotton as carried on in the Imperial Austrian Establishment.

(1) The cotton employed is of superior quality, tolerably free from seed ; it is carded loosely, twisted, and made up into skeins before conversion. The strands of the cotton composing the skeins are of two sizes—the larger being intended for cannon-cartridges, and the other for small-arm cartridges and bursters.

(2) *Preparatory treatment of the cotton.*—The cotton, made up into skeins weighing about 3 ounces each, is washed in a solution of pure carbonate of potash of a specific gravity of 1·02, being immersed in the boiling solution for a short time. Upon removal from the alkaline liquid, the skeins are placed in a centrifugal machine, by which the greater portion of the liquid is separated. The skeins are now washed in clear running water, either by allowing them to remain in it for three or four hours, or else by washing each skein by hand for a few minutes. They are then again worked in a centrifugal machine and afterwards dried—in summer by the rays of the sun, but during winter in a drying-house heated by air-pipes to between 30° and 38°C. ; the latter plan usually takes four or five days.

(3) *Production of the guncotton.*—The nitric acid employed has a spec. grav. of 1·53, and the sulphuric acid a spec. grav. of 1·82. They are mixed in the proportion of three parts by weight of sulphuric acid and one part of nitric acid.

Two skeins (about 6 ounces) of the cotton are immersed at one time in the mixed acids, and moved about for a few moments with iron paddles. They are then raised upon a grating above the level of the acids and submitted to gentle pressure ; thence they are transferred to covered stone jars, each of which received six skeins of known weight. The jars are then weighed, some of the mixed acids being added if necessary, to bring the proportion of acids up to 10½lbs. to 1lb. of cotton.

The jars are set aside for forty-eight hours in a cool place ; in summer they should be placed in cold water. When that period has elapsed, the acid is separated from the cotton as far as possible by means of a centrifugal machine, as before described. The men working the machine are protected from the fumes of the acids by a wooden partition. The acids removed from the cotton are not used again in the preparation of guncotton.

The skeins of guncotton are at once removed from the centrifugal machine to perforated receptacles, which are immersed in a stream, where they are allowed to remain at least three weeks. Each skein is afterwards separately rinsed in the stream to remove mechanical impurities, and the water is then separated by the centrifugal machine.

The guncotton is next submitted to treatment with a solution of carbonate of potash, as in the preliminary process, and again washed after the alkaline liquid has been expressed. When the skeins have been allowed to dry tolerably by simple exposure to the air, they are placed in a large wooden tub containing a solution of silicate of soda, the temperature of which is about 15°C. This solution should have a specific gravity of 1·072, and is prepared as required from a solution of spec. grav. 1·216. The cotton remains one hour in the solution of silicate of soda, which is supposed to exercise two functions :—

(*a*) That of protecting the cotton by acting as a varnish upon the fibres.

(*b*) That of retarding its combustion.

Upon removal of the guncotton from the bath of water-glass, the liquid is partly expressed by hand, and afterwards more fully by means of the centrifugal machine. The skeins must then be thoroughly dried. They are afterwards immersed in running water for five or six hours, and each skein subsequently washed by hand. The water having been extracted by the centrifugal machine, the guncotton is removed to the drying-house, where it remains eight or ten days. Its manufacture is then completed. The guncotton is packed in ordinary deal boxes lined with paper, and kept in dry magazines until required to be made into cartridges, etc. Well-organized arrangements are employed for mixing the sulphuric and nitric acids, immersing the cotton, and for conducting the various other operations connected with the manufacture.

Abel found in the Austrian guncotton, after drying *in vacuo* over sulphuric acid, a moisture of about 2%. He further analysed the samples according to the method devised by Hadow, which consisted in digesting weighed quantities of the guncotton in the cold for 24 hours, in an alcoholic solution of potassium hydrogen sulphide, and the reduced cotton thus produced was thoroughly washed and dried. The products so produced were proved to be free from nitrogen compound by ignition of portions with potassium hydrate when no indication of the existence of nitrogen in the specimens was obtained. Theoretically, trinitrocellulose should shew 54·54% of regenerated cotton. Abel found from the Austrian cotton, the following figures : 54·97, 55·13, 55·07, 55·20 per cent.

The ash in the various guncottons varied from 0·42% to 1·9%. Von Lenk considered that impregnation of the guncotton with soluble glass was very advantageous. According to his view, it closed the pores of the guncotton fibre, by precipitating silica within them, by which the velocity of explosion of the guncotton was retarded ; and further, any trace of acid remaining would be neutralized by combination with the sodium carbonate liberated from the soluble glass.

Abel could not find that any proportion of silica remained of any moment, after carrying out the process as described by von Lenk, *i.e.*, washing in running water for 5 or 6 hours, and subsequent rinsing of each skein after the treatment with silicate of soda. Von Lenk also considered it desirable to keep the fibres of the guncotton soft, in order to guard against the contingency of explosion from very violent friction. This was effected by dipping the material, previous to final drying, in a soap solution, the excess being afterwards squeezed out, and the guncotton dried.

The Austrian chemists pointed out the following differences, between the French guncotton and that of von Lenk. " According to the method pursued by the French Commission, the raw cotton was immersed in the acid mixture for one hour. Baron Lenk leaves his cotton forty-eight hours in the acid bath. The French cotton was afterwards dipped in running water for an hour or an hour and a half. Baron Lenk's guncotton lies four, six, or eight weeks in a stream. The French cotton had, after washing, so much free acid left, that carbonate of potash was neutralized by contact with it, and after long use became sour. Baron Lenk's cotton is so freed from acid by long immersion, that a two per cent. solution of potash, in which two cwt. of guncotton had been boiled, has lost none of its alkaline properties, and hence the guncotton was completely free from acids. The French guncotton having been prepared in a manner so different, it must necessarily have had a different composition from that of Baron Lenk's ; hence it is clear that the French experimental results cannot, without considerable reserve, be accepted as precedents."

They further go on to say, " The history of guncotton, as chronicled by chemists and artillerists, short though the history be, is so full of records of explosion under unexpected circumstances, that an unbiased mind can hardly fail to be impressed with the belief that, amongst the ordinary conditions of military practice, there may be some competent to induce the spontaneous combustion of this material. Nevertheless the experience of Baron Lenk, acquired during a period extending over more than ten years, is more pregnant with reliable testimony than can be found in the entire remaining history of this material.

The manufacture of guncotton in Hirtenberg consists of a number of perfectly harmless operations ; and it is remarkable that, contrary to what happens with gunpowder, if fire be not actually applied, explosion is impossible. All operations are so arranged that the material acted upon is in a moist or wet condition—hence not explosive. Drying takes place in a capacious building, on every side open to the air. The last process of drying is carried out in the drying-chamber, where it is effected by a stove situated on the outside, distributing its heat to the building by earthenware pipes—drying being thus ensured through a gentle warmth. The guncotton next goes either into a magazine to be packed away in chests, or is at once prepared for ammunition. In this magazine, Hirtenberg cotton has been stored for a period of twelve years, and not a single instance of explosion has taken place. How many powder-mills have exploded in that time ? In Prussia, however, a drying-chamber has lately blown up ; but they have worked for eight years with guncotton, and not a single explosion has

occurred except the last-named. In the Prussian drying-chamber referred to, a stove with iron smoke-pipe was used—a sufficient explanation of the misfortune.

During twelve years we have prepared guncotton at Hirtenberg for ammunition—that is, for yarns, spun ropes, and threads twisted and woven. One single case of explosion has occurred in the course of Baron Lenk's manufacture, the result of improper speed of working the spinning machinery. Now, the circumstances hardly need be insisted on, that gunpowder as well as guncotton can be exploded by friction. Guncotton has been used for military purposes now more than twelve years; it has also been employed for mining and blasting. It has been subjected to every variety of transport. Packed in black wooden chests, it has been exposed to sunshine for months together—all this without one single accident. In the face of such testimony, it cannot be said that guncotton manifests any tendency to explode spontaneously."

To comply with the provisions of the new Patent Act the firm of Hunter and Warren Ld. of Glasgow have made arrangements for the manufacture in this country of the electric exploders or blasting machines which were sucessfully introduced by them some years ago, and the merits of which have been manifested by ever-increasing sales. The exploders hitherto have been manufactured in Austria under British patents. The new arrangement will not affect the position of Hunter and Warren who will continue to be the suppliers of these goods.

APPLICATIONS FOR PATENTS.

JANUARY 18, 1908—FEBRUARY 13, 1909.

1,191. Target. J. M. Proctor.
1,243.* Safety Devices for Guns. J. B. and A. B. Ward.
1,384. Report Silencer. A. Thompson.
1,664. Magazine Fastenings of Automatic Firearms. W. J. Whiting.
1,767. Rifle Backsights. C. S. Southin.
1,851. Automatic Firearms. W. G. Farquhar and A. H. Hill.
1,954.* Pistols. T. Martin.
2,079. Breech Loading Firearms. C. G. Bonehill and H. Homer.
2,278.* Magazine for Firearms. P. Mauser.
2,319. Single-Trigger Guns. W. Baker.
2,347. Heavy Ordnance. E. C. Kingsford and T. W. Just.
2,462.* Pistols. Count Bela Kreith.
2,475.* Wheeled Gun Carriages. Fried Krupp.
2,533.* Extracting Percussion Caps. P. J. Johansson.
2,569. Automatic Smallarms. W. J. Whiting.
2,570. Automatic Firearms. W. J. Whiting.
2,576.* Locking Mechanism of Guns. C. Osborne & Co., Ld., and C. Ryland.
2,602. Ordnance Barrel Carriages. A. T. Dawson and G. T. Buckham.
2,607. Barrel Cleansing Device. A. W. Chichester.
2,634. Gun Control. J. B. Ryan.
2,905. Target Signalling Apparatus. J. Breckenridge.
3,037. Magazine Rifles. J. Formby.
3,095. Projectiles. C. S. McDougall.
3,182. Position Finders. F. Bredenberg.
3,307. Breech-loading Firearms Mechanism. J. Robertson.
3,308. Automatic Ejectors. J. Robertson.
3,436. Cartridges. A. Barnett.
3,439. Range Finders. F. Mitchell.
3,506. Small Arms. P. Mauser.
3,523. Automatic Rifles. C. R. S. J. Halle.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

JANUARY 28—FEBRUARY 11, 1909.

COMPILED BY HENRY TARRANT.

1,068 (1908). **Cleaning Brush for Rifle Barrels.** H. Meier, Germany. Brushes are fixed to strips of metal running parallel with the axis of the cleaner. By screwing a bolt into or out of the central shaft of the device (as mentioned in Patent No. 22,072, 1905) the brushes are pushed outwards or drawn inwards towards the centre by means of intermediary links. Accepted Jan. 18, 1909.

1,227 (1908). **Target Practice Apparatus.** F. Mitchell, London. "Sub-target" apparatus of the kind mentioned in other patents Nos. 14,636, 1904, 15,500, 1908, and 18,638, 1907, is modified to allow it to be used in conjunction with targets in different positions or with targets with more than one bull. Mechanism is introduced to shift the aiming apparatus the necessary amount to correspond with the different positions of the objective target. Accepted Jan. 14, 1909.

1,677 (1908). **Waterproof Nitrate Explosive.** F. Sparre, U.S.A. An example of this improved and waterproofed explosive compound is as follows. Ammonium nitrate 50 parts is mixed at say 90°C., with a previously melted compound consisting of dinitrobenzene 8 parts, and mononitrobenzene 2 parts. After half an hour's intimate mixing in a rolling mill in a steam heated pan, the mass is allowed to cool. Another mixture is then prepared of 20 parts of potassium nitrate, 10 parts of ferrosilicon, and 10 parts of nitrocellulose, these constituents being incorporated together for an hour in a rolling mill. The two compounds are then mixed together at an ordinary temperature for an hour in a mill. It is claimed that the resultant compound is non-hygroscopic, non-freezing, safe to make and use, and possessed of great strength. It may be modified to adapt it for shell charging. Accepted Jan. 21, 1909.

1,722 (1908). **Hammerless Sporting Gun Locks.** T. Rigby, Wolverhampton. When the hammers of a side-lock break-down sporting gun of the well-known double barrel type are cocked, a spring like limb is forced flush against the lock plate so that a little projection is pushed outwards to indicate that the lock is cocked. When the hammer falls the spring is released and the little projection recedes. Accepted Jan. 21, 1909.

1,749 (1908). **Combined Shrapnel and Grenade.** W. Hein and C. Otto, Germany. Two tubes telescopically arranged in the centre of the shell connect the head carrying the fuse and the base carrying the shrapnel explosive charge. The outer of the two tubes carries the grenade charge and around the outer tube the shrapnel balls are placed. The tubes may be shifted longitudinally relatively one to the other so that ports may be opened or closed to regulate the ignition of either shrapnel or grenade charge. Accepted Jan 14, 1909.

2,510 (1908). **Ordnance Sighting Apparatus.** E. Schneider, France. Apparatus of the type which carries a doubly reflecting prism to facilitate laying from different points is simplified and is rendered capable of easy adjustment for direct or indirect sighting. The device is applicable for use with sighting apparatus whether lens or collimator is employed. Accepted Jan. 7, 1909.

4,707 (1908). **Ammunition Making Machinery.** The Birmingham Metal and Munitions Co., Ld., and F. Bennett, London. In work-feed motions for delivering elongated articles such as cartridge cases fed indiscriminately from a hopper, means are introduced for ensuring delivery in proper position. Accepted Jan. 14, 1909.

5,205 (1908). **Breech Mechanism of Ordnance.** Lt. A. T. Dawson and G. T. Buckham, London. The portion of the breech actuating lever grasped by the hand is fitted

with a catch which is adapted to lock the hand lever when the mechanism is closed. The device consists of a self-contained single part which can be bodily detached from the handle. Accepted Jan. 14, 1909.

6,353 (1908). **Bullet Traps and Target Holder.** H. G. Brain and F. E. Stephens. Bideford. A funnel-shaped arrangement standing on legs carries at its wide end the necessary paper target attachments. At its restricted end it terminates in a downwardly extending semicircular device. The bullet is turned back by this device and is thrown against another similar device from which it drops harmlessly to the ground. Accepted Jan. 14, 1909.

9,052 (1908). **Disappearing Target Apparatus.** R. T. Gates, London. The target apparatus here described is an improved form of that dealt with in patent No. 16,483, 1905. The electrically fired detonator mechanism hitherto used is substituted for ordinary revolver mechanism. Every time the target is raised a shot is automatically fired. Other improvements are set out. Accepted Jan. 21, 1909.

9,259 (1908). **Wrappers for Blasting Explosives.** Kynoch, Ld., Birmingham, and J. P. Udal, Sutton Coldfield. A wrapper for blasting explosive cartridges in which the amount of the material covering the end of the cartridge is reduced by making the width of the wrapper equal to the length of the cartridge plus the allowance for the turn-over at the other end. Accepted Jan. 21, 1909.

9,559 (1908). **Range Finders.** Major R. E. H. Dyer, India. Range finders of the type in which two mirrors are mounted on a bar at an angle of 45° are improved. The patentee fixes the mirrors and arranges for a movement of the bar instead of *vice versa*. Accepted Jan. 14, 1909.

10,589 (1908). **Mounting of Rifle Sights.** L. R. Tippins, Manningtree. In order to allow aperture sights to be used on service rifles as near to the eye as possible at the same time complying with the rule of the National Rifle Association the patentee introduces a sight bed extension which can be fixed to the ordinary bed by the existing hinge pin. The extension brings the sight two or three inches nearer the eye than the usual position of the open leaf sight. Accepted Jan. 21, 1909.

10,698 (1908). **Recoil Operated Small-Arms.** W. Fairweather, London. (Agent for *Aktiebolaget Svenska Vapen-och Amunitionsfabriken, Sweden*). This patent deals with improvements in detail of automatic guns in which the breech bolt travels on guides and co-operates with a weight which takes up part of the recoil and which cocks the striker spring by its inertia. Accepted Jan. 7, 1909.

10,797 (1908). **Small Arms Safety Locking Device.** H. Stephan, and C. Lenz., Germany. Beneath the grip of the stock of a gun or rifle is arranged a lever pivoted to the trigger guard. When the stock is grasped to fire the weapon one end of the lever is moved inwards and its other end outwards, away from its locking engagement with the triggers. Accepted Jan. 7, 1909.

15,769 (1908). **An Automatic Rifle.** A. G. Bloxham, London (Agent for *Oesterreichische W.-G., Austria*). The bolt mechanism of this rifle is of the straight pull type and is adapted for operation by hand or automatically. For automatic working, a sleeve, operating in a fixed sleeve, just behind the muzzle, is pushed backwards by the powder gases, and so forces back a rod which reciprocates the bolt mechanism. Accepted Jan. 21, 1909.

16,599 (1908). **Trinitrotoluol & Potassium Chlorate Explosive.** J. Rudeloff, Germany. The mixture of trinitrotoluol and oxygen carriers has, says the patentee, hitherto not been successfully accomplished to adapt the explosive for shell, torpedo, etc. By mixing as an oxygen carrier chlorate of potash and nitrate of lead the specific gravity can be raised to about 2·5 without altering the comparative power of the compound. The trinitrotoluol is, previous to the admixture, heated to about 82°C. and after mixing with gelatine as a binding substance. The following are the proportions of the ingredients. Gelatinized dinitrotoluol (containing in every 100 parts about 3·3 of collodion cotton) 18%; trinitrotoluol 14%; chlorate of potash 60%, and nitrate of lead 8%. Accepted Jan. 14, 1909.

16,980 (1908). **Carriages for Field Ordnance.** Lt.-Col. J. A. Deport, Paris. The gun is mounted on a small carriage carried by the axle and provision is made for training the gun to extreme right or left and through an extended arc vertically. The trail consists of two parts which are turned outwards to leave the rear of the gun clear for the gunners. Each part of the trail is provided with a spade of the kind set out in patent 6,004, 1907. Accepted Jan. 21, 1909.

17,629 (1908). **Break Down Automatic Pistol.** N. Pieper, Belgium. (*See Selected Patents*).

18,843 (1908). **Machine Guns.** A. Vickers, London (Agent for *Deutsche Waffen und Munitions-Fabriken, Berlin*). This invention relates to automatic ordnance of rifle calibre. Instead of releasing the breech block retaining catch by means of the cartridge when it is inserted in the gun it is liberated by the cartridge carrier during its forward movement. The cartridge carrier is brought into engagement with a fresh cartridge by the rising block after the latter has been released in the manner explained. Accepted Jan. 7, 1909.

19,102 (1908). **Detachable Locks.** R. Hill & J. Smith, Birmingham. (*See Selected Patents*).

20,315 (1908). **Range Finder Frames.** H. D. Taylor, York. The patentee has discovered a metal having approximately the same rate of thermal expansion as the glass mirrors of an optical square or other doubly reflecting device such as is dealt with in patent No. 13,562, 1907. The alloy consists of about 57½ parts of cast iron and 42½ part of nickel by weight. The mirrors are fixed to this casting in a special manner. Accepted Jan. 21, 1909.

21,248 (1908). **Percussion Fuses.** Fried Krupp, A.-G., Germany. A safety device is provided for delaying the readiness for action of percussion fuses. Certain disadvantages which were hitherto attendant upon the use of such devices have, the patentee claims, been removed by this invention. Accepted Jan. 7, 1909.

21,456 (1908). **Range Finders.** Major R. E. H. Dyer, India. Patent No. 9,559, 1908 dealt with above contains a description of an improved range finder. The present invention does away with the necessity for a cross bar or similar sighting device and allows of the neat and compact attachment of a telescope. The supporting head of the instrument is also improved. Accepted Jan. 14, 1909.

21,854 (1908). **Telemeter Prisms.** Optische Anstalt C. P. Goerz, A.-G., Germany. This patent deals with an improved construction of the ocular prism of telemeters. Accepted Jan. 21, 1909.

23,200. (1908). **Automatic Pistol Firing Mechanism.** Webley, & Scott, Ltd. & W. T. Whiting, Birmingham. (*See Selected Patents*).

25,269 (1908). **Firearm Report Silencer.** H. P. Maxim, U.S.A., The report silencer described in patent No. 14,310, 1908 is modified in order to adapt it to prevent the escape of the core or pencil of gases which follow immediately behind the projectile. The silencer is also shaped so that no disturbance of the sights is necessary. Accepted Jan. 21, 1909.

SELECTED PATENTS.

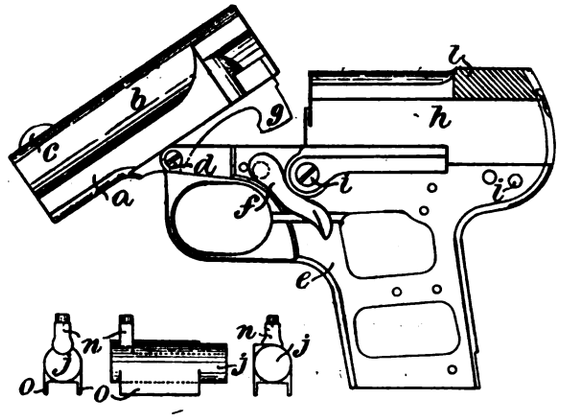
BREAK-DOWN AUTOMATIC PISTOL.

17,629 (1908). N. Pieper, Belgium. In patent No. 9,379, 1905, an automatic pistol in which the barrel or the breech casing or both can be turned down on a pivot is described. The construction dealt with in the present patent and illustrated by the accompanying drawings is an improved form of this pistol. The recoiling breech bolt return spring is arranged behind the barrel—not above the barrel as in the old construction, so that the drop-down part comprises the barrel only.

Above the barrel *a* is arranged the rib *b* carrying the front sight *c*. The barrel is pivoted at the point *d* in the body *e* and is held in the firing position by the engagement of the locking lever *f* with the lump *g* beneath the barrel.

The breech casing *h* is fixed by the pins *i* to the top of the

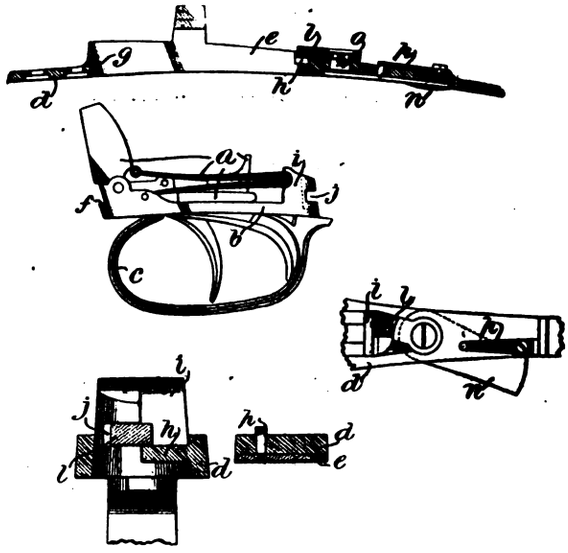
body *e* and within this casing is arranged the sliding breech block *j* which is connected to the top slide *l* by the projection *n* and with the body by the bottom extensions *o*. The return spring is of the usual spiral type and is introduced into the casing from the rear. It is held by a screw carrying a guide rod.



By turning down the lever *f* the pistol may be opened to facilitate examination or cleaning of the barrel or to allow of the introduction of a cartridge as a supplement to those in the magazine or for the purpose of using the pistol as a single firing weapon. The arrangement is claimed to simplify the construction, and to obviate the use of parts liable to render the barrel less accessible. Accepted Jan. 14, 1909

DETACHABLE LOCKS FOR BREAK-DOWN GUNS.

19,102 (1908). R. Hill and J. V. Smith (Messrs. Hill and Smith). Birmingham. To facilitate the removal of the lock work of guns or rifles of the well-known double-barrelled break-down type the patentees arrange the whole of it on the trigger plate. By simply turning a lever neatly built into the bottom strap of the gun, the trigger plate carrying the lock work may be bodily removed.



In the drawings accompanying this short description the parts and their arrangement are illustrated. The whole of the lock work *a* consisting of the hammers, mainsprings, sears, triggers, etc., are as will be seen, mounted compactly on the trigger plate *b* to the bottom of which is attached in the usual way the trigger guard *c*. The bottom strap *d* of the gun is formed with the opening *e* of exactly the same shape as the trigger plate whose area is just sufficient to accommodate the lock mechanism it carries. When the trigger plate is inserted into the opening the lip *f* comes up against the overhanging ledge *g* so positioning it so far as its forward end is concerned. At the back the stop *h* is arranged to abut against the top of the extension *i* on the rear of the plate. This extension is slotted at *j*, and into this slot the bolt arm *l* of the lever *n* is adapted to be turned to lock the plate with its mechanism in the proper position.

The lever *n* as is clearly illustrated is a limb of no great thickness adapted to turn on the pivot *o* and to lie snugly in a slot provided for it on the underside of the strap *d*. To hold the lever *n* in one or other of its positions, the spring *p* may be provided. The end of this spring carries a projection adapted to be snapped into either of two holes brought beneath it when the lever reaches the limit of its movement in either direction.

A modified arrangement is also described and illustrated in the patent specification. Accepted December 31, 1909.

AUTOMATIC PISTOL FIRING MECHANISM.

23,200 (1908). Webley and Scott, Ld. and W. J. Whiting, Birmingham. The pistol to which the improved firing parts described in this patent are adapted is of the type dealt with in patent No. 18,567, 1908, at present in the provisional form. The arrangement of these firing parts is such that unintentional firing of a second shot or a series of shots is impossible even though pressure on the trigger is sustained.

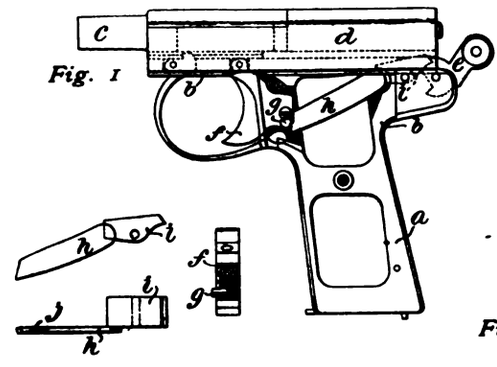
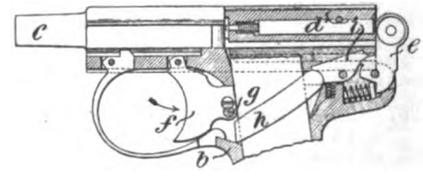


Fig. 1

Fig. 2



The handle *a* of the pistol illustrated in the appended drawings is designed, as usual, to accommodate the magazine, and like the body *b* fixed barrel *c*, breech slide *d*, and hammer *e* is of the type set out in the provisional patent mentioned.

The subject of the present specification principally concerns the arrangement of the trigger *f* with its spring influenced stud *g* and the bar *h* which forms part and parcel of the sear *i* (see drawings in detail).

When cocked, the relative postions of the parts are as illustrated in Fig. 1. It will be observed that the end of the bar *h* lies directly behind the little stud *g* which is pushed out from the surface of the trigger side by a small spiral spring. When the trigger is pulled the rod is impelled downwards slightly so that its back end constituting the sear is lifted out of the bent in the hammer. The last named falls and fires the pistol, assuming momentarily the position illustrated in Fig. 2. The recoil almost immediately recocks the hammer so allowing the sear *i* to resume its former position.

The forward end of the sear bar *h* is inclined on its inner side at *i*. It will be readily understood, therefore, that should the trigger not have been released, the return movement of the bar will force the little projection *g* into the trigger and this relative arrangement will be maintained until the trigger is again allowed to take up its normal position as shown in Fig. 1. Thus the cycle of operation proceeds without fear of unintentional double or serial discharges. Accepted Jan. 7, 1909.

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CONTENTS.

CURRENT TOPICS.

Powder Factory Arithmetic.—The conference of miners' representatives, to discuss the prices that are being paid for blasting powder, in the Northumberland district, resulted in the propounding of some remarkable fallacies. There is admittedly a powder ring, equally certainly it has raised prices, but the old level of suicidal rates is hardly a fair basis upon which to decide whether the present cost of gunpowder is reasonable or otherwise. If the miners wish to frighten the manufacturers they must bring forward a more expertly drafted scheme of co-operative manufacture than that submitted for consideration at Morpeth last month. To judge the price of a finished article by the approximate cost of the raw materials is to lose sight of the very large margin which must exist between manufacturing cost and selling price. The explosives business is especially subject to a number of charges which occur in no other trade. Co-operation is a blessed sounding name, but it will not avail to dismiss the essential elements of the manufacturing problem. Dead charges are sufficiently alive and numerous to absorb a large margin of the selling price before the payment of interest on capital outlay comes to be considered. The miners will presumably expect interest on whatever sum they may raise amongst themselves for the purpose of establishing a factory. This alone will place them at a disadvantage, for the blasting trade has been educated to forego dividends during a large proportion of the period since the newer explosives displaced saltpetre from its old monopolist position. Co-operative enterprises almost invariably take on the ordinary aspects of the trade to which they belong; otherwise they seem automatically to disappear. Sometimes they are effective in breaking a monopoly or otherwise remedying conditions which unfairly harass the consumer. But on the principle of judging each case on its merits the black powder industry is notoriously not in a position to pay the producer a fair return on his investment, and if the proposal to start a co-operative factory in the region under consideration comes to maturity it is almost certain that the result will be a disappointment so far as regards the anticipation that explosives can be produced cheaper than they can be bought

Aperture Sights at Bisley.—A card illustrating the sights authorised for issue at the coming Bisley Meeting, has been published by the National Rifle Association for the information of competitors. The rule that all models had to be submitted by the 1st of January means that the list is a complete one, and that no unpleasant surprises can be sprung upon shooters at the last moment by the authorisation of designs giving an advantage to the possessors of the few hand-made models available. Every type in this year's list will in the nature of things either be on the market in sufficient quantities or not on sale. At the first glance there appears to be a plentiful range of choice; but when it is realised that there are less than half-a-dozen models of aperture sight situated in juxtaposition to the shooter's eye it is obvious that the choice is really very much restricted. Service riflemen cannot fail to learn in the space of a very few weeks of practice that the ordinary system of sighting goes by the board in competition with a properly located aperture. A month or two will probably elapse before the newer types are available for sale. During

the intervening period the models carried forward from last year may be expected to enjoy a fair run. After that the newer models will begin to emerge from their respective machine shops, and, unless all existing theories are reversed, they will sweep all their competitors aside. The superiority of the aperture as an aiming device has been proved up to the hilt in so many different ways that it is curious there should be anybody left with the lesson still to learn. But the Bisley rifle shot occupies a peculiar position. First and foremost he is a volunteer and incidentally a rifle shot, his practice in the large majority of cases having been rigidly confined to the service weapon. Hence the virtues of the little sight which the late Mr. Lyman popularised throughout the world, are not known to some of the ablest exponents of rifle shooting.

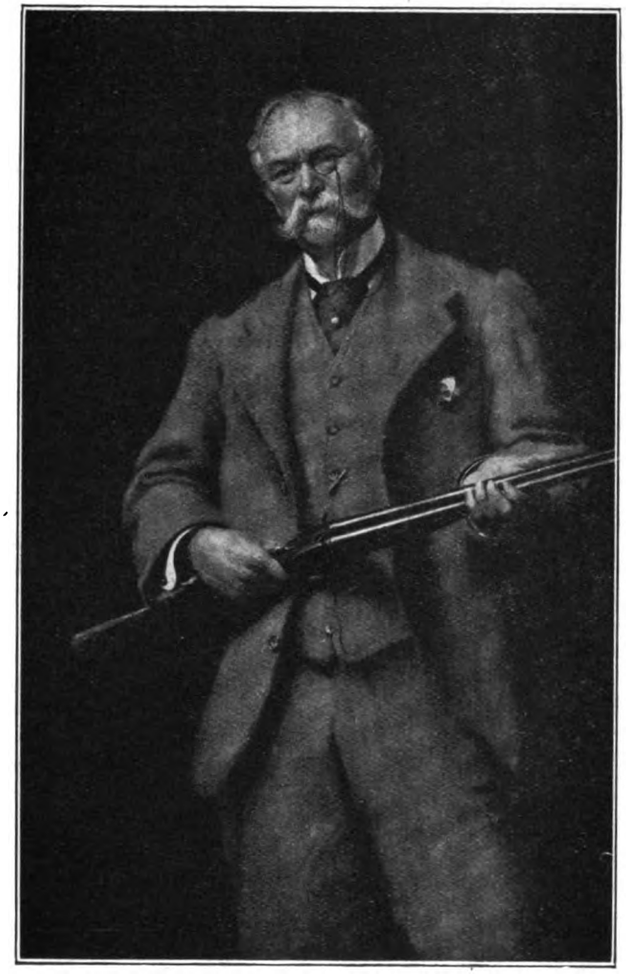
Politics and Armaments.—The past month or two has witnessed an extraordinary recrudescence of public interest in all matters relating to the efficiency of the defensive forces. The present Government came into power with an important programme of financial and social reform to carry out, and it was not surprising that an effort was made to economise in the purchase of war materials. The taking out of commission of large numbers of vessels of a more or less obsolete type rendered available large quantities of stores for current consumption. The natural consequence has been a marked diminution of production of certain articles in the Government factories and likewise of orders for contractors. Company finance has been seriously inconvenienced by the lean years which commenced with the cessation of demand at the conclusion of the Transvaal war. The present need for a more active policy of naval construction coinciding as it does with the fruition of Mr. Haldane's territorial scheme will doubtless assist to bring business to a more normal level than it has occupied for some period past. In several branches of demand private trade also shows greater activity. In fact all things, bar the demand for high-class sporting guns for home consumption, are displaying healthier conditions. The problem for every manufacturer is to adapt himself to the conditions prevailing at the moment, and the companies who divide their production between war and industrial materials will welcome the present signs of relief. One department of business cannot for long live upon another, and the time has certainly arrived when the manufacturing facilities which have been created in anticipation of Government demands should be utilised to a fuller extent than has recently been the case.

Rifle Fire Control.—Particulars of an ingenious suggestion by Captain K. A. Enklaar of the Netherlands Army for the control of rifle fire have been forwarded to this office. The idea briefly stated consists of mechanism for preventing the discharge of a military rifle except within certain limits of angle approximating the horizontal. The grounds alleged in justification for such a device are that observations taken in warfare have shown that a large proportion of the troops engaged in fighting have lost control of their actions to such an extent that they fire before the weapon is at the shoulder or the sights properly aligned. These matters are of course well understood, but the idea of automatically restricting a soldier's fire, so that his weapon will fail to go off unless held at a reasonably favourable angle certainly smacks of novelty and ingenuity, and possibly of practical utility as well. Though objections might be advanced against the employment of such a device in actual warfare, the suggestion of the inventor that it would vastly increase the educational side of manœuvres if it were used in combination with blank ammunition has much to recommend it. In the excitement of mimic warfare a soldier might easily be satisfied with the mere making of noise, thereby unconsciously cultivating the bad habit of random firing, whereas if he were constantly reminded by automatic mechanism that the gun will not go off unless genuine aim is taken, he would learn a lesson which might be of value later on. Experience with the scatter gun frequently provides most convincing proof that the novice fires the first barrel more often than not with entire disregard of aim. The old sportsman owes the greater part of his success to the keeping of a cool head rather than to the accomplishment of difficult feats of marksmanship.

Technicalities in Cartridge Loading.—In the slack interval between when one shooting season is over and the next has hardly commenced to cast its shadow before, the question of introducing improved methods in the department of cartridge loading should be seriously considered. The standard of accuracy observed by the more responsible country-town gunmakers shows, according to all reports, a steady improvement year by year. Old beliefs for a time retarded development, but nowadays it is widely recognised that a successful cartridge loading business can only be maintained or developed by utilizing standardized components in a recognised manner. When the policy of doing a simple thing well was first mooted it gave rise to the complaint that the gunmaker could not keep his business together if denied the opportunity of imparting individuality to the output. Since that time it has become increasingly evident that the performing of the simple operation in the hundred and one forms in which it may present itself is after all a problem requiring both enterprise and administrative capacity. Just in fact as the sportsman has learnt the virtues of the happy mean, so the gunmaker has trained his staff in the use of more accurate gauges and testing apparatus than they had previously been accustomed to regard as necessary. The process of re-organization is necessarily of slow growth, because the gunmaker is denied the free contact with others of his kind which traders in articles of more general consumption enjoy. Specialist mechanic at one end of his business, and sportsman and interpreter of his customers' physical peculiarities at the other, the gunmaker has little enough time to develop the laboratory side of cartridge loading. Yet it is here that the means exist for improving output, and thereby gaining an ever improving reputation in the district served. When treated as a hobby cartridge loading possesses a never ending interest, and so long as discoveries and inventions are strictly excluded as an unbusinesslike waste of effort the results can hardly fail to be commercially satisfactory.

THE LATE MR. JAMES PURDEY.

Mr. James Purdey, who for several years has been obliged for reasons of health to abstain from active participation in business, died on the 13th ult. at his residence, 20 Devonshire Place, W. As a gunmaker his name ranks with that of the celebrated Joe Manton, but unlike Manton he possessed worldly and administrative knowledge, as well as a special gift for gunmaking. Behind the great name and reputation of the firm whose policy he directed, there was an acute business mind which estimated with absolute precision the lines upon which it was necessary to work in order to make the policy of perfection pay its way. In feebler hands there might have been hesitation to incur the heavy cost involved, but Purdey reckoned that his patrons would not grudge his prices if the desired standard of quality could be guaranteed. Just to what extent the policy of the firm was framed by the father and carried out by the son is a matter difficult of decision and involving unnecessary comparisons. James Purdey undoubtedly received a fine start through following in his father's footsteps, but such an argument does not affect the much more practical conclusion that he was a man of strong individuality himself, and quite capable of deciding the course to be followed when novel situations arose.



Essentially a practical man his methods were neither theroetical nor abstruse. He aimed at perfection, he knew what perfection was, and he possessed the gift of extracting it from his work-people. His reputation stood so high that anyone who worked for the firm, whether inside the factory or outside, felt that he was put upon his mettle to reach the Purdey standard. This high level was attained by virtue of an excellent eye for workmanship and the unfailing power to detect hidden imperfections. The cultivation of an aristocratic clientele no doubt received special attention, but the firm did not advertise in the accepted meaning of the word. Instead they possessed the knack of being quoted and talked about and recommended, so that business flowed steadily to their door, and they were even accused of making a favour of taking it. In point of fact this was an exaggeration, but what really happened was that the particular methods adopted fitted in with a particular rate of output which could not be materially accelerated to meet a rush of orders. Therefore a variable amount of time, depending on the work in hand, necessarily ensued before delivery could be made. Such an unusual state of affairs naturally induced comment, and the firm benefited by the knowledge that Purdey guns were produced in a certain way, and the purchaser had to control his patience during the period of manufacture.

The late Mr. James Purdey would have completed his 81st year had he lived another six days. He joined his father's business on leaving school. This would be roughly about 1844, and he so rapidly acquired knowledge and experience that in a very few years' time he was practically managing the business. His father took an extraordinary interest in the shooting of sporting rifles, which kept him for days together fully occupied at the shooting ground, thus leaving the son a clear field in which to exercise his talents. Anyhow when the younger Purdey had reached the age of 30 his father definitely retired from business. In due course his own sons relieved him of some of the burden of management, and their share of responsibility naturally increased as years went by. Certainly during the past fifteen years visitors at the firm's premises in South Audley Street have looked upon Mr. Athol Purdey as the man to see. The senior partner was frequently in evidence bustling about and forwarding matters of business, but it was apparent that the real direction of affairs rested with Mr. Athol Purdey, and his brother, Mr. C. O. Purdey. There is thus no lack of young blood in the business, and under the management of the new heads of the firm, many years of successful production may be confidently anticipated. No outward change results from the loss of the senior partner, who had already retired.

LECTURES TO YOUNG GUNMAKERS.

LV.—THE ALPHA AND OMEGA OF CARTRIDGE LOADING. PART I.

IF only the fact were generally known, the science of cartridge loading begins and ends with a proper understanding of the tables which it will be the purpose of this and the subsequent lecture or lectures to explain. The essence of the tables in question is to give a particular length to each powder and shot charge respectively, having, of course, due regard to the bore, to add these lengths together, to compare them with the length of the cartridge case, and to decide thereby the appropriate thickness of felt wadding to be used. Complaints are at the present time very rife concerning the high pressures to which guns are subjected. Sometimes blame is attached to the *Field* for advocating the three-ton level of pressure for all smokeless powders, at other times the powder maker is discovered to have sent out some rather active batches of manufacture, but when all is said and done superabundance of wadding is the final aggravation of the evil, whereby pressure is raised to a level not contemplated in the scales of proof.

The following illustrations refer to actual occurrences, and they are only a few out of many instances, all pointing the same moral. A very important firm sent out 500 cartridges which in use gave the greatest possible satisfaction. A repeat order produced cartridges of equal merit. By the time the third order was given confidence in the cartridges was fully established, and yet as day followed day it became increasingly difficult to account for the constant missing of easy shots when the aim taken seemed to be perfect. Frequently, birds which were hard hit with both barrels to the knowledge of all onlookers, carried on out of sight and were lost to the bag. A careful test of this unsatisfactory batch gave the following results :—

	Pressure.	*Pattern.*	*Velocity over 20 yds.*
1.	3·22 tons per sq. in.	medium.	1060 f.s.
2.	3·84 ,, ,, ,,	wide.	1040 ,,
3.	3·98 ,, ,, ,,	wide.	lost.
4.	3·42 ,, ,, ,,	scatter.	985 ,,
5.	3·46 ,, ,, ,,	scatter.	940 ,,
Av.	**3·58** ,, ,, ,,	Av. bad.	**1006** ,,

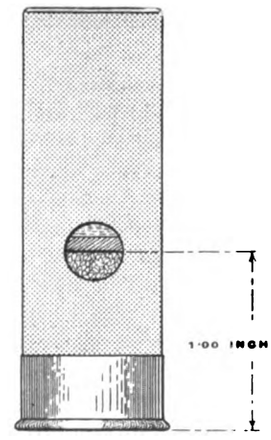
These cartridges were specified to contain 33 grains and $1\frac{1}{16}$oz. The powder charge upon actual test proved to be correct, though a little on the full side, but the shot charge was exactly $1\frac{1}{8}$oz. The wadding was that suited for the shot charge ordered, and somewhat tight at that, in so far that a one-tenth inch card was used over the felt, in place of the usual medium size. Some of the powder from the above cartridges was re-loaded with the correct charge and wadding appropriate for the same. The following results were then obtained :—

	Pressure.	*Pattern.*	*Velocity over 20 yds.*
1.	3·89 tons.	good.	1076 f.s.
2.	2·94 ,	good.	1050 ,,
3.	2·94 .	medium.	1020 ,,
Av.	**3·26**	Av. satisfactory.	**1049** ,,

These results conclusively proved that given proper loading the powder would have given correct results, but a load of shot recognised as unsuitable for 33-grain powders, coupled with a surplus of wadding, i.e., that intended for the charge ordered, caused good components to go wrong, and created great disappointment on each occasion when the cartridges were used.

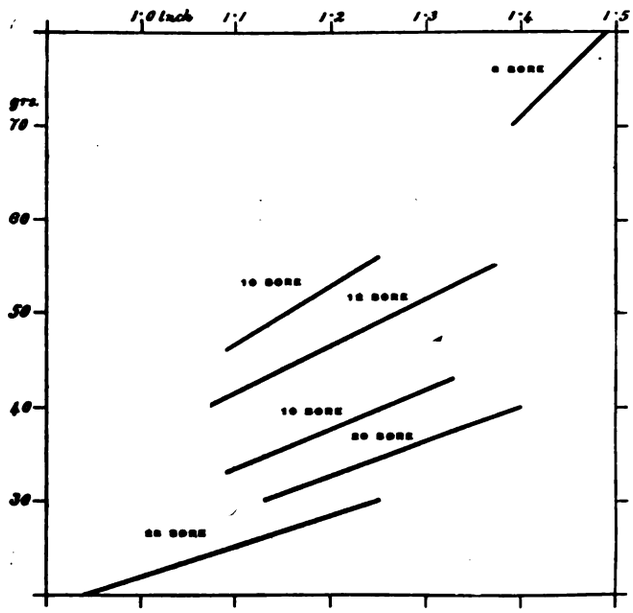
The concluding examples must be dealt with more briefly. Another important firm had trouble because some cartridges of their loading broke the action of a high-class gun. The load was 36 grains and one ounce, which is a fairly lively charge in any case, but on this occasion was made vastly more so by the employment of a half-inch felt and $\frac{1}{8}$-in. cloth, instead of the appropriate $\frac{3}{8}$-in. and $\frac{1}{16}$-in. respectively. Tests showed pressures rising very near to the five-ton limit, whereas the proper pressure of the powder would have been at most 3·5 tons had the wads been properly proportioned to the load. Another gun owner felt an uneasy suspicion that his 20-bore cartridges were giving an undue amount of pressure. His inclination was to blame the gun, which was new and had no doubt been purchased on the strong recommendation of the maker. The gun was however, perfect, but the cartridges, upon being tested, proved otherwise. They contained the right amount of charge, but the extravagant quantity of wadding employed caused the powder to be compressed nearly the fifth-of-an-inch more than the appropriate amount, with the result that the pressure rose within a few points of five tons.

In every instance where comparisons have been made increase of gas pressure when produced by an excess of wadding results in relatively high recoil, low velocity and scattered patterns. In other words the high pressure produces a high muzzle velocity, but the battered condition of the pellets leads to a rapid falling off, whereby the chronograph shows a low record of mean velocity over the distance covered by the test. In explanation of the bad patterns, battering of the pellets is one of the well-known causes of irregular and patchy distribution.



The one golden rule for the loading of all the $2\frac{1}{2}$-in. cartridges is that there should be a space of exactly one inch between the wad over the powder and the base of the cartridge. This curious incidence of a round number value for such an important measurement has been observed in the firing of thousands of rounds in connection with pressure tests. A circular hole has to be formed in the walls of the cartridge tube by means of a very

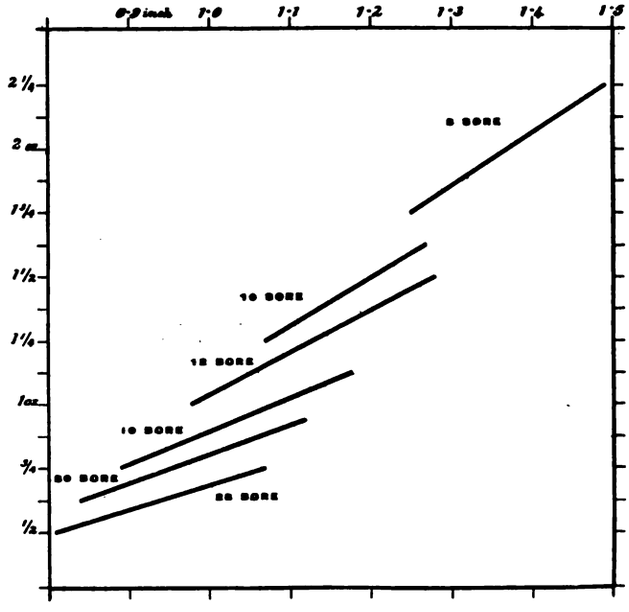
sharp punch in order that the gases may have direct access to the pressure piston. This hole exposes the powder, and in properly loaded cartridges it is exactly intersected by the nether edge of the over-powder wad. Now, when a three-dram charge is fed into a 12-bore cartridge it occupies a little over an inch, measuring from the base of the cartridge. When the wads and shot have been inserted, and the turnover has been made this distance is reduced by compression to the one inch already referred to. With other calibres of cartridge of the same standard length, the appropriate powder charges occupy the same space.



The Table for 33 grain powders graphically represented.

This simple and obvious check on cartridge loading is applicable to the large majority of instances where standard conditions exist. At the same time special cases and special loads must not be ignored, and these require individual treatment by means of tables. Such a set of tables was in fact published and fully explained in the lecture which appeared in the issue of October 1907. Since that time the values have been subjected to a never-ending process of test and examination in the course of regular use, and they have proved of infinite value in the fixing of charges for special cartridges of which the experimental data are by no means complete. The same process of tabulation of shot and powder space has recently been applied to facilitate the examination of loads for thin brass cartridges. Incidentally, improved methods of tabulation have been arrived at, and new systems of check devised. Therefore, it has for some time past been intended to re-measure the whole of the known calibres of paper cartridge, to subject the results obtained to careful mathematical analysis, and finally to evolve a new set of tables. Such a monument of labour will ultimately condense itself into the smallest compass, and it is proposed that the resulting essence shall be issued in the form of a ready reckoner card so as to be available for future use. Such a table of values would in no way trench upon the card of recommended loads which is yearly issued under the authorisation of the various powder manufacturers. A specific combination of powder and shot, in other words a recommended load, is arrived at as the result of experiments, whereas the card which treats of powder and shot charges from the point of view of cubic capacity deals with all combinations—impossible as well as possible.

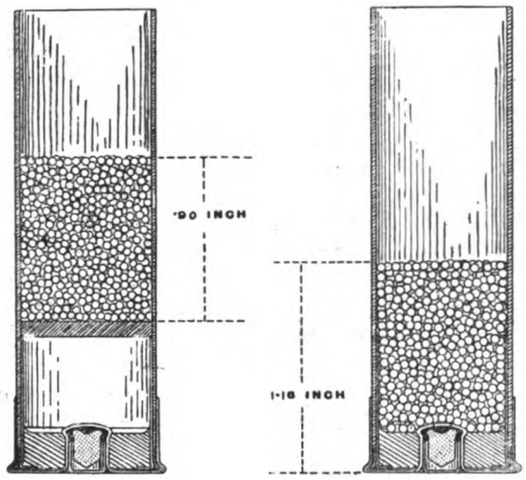
To summarise briefly the work which was accomplished in the previously issued tables, the accompanying diagrams are presented, the one relating to powder charges, the other to shot. They depict the relative space occupied by sundry graduations of charge. The powder measurement is taken from the base of the cartridge, and, therefore, includes the thickness of the "lump" or base; it also takes into account the metal lining, whilst for convenience the thickness of the two card wads on either side of the felt is included as a constant addition. Now the defect of the powder table, as depicted in the accompanying curves, is obvious. The sundry bores are indicated by a series of straight lines having a general tendency to converge at a particular point outside the drawing. The zero point is rendered peculiar by reason of the included thickness of the lump. Whilst no powder should be reducible so as to show that it occupies no space, as a matter of fact the powder table shows a variable amount approximating the third-of-an-inch. The shot charge is easily reduced to a correct zero basis by eliminating the allowed thickness of the turnover and top wad. The re-working of the old tables is justified by the circumstance that a means has been found for measuring the powder charges independently of the cartridge base, the last named being afterwards included in the final results.



The Shot Table graphically represented.

To deal first of all with the vital question of lump thickness it is interesting to know that an exceedingly simple

method is available of subjecting it to direct measurement. Specimens of all the leading cartridges having been obtained, one of each had inserted into it a card wad which was pressed down as far as it would go, generally speaking till it rested on the lining. A weighed quantity of No. 10 shot was employed as the medium for testing the interior capacity of the cartridge. Shot in such a connection is better than powder, because it packs more uniformly and is practically incompressible. The values obtained with the shot will ultimately be expressed in terms of powder, but in the meantime the insertion of a suitable quantity of shot into a cartridge sealed at the bottom by a wad, provides a ready means of making two marks on the side of the case, indicating the height of the column of shot. The same



Method of Determining Depth of Head.

NOTE.—*The actual weight of shot used is immaterial. Any convenient unweighed amount could be measured in the two ways, and the difference noted.*

amount of shot filled into another cartridge, not containing a wad of any sort, gives a second measurement, viz., the space occupied by the same quantity of shot when the thickness of the head is included, the lining, the cap chamber, the lump and other parts, being comprised in the term head. A series of measurements arrived at by this system of working gave the following results :—

TABLE I.—*Cartridge Head Dimensions for the various bores.*

Size of Bore.	Length of Shot Column.	Same quantity in Powder Chamber, measuring from base	Difference = thickness of base.
4	5oz. occupy 1·83in. of tube	2·24in.	·41in.
8	3oz. ,, 1·40in. ,,	1·72in.	·32in.
10	3oz. ,, 1·61in. ,,	1·88in.	·27in.
12	3oz. ,, 1·80in. ,,	2·06in.	·26in.
14	2oz. ,, 1·34in. ,,	1·63in.	·29in.
16	2oz. ,, 1·50in. ,,	1·79in.	·29in.
20	1oz. ,, ·85in. ,,	1·13in.	·28in.
24	1oz. ,, ·96in. ,,	1·23in.	·27in.
28	1oz. ,, 1·09in. ,,	1·37in.	·28in.
32	1oz. ,, 1·27in. ,,	1·54in.	·27in.

It well nigh amounts to a discovery to find that such an extraordinary degree of uniformity runs through all the sizes of cartridge. The length of head for all the usual sizes apparently has a constant value. Therefore the space occupied by the powder can be tested starting from the plain surface of a card wad, whereby no powder occupies no space, three drams so much, six drams so much more, und so forth, till the length of case per grain of powder has been effectually decided. When all the bores have been similarly treated, and differences due to accidental variations of samples have been eliminated, the powder values will be complete and ready for addition to the allowed thickness of base. A further addition for the card wads, and a suitable deduction for compression will be made in due course, all in a manner to be fully explained hereafter. The shot values will be standardised afresh on the same basis of working, but beyond filling in the calibres not previously included, very few changes are likely to be made.

Whilst the present lecture may appear to be mainly of an introductory nature, it includes much that merits careful thought and consideration. Particularly does this refer to the elucidation of base thickness, whereby it is shown that an element of disturbance generally supposed to introduce considerable differences is in reality an extremely constant value not only amongst cartridges of the same bore, but between one bore and another.

The Army and Navy Auxiliary Co-operative Supply Ld. were summoned at Westminster at the instance of the Gunmakers' Company for selling by auction an unproved rifle. For the defence it was urged that a perfectly legitimate mistake had been committed, a view which the Bench adopted, as was shown by their infliction of a nominal fine of 5s. carrying however costs of £5 5s.

The City Press of February 27th last publishes the annual return to the Court of Common Council of Dr. F. J. Waldo, the City Coroner. In the course of his remarks on inquests during the past year, he recalls the official recommendations which were made both by the jury and by the Home Office inspectors in connection with the explosion on registered premises situated in Aldermanbury.

The directors of Sir W. G. Armstrong, Whitworth & Co., Ld., show a profit for last year of £277,011 from which it is proposed to take a dividend for the ordinary shares of 2s. per share free of income tax and to pay the £40,000 dividend due on the preference shares. The carry forward is thereby reduced from £161,199 to £77,210. The reduction of profits is explained by diminished output due to strikes.

Mr. G. Hinton of Taunton was summoned last month for selling cartridges at a pigeon meeting which he attended in his capacity as a gunsmith. The alleged offence lay under the Explosives Act, which contains a proviso expressly excluding the delivery at pigeon meetings of cartridges previously ordered, and the bench found that the defendant had been technically in error in selling a cartridge not so ordered in advance. They ordered him to pay the amount of the costs, 8s. 6d.

The report of Walkers, Parker & Co., Ld. mentions that there has been a marked shrinkage in the margins obtained by the Company between the cost of their metals in an unmanufactured and manufactured state. Considerable capital expenditure has been incurred during the past year a portion of which will be charged over the next three years. The net trading profits are £18,986 against £40,782 a year ago. The directors recommend that the A ordinary shares shall receive three per cent., absorbing £6,000 and the B ordinary shares, £111, the remainder to be carried forward making the total £17,386.

ROUND THE TRADE.

The Ross Rifle Company wish it to be known, in connection with the financial mishaps of the South British Trading Company, that intending purchasers of their rifles should address enquiries direct to Quebec until such time as new arrangements have been completed for an English agency.

The preliminary notice of the Miniature Bisley Meeting fixes the date for the 12th to the 27th of May, and the place, the Gilbey Hall which forms part of the Agricultural Show buildings at Islington. It will run in connection with a territorial forces exhibition of equipment and appliances and an international sports exhibition.

The annual accounts of the Roburite Explosives Co., Ld. show a net profit on last year's trading of £5,188 which compares with £4,486 for the previous twelve months. The usual ten per cent. of net profit is carried to reserve, and the interim dividend already paid is now made up to the full ten per cent. on the preference shares, which leaves £249 to carry forward as against £520 brought into the account. The report contains no reference to the state of business.

The local magistrates, after hearing the arguments for and against the application of the British Explosives Syndicate for an extention of their licence at Pitsea to enable an increase of storage capacity to be made, granted the same. It was explained in the course of the proceedings that the increasing demand for cordite of the larger sizes to suit the armament of vessels of the Dreadnought type necessitated a longer period of drying and a consequent need of more accommodation for storage during the process.

It gives us great pleasure to publish the following letter dated 9th ult. from Messrs. Eley Bros., Ld. :—" In reference to the last paragraph on Page 36 of your current issue, we beg to state that so far as this Company is concerned, we do not sell, and have not for some time sold any " job " or " blemished " cases or cartridges for use in Great Britain and Ireland. With regard to your last remark all orders for named cartridge cases are booked by us on the understanding that customers agree to take, as full execution of their order, plus or minus ten per cent. of the quantity ordered."

The report of Messrs. Webley and Scott, Ld. for last year states that the depression in the sporting gun trade which commenced to be acute in 1907 was very much worse during the whole of 1908, but fortunately owing to the demand for automatic pistols, which materially improved in the latter part of the year, and from business obtained in directions outside the gun trade, the directors have been able practically to maintain the turnover of 1907, and with slightly improved results. The prospects for 1909, having regard to the orders on the books, are satisfactory. The accounts show a net profit of £4,505 after providing for directors' fees and charging £3,289 for upkeep and depreciation of plant, etc. It was proposed and passed at the General Meeting that £2,931 be appropriated for the payment of preference dividend for the half year to June 30, 1907, and that £1,500 be placed to the reserve of trading investments. The carry forward is thereby increased from £141 to £215. In the course of his speech at the Annual Meeting the chairman, Mr. E. B. Winn, made some interesting remarks concerning the present state of business in the gun trade, from which it appeared that the large retailers had been working off their stocks, and that the need for fresh supplies might soon be manifest. Meantime the demand on the Continent for first class guns had been maintained. He referred to the success which had been achieved with automatic pistols, and Mr. Frank Murray gave some further details of a military model which had successfully withstood a course of severe tests.

A leaflet of the B.S.A.-Martin (i.e. Martin of Glasgow) rifle sight displays a workmanlike piece of mechanism which embodies all the latest requirements in V-notch rifle sights, viz., quick approximate adjustment of elevation, fine intermediate adjustment, lock to prevent accidental change of elevation, side traverse for wind with a " click " for each minute of angle.

Match riflemen at Bisley have cause to congratulate themselves that the unpleasant crowding of last year's contests into an inadequate number of days has for a start been relieved this year by fixing the Elcho match to take place on the Friday. Match rifle tie shooting will for the future be curtailed by scoring the carton circle inside the bull at the value of six points.

The Fraser rear aperture sight is one of those which will no doubt be heard of a good deal during the coming rifle shooting season. The aperture is fitted on the firing pin where it takes the place of the ordinary nut. It moves backwards and forwards with the bolt on a principle which has already been worked for sporting rifles, but the present design for range use is a much more elaborate affair with an elevation scale and vernier, also a traversing wind gauge adjustment.

The Normal Powder Co., Ld. held a demonstration of the Sjogren automatic system as applied to guns and rifles at Hendon on the 20th ult. The object was to make the idea known to members of the stock exchange, and the party of invited guests were entertained with clay bird practice and other forms of shooting. It has been announced in the columns of the *Globe* that the prospectus of the Automatic Arms Co., Ld. (Sjogren system) will shortly be issued, when 100,000 of the 150,000 £1 shares will be offered for public subscription.

The annual report and balance sheet of Messrs. Curtis's and Harvey, Ld. shows a gross profit of £29,340 which after the deduction of debenture interest, directors' fees and other expenses, leaves a balance of £3,339. Of this sum £2,000 is set aside to reserve, and the balance increases the carry forward to £6,822. The directors express regret that the year's trading results have not been more satisfactory. Though there has been an improvement in prices since the previous year, they are still at too low a level, and the Company has been further unfortunate in having had a costly and destructive fire at the Cliffe factory.

The balance sheet of Messrs. Vickers, Sons and Maxim, Ld., shows a profit after providing debenture interest and the usual depreciation amounting to £416,846 which compares with £768,525 a year ago. Taking into account the interim dividend already paid this allows for the payment of the usual five per cent. on the preference shares and preferred stock, also 2s. per share or 10 per cent. on the ordinary shares as against 3s. on the previous occasion. The carry forward is thereby reduced from £211,076 to £186,672. The falling off is attributed to the depression of trade which has been general throughout the world.

Mr. H. J. W. Drummond in the course of his statement to the shareholders of Eley Bros. Ld. on the 26th of February last explained that last year's results had not fulfilled the anticipations formed during the opening months. Apart from the disturbing influence of the weather on the head of game produced in the breeding season there were various other causes which acted detrimentally. One was the interruption of orders from Canada which had now been renewed in satisfactory quantities. With the quieting of the political situation in South Africa an increase of trade from that quarter might shortly be expected. He referred to the Company's purchase of the fulminate factory of Helcké Bros. at Faversham, also to the completion of the Company's own shot tower, which was working very satisfactorily.

THE MANUFACTURE OF GUNCOTTON AT WALTHAM ABBEY (1863).

By GEORGE W. MACDONALD, M.Sc., F.C.S.

Abel communicated to the Committee at the British Association, the details of his method of manufacture at Waltham Abbey, from which the following extracts are taken :—

Very considerable difficulties were experienced in procuring the small quantity of cotton (two or three cwts.) required for these experiments, in a condition resembling sufficiently closely that employed at Hirtenberg, as its production in the form of the thick and the thin loose rovings or yarn, necessitated some deviation from the ordinary method of spinning, which it was difficult to induce manufacturers to attempt without the promise of an extensive order. Eventually I succeeded, in obtaining the requisite quantity of coarse and fine yarn or roving, resembling closely in character, and quality of cotton, the specimens obtained from Hirtenberg.

The acids were readily obtained at moderate prices—the sulphuric acid having a specific gravity of 1·84, and that of the nitric acid (a light amber-coloured acid) being 1·52.

The apparatus and implements employed, and the modes of conducting the various operations, were, as closely as practicable, in accordance with those in use in Hirtenberg, a slight deviation only, in the form or material of some of the implements, being adopted where it was decidedly advantageous and could not in any way influence the nature of the results. The following is an account of the details of manufacture :—

Preparation of the Cotton.—The cotton was made up into skeins, those of the stout yarn weighing from four to six ounces each, and those of fine yarn from three to four ounces. It was then boiled for about 15 minutes in a dilute solution of potassium carbonate (sp. gr. 1·02) and transferred thence to a centrifugal machine. The cotton was then washed thoroughly, first by hand in a large tank, and afterwards by submersion in a stream for forty-eight hours. The water was separated from the skeins by the aid of the centrifugal machine, and the purified cotton was then dried. Although the cotton was of good quality and very fairly cleaned from seed (being quite equal in these respects to the Austrian samples), it was found to sustain a loss of about 5 per cent. by the treatment with alkali and washing. The potash solution in which it was boiled acquired a coffee colour. Portions of seed were still retained by the purified cotton, which were subsequently dissolved out perfectly by the acids. *Preparation of the Acids.*—The proportions of acids (three parts by weight, or 2·45 by volume, of sulphuric acid to one part of nitric acid) were weighed off and transferred to stoneware barrel-shaped vessels provided with taps, two of these receiving the sulphuric acid and a third the nitric acid. The barrels were so arranged upon a suitable table that the acids could be delivered from the taps into a deep and very capacious stoneware vessel, fitted with an iron lid with suitable apertures and a tap ; this vessel was raised from the ground sufficiently to allow of the acids being transferred from it to well-stoppered stoneware bottles. While the acids were flowing slowly and uniformly from the barrels into the covered mixing-vessel, the resulting mixture was kept continuously stirred by means of a large iron paddle, and after they had been entirely transferred (which occupied about ten minutes), the stirring was continued for about twenty minutes before the mixture was drawn off into the bottles. The product of this operation had a sp. gr. of 1·82. The acid, thus prepared, was set aside in a cool place, and never employed until at least twenty-four hours after the mixture had been made. *Treatment of the Cotton with the mixed Acids.*—About twelve hours before immersion in the acids, the skeins to be operated upon at one time (which had previously been dried in the air) were suspended in a drying-chamber, at not less than 49°C. They were then transferred, while in the chamber, to stoneware jars with tightly closing lids, and were allowed to become perfectly cold in these before submission to treatment with acid.

The vessels which were found most suitable for use in treating the cotton with the acid were large and rather deep stoneware pans ; one, provided with an iron lid, contained the quantity of mixed acids required for the treatment of a certain number of skeins ; a second, which was fitted with a perforated ledge of iron, and was surrounded by cold water, served for the treatment of the cotton, which was conducted as follows :—A proportion of the acid having been transferred to the second pan, two skeins were thoroughly immersed in it, and stirred about for two or three minutes ; when saturated with acid they were raised upon the shelf and pressed together with the paddle, so as to allow the superfluous acid to flow off ; the quantity of acid absorbed by these skeins was replaced in the pan by an addition of fresh acid, and further skeins were immersed, those which had drained being transferred to a jar while the freshly immersed ones were soaking. In this way the operation of immersion was continued until the whole of the skeins to be treated at one time had been transferred to the jars, six of the large yarn or nine of the fine being introduced into one of these. The skeins were pressed down in the jars by means of the paddle, and sufficient acid was added just to cover the cotton completely. The jars were then closed and placed into vessels containing water, in a cool building, where they remained for forty-eight hours.

It was found an important precaution to keep the vessel in which the cotton was first immersed surrounded with water, especially in the warm season during which these experiments have been conducted, as the evolution of heat during the first action of the acids upon the cotton is considerable. The contents of the jars to which the guncotton was transferred were not found to become heated to any important extent, even when not surrounded by water. The proportion of acid to cotton said to be contained in the jars, as the process is carried out at Hirtenberg, is that of ten to one ; but it was found necesssary, in order to cover the cotton completely as directed, to employ at least fifteen

parts of acid to one of cotton. This proportion would doubtless be much diminished if means were employed for compressing the cotton in the jars more highly than was the case in these experiments. The precaution of adding a fresh supply of acids to that which remains in the immersing vessel after the withdrawal of each quantity of cotton treated, was proved by experiment to be of the greatest importance in securing the uniformity of the product. In one of the first operations, no fresh quantity of acid was added before immersing the skeins treated last. In other respects these skeins were submitted to precisely the same treatment as the remainder (i.e. an additional quantity of acid was added to them in the jar, they were allowed to remain for forty-eight hours, &c.). When examined synthetically, they furnished at least one-half per cent. more cotton than the skeins first treated in the same operation; and when fired in the proof-mortar, a decidedly lower range was obtained with the cotton last treated. *Purification of the Guncotton.*—At the expiration of forty-eight hours the jars were conveyed to a centrifugal machine. The machine employed at Hirtenberg for this purpose is made of copper, the one used by me was constructed entirely of iron, the sides of the revolving cylinder consisting of coarse iron-wire gauze, rendered sufficiently rigid by an iron framework. After each operation the machine was washed out with an abundant supply of water, and thus the corrosive action of the acids upon it has really been very trifling. The skeins were rapidly transferred, by means of an iron hook, to the centrifugal machine. Within ten minutes the acid was so far separated from the cotton that the skeins were only damp. Some precautions were necessary in effecting the first transfer to water of the skeins, with acid still clinging to them. If they were simply thrown into water so that the latter would penetrate them only gradually, the heat resulting from the union of the free acids and the water immediately established a violent action of the nitric acid upon the cotton, quantities of nitrous vapours being disengaged. At Hirtenberg the guncotton, when taken from the machine, is quickly placed under a small cascade, where its saturation with water is effected with very great rapidity. As this arrangement was not attainable at Waltham Abbey, the skeins, directly they were removed from the machine, were plunged singly, as rapidly as possible, and moved about violently, in a large body of water. They were then washed by hand in a stream until no acid taste whatever was perceptible in the cotton, and were afterwards immersed in the stream for a period of not less than forty-eight hours. For this purpose they were arranged in rows upon poles fixed in frames, which were so placed in the water that the skeins were in a vertical position, the water circulating among them freely. The current of the stream used at Waltham Abbey (at the only available place for these experiments) was not so rapid as could have been desired, and the dryness of the season had rendered it unusually sluggish; still it was sufficient to afford a continual change of the water surrounding the cotton. The character of this water is by no means such as to render it specially fitted for the purification of the guncotton. The bed of the stream is always thickly covered with luxuriant vegetable growth, and the water itself is consequently so highly charged with vegetable matter, that, although light was excluded as far as possible from the cotton during its immersion, the skeins became covered in many places, within a few days, by vegetable growth, which in time attached itself so firmly to the cotton as to be very difficult of removal by hand-washing.

The system of purification, as carried on at Hirtenberg, differs very considerably from that described in General Lenk's process as patented in this country. At the above-named establishment, the guncotton is in the first instance left in the stream for three weeks and upwards; it is afterwards washed in a dilute solution of potassium carbonate, again washed in water, dried, and then treated with a solution of soluble glass. After this treatment it is dried, washed for six hours in the stream, and finally by hand.

In the patented process, it is directed that the guncotton in the first instance should be immersed in running water for forty-eight hours and upwards; it is not submitted to any treatment with potassium carbonate, but is boiled, after the first washing, in a weak solution of soluble glass, and on its removal from this, without any intermediate desiccation, it is immersed in the stream for about six days.

The process of purification which I adopted differed from that in use at Hirtenberg only in the postponement of the long-continued washing until after treatment of the guncotton with alkali. At the expiration of forty-eight hours the skeins were removed from the stream, centrifugalled, and they were then boiled for a few minutes in a solution of potassium carbonate of sp. gr. 1·02. Having been returned to the centrifugal machine, they were again placed in the washing-frames and left in the stream for a period of fourteen to eighteen days. On subsequent removal from the stream, each skein was washed by hand, to separate mechanical impurities, and one-half of each quantity of guncotton prepared was finally left in soak in distilled water for some hours. The guncotton thus finally purified was dried in the open air.

The treatment of the purified guncotton with soluble glass.—In General Lenk's process, as described in the English patent, the soluble glass is applied, as already stated, to the guncotton which, after the removal from the acids, has undergone no further treatment than an immersion in running water for forty-eight hours or thereabouts; when removed from the bath of silicate, the guncotton is not dried but at once immersed for a period of six days in running water. It is at once obvious that this treatment cannot exert any effect upon the cotton, beyond possibly the neutralization of a minute trace of free acid still retained by it after the first washing. That the treatment with soluble glass is not intended to exert any other than a purifying effect upon the guncotton, appears also to have been understood by Professors Redtenbacher, Schrotter, and Schneider, in their inquiry into Baron Lenk's system of manufacture; for the only allusion which in their joint report they make to this point, is as follows, "the treatment with soluble glass has no influence on Baron Lenk's guncotton it being previously free from acids."

In order to test, the system of manufacture as carried

on at Hirtenberg, it was determined to submit one-half of each quantity of guncotton produced in one operation to the treatment with soluble glass, the other half being dried, as a finished product, after the immersion in distilled water. The first portion was soaked for one hour in a boiling 2 per cent. solution of the silicate. After being centrifugalled the guncotton still retained about 80 per cent. of the solution, which, by evaporation, left therefore about 8 per cent. of soluble glass in the material. The skeins were thoroughly dried in air, and then immersed in the stream for about forty-eight hours. A longer period of immersion was adopted than in use at Hirtenberg, on account of the comparatively sluggish current of the river. The skeins were finally washed by hand and dried, this operation completing the manufacture of the guncotton.

The ash of a "silicated" product was 1·85 per cent.; that of the non-treated 1·45 per cent. The proportion of silica left in the guncotton was greater than that found in the Austrian specimens: but the portion not treated with soluble glass also contained a very notable amount of silica, derived from suspended matter in the water. Artificial heat was not employed in drying any portion of the purified guncotton. This operation was accomplished by suspending the skeins during the day upon lines in the open air, or in a well-ventilated shed in wet weather and at night.

THE AMERICAN SPORTSMAN AND HIS RIFLE.

By EDWARD C. CROSSMAN.

(*Concluded*).

The German manufacturers are at present supplying the demand that exists for bolt action rifles, the question of fine finish and fine balance is still a minor one with the average purchaser of a rifle. However, with the finer balance and finer finish offered by the German arms, incidental to their being of the desired bolt action, the tastes of the American rifle crank are being educated up to the stage where he will soon demand that his rifle be as finely finished, as well balanced, and as reliable and well made as the shotgun for which he cheerfully pays a good price. The American machine-made and roughly finished rifle, with its crowbar balance will no longer suffice, and the American manufacturers will have to improve their rifles very much or see the foreign rifle makers getting the cream of the trade—the trade able to pay good prices—in spite of the high protective tariff imposed on arms of foreign make.

With every dollar additional—up to a certain price at least—the lover of a fine shotgun can obtain that much additional care in the manufacture of the arm, that much finer locks, finer material in the barrels, finer finished parts, better balance and better fitting throughout the arm.

It is only in American made rifles that this is not true. The parts are turned out by machinery, they are finished to a great extent by machinery, they are "assembled" not fitted, by men who do nothing else, and the price of the rifle multiplied by ten will not enable the prospective purchaser to have these parts finished in better shape. They will take the rifle after it is finished, to the engraving room, and will there put on engraving and gold inlay work to any extent desired, but, the rifle is exactly the same underneath as the one Sam Smith or Bill Jones paid $15.00 for. The parts will not be fitted a whit better, they will not be finished a degree smoother, the rifle will not shoot any better or be any less liable to break or jam for all the engraving piled up on the receiver, or all the fine wood in the stock. The American rifles are marvels of gunmaking—for the prices obtained for them, but there are a good many sportsmen, able and willing to pay the price, who want better rifles, from the rough stock used for the parts, to the finished product, and these men, unable to get what they want at home, are turning their eyes across the Atlantic, as they used to do when they wanted fine shotguns. Thus there are two reasons for the popularity of the foreign rifle at present—it is possible to obtain the bolt action in rifles of foreign manufacture, and it is possible to get the worth of the extra amount of money invested, in better materials and better finish. The latter class—cranks as they might be called—is still a small one, the American sportsman still believes that the American rifle is made and finished well enough for anyone, but this is because he does know what a really fine rifle means.

Just why, when thousands, tens of thousands of English made double guns have been sold in the States, this splendid market for English rifles had been neglected, it is hard to understand. It cannot be entirely because of the protective duty aganist foreign made rifles and guns, English made guns continue to be sold in spite of this added handicap against them. It is not because the American rifles were so much cheaper that it was impossible to compete with them. The factories in the United States have turned out cheap shotguns for years but in spite of this, the fine English guns are sold to discriminating sportsmen.

Of course there never has been, nor will there ever be, a market for double express rifles, in the States. There are several reasons why these arms cannot be sold. The American sportsman must have a repeater and no amount of argument could convince him that two shots were enough to have at his command in the hunting of game at any sort, where a rifle was used. The express rifle of the double variety is too heavy, the American sportsman, more than ever, demands a light rifle, preferably not to exceed seven-and-a-half pounds and better still weighing seven. The Savage company make a rifle they call their Featherweight, in the American calibres of 30-30, .303, and 25-35, that only weighs six pounds. This rifle has had an enormous sale. The cost of the double express rifle is another argument against its popularity in the States. And in addition to all these reasons, there is the old idea that the double barrelled rifle is not as accurate as the single barrelled rifle.

The popular rifle for export to the States would be a rifle of light weight, fitted with either Mauser, Mannlicher or Mannlicher-Schoenauer action, nicely finished and balanced, and costing from $50.00 to $90.00 according to finish. If a cheaper grade than the cheapest one mentioned could be turned out, it would be of great help to the

introduction of the English made rifles. The prices mentioned would be of course New York prices, which mean of course with the duty and the transportation included in the figures given above. With the American sportsman impressed with the idea that he could pay as much as he pleased and for his additional dollars, get "gun," better finish, more care in the manufacture of the arm, and perhaps better material, with ornamentation as the last thing to be considered, there would undoubtedly be many orders sent across the water for the higher priced rifles, rifles approaching the prices of the fine English guns sold in the States. The first step is to get the quality of the English made rifles established in the minds of the sportsmen of the States, as thoroughly as the quality of the English shotguns. The good American sportsman prides himself that his mechanics are as good as any in the world and that his factories can turn out guns as fine as any in the world. It is probable that this is true, but the fact remains that the American rifle factories do not turn out guns equal to any in the world, regardless of what they are able to do. For the prices, the American made rifles are very fine but there are a good many men who are able to pay a trifle more than $15.00 for their rifles to take big game hunting, and who expect to get finer materials and workmanship if they pay more money. The German factories are quietly taking in this trade, in spite of the fact that English made guns are very favourably known in America and German guns are known not at all.

English rifles, to be popular in the States, should be made in a variety of calibres, and preferably for the better known American hunting cartridges, such as the 30–30, 30–40, and the U.S. Government Model 1906 cartridge as used in the U.S. Army. In addition to these three cartridges, the 32–40 High Power is a very popular cartridge in the States. The ·303 British is of course well known and rifles taking this cartridge would sell, but not as well as rifles made for the cartridges mentioned above.

The English rifle makers have some calibres which have no duplicates in the States, and which fill a long felt want with the American sportsmen. For instance the Ross-Eley cartridge, ·280 calibre with its terrific initial velocity would find many appreciative buyers on this side of the water when its advantages became known. The Jeffrey ·333 would be one of the most popular cartridges ever sold in the States, when its merits became known through proper advertising. This cartridge gives the flat trajectory combined with great striking energy that has been so much sought by hunters in Alaska and British Columbia, not to speak of the Rockies in the States. Some of the other English cartridges would appeal to cranks who have been seeking just that sort of a cartridge, and the English makers would find it paying to advertise their entire line of rifles that are fitted with the bolt action.

The American sportsman is a great catalogue fiend and the catalogue is not confined to the hunting man alone. Two of the greatest mercantile concerns in the world, Sears, Roebuck & Co. and Montgomery Ward & Co. sell every pennyworth of their goods through catalogues alone, to customers residing at a distance and never see one of their customers from one year to another, unless by chance. One of these concerns, Sears, Roebuck & Co., sold $53,285,792.00 worth of goods during the year 1907 alone, the goods sold ranging from a steam locomotive to a bar of soap or a spool of darning cotton and the customers living in all parts of the United States, from Maine to California.

If the United States had the postal laws which it should have, these concerns would undoubtedly increase their business three times over, the unreasonable cost of transportation and the lack of a parcel post law, preventing many persons from buying of these mail order concerns. This is merely quoted to show what a catalogue crank the American is, and how easy it is to get him interested in a line of goods by advertising, making the advertisements attractive and catchy, and emphasizing the fact that the article advertised is something new and better than anything offered in that line before. Probably nine American shooting men out of ten, buy their arms by the aid of catalogues and probably half of them buy entirely through the catalogues, never seeing the arm until it arrives. It would take but little judicious advertising to create a demand for English rifles, and to put the German-made arms out of the running, if the English makers could meet the German prices for a few years until the superior quality of their rifles became known to the American shooting man. A judicious distribution of catalogues by the English makers through the States, which could be done at little expense, would undoubtedly result in enough orders to make the cost worth while, as the English catalogues contain much that is interesting to a shooting crank in the States. Even the writer, who has made shooting his hobby ever since old enough to hold a gun, was much interested in several catalogues recently received from a couple of the better known English makers, and his next rifle will be a ·333 Mauser, which he found in the pages of one of these catalogues, and of which he had never heard before.

It is to be hoped that the English rifle makers will not allow the German factories to take complete possession of the American market for the higher grade rifles as they threaten to do at present. A good market exists at present for good, well balanced, bolt action, foreign made rifles, and by the proper stimulation and education this market could be much increased. It remains with the English makers to decide whether or not they will allow the German rifle makers to reap the benefits of the steadily increasing demand for better rifles in the United States.

Mr. J. J. Steward, in his capacity as chairman at the annual general meeting of the City Rifle Club, spoke in support of the bull's eye as the correct means of acquiring skill in rifle shooting. The reprint leaflet of his speech provides an eloquent and comprehensive statement on the subject.

APPLICATIONS FOR PATENTS.

FEBRUARY 15—MARCH 20, 1909.

3,651. Rifle Practice Apparatus. F. Mitchell.
3,847. Targets. E. J. Solano.
3,885. Gun Actions. T. W. Crampton.
3,894. Cleaning Rod Handles. W. Andrews.
3,937.* Explosives. H. W. Lake.
3,963. Leydite Shell. T. Davage.
4,094. Explosives Buildings. O. Guttmann.
4,124.* Targets. W. V. Rhemrev.
4,174. Single-Trigger Guns. W. Baker.
4,182. Targets. C. H. Ross.
4,214.* Ordnance Trigger Mechanism. Fried Krupp.
4,227. Range Finders. R. E. H. Dyer.
4,291. Target Systems. F. G. Skerritt.
4,292. Firing Mechanism for Artillery. W. E. Napier.
4,446. Determining Points Obtained at Rifle Practice. C. J. Stewart.
4,453. Ejecting Mechanism. H. Price.
4,615. Range Finder. P. W. Gray and T. Cooke & Sons. Ld.
4,658.* Automatic Igniting Projectiles. P. Lentz.
4,946.* Sliding Barrel Guns. K. Haussner.
4,950. Lessening Sound of Discharge. L. T. G. Evans.
4,978.* Artillery Projectiles. Rheinische Metallwaaren und Maschinenfabrik.
5,012.* Projectile. W. I. Scasin.
5,021.* Telescopic Sights. A. C. Curtis.
5,094. Ordnance. H. C. Woltereck.
5,169. Range Finders. R. E. H. Dyer.
5,310. Projectile Fuses. E. Schneider.
5,480. Rifles. T. R. R. Ashton.

5,636. Light Field Guns. A. J. Swallow.
5,654. Fuses for Shells. King's Norton Metal Co., Ld., T. A. Bayliss and E. Whitworth.
5 655. Rifle Sights. J. E. Martin.
5,807.* Sights. J. T. Peddie.
5,814.* Gun Turrets. E. Schneider.
5,825. Range Finder. W. R. Beeston and G. B. Read.
5,947. Shot Firing Appliance. W. Cochrane.
6,077. Backsight. H. J. Harriss.
6,420. Revolver Instruction Apparatus. W. S. Simpson.
6,470. Gun Closing-Plug. W. Butcher.
6,708. Disappearing Targets. R. Foster.
6,723.* Ordnance. Fried Krupp.
6,731. Machine Gun. A. Carson.

* These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

FEBRUARY 18—MARCH 18, 1909.

COMPILED BY HENRY TARRANT.

23,727 (1907). **Ordnance Sights.** Lieut. A. T. Dawson and G. T. Buckham, London. Ordnance sighting mechanism of the types set out in Specifications Nos. 4,404, 1906, and 673, 1907 is improved. Instead of setting through a rack and pinion a cam and roller are used. The latter is carried by a lever to enable the pivot position to be changed—the link thus serving as a calibrating device. Accepted Jan. 26, 1909.

2,629 (1908). **Electrically Fired Small Arm.** H. Whittington, Birmingham. In patent No. 19,620, 1908 an electric cartridge is described. The apparatus in the present patent is for firing it. A battery is contained in the stock and the pulling of the trigger completes the circuit. A safety switch is provided to bridge part of circuit when necessity arises. Accepted Feb. 4, 1909.

2,708 (1908). **Electrical Target.** S. A. M. Rose, Australia. This apparatus is intended principally for recording company fire without reference to human markers. The target moves intermittently and has a reproduction in miniature at the firing point. The position of hits on the main target is automatically recorded by the small one. Accepted Feb. 4, 1909.

3,587 (1908). **Ordnance Breech Mechanism.** Col. H. C. L. Holden, F.R.S., Woolwich. (*See Selected Patents*).

4,002 (1908). **Electrical Target.** W. Hadley, Birmingham. A target of the sort usually identified with air rifle shooting has a hole in the front plate representing the bullseye. When a pellet enters the hole it drives back a stud, a sliding bar is released, and an electric circuit is completed which rings a bell. An indicator showing the value of the shot is also released. Accepted Feb. 22, 1909.

4,128 (1908). **Forming Explosive Cords.** H. Auchu, U.S.A. The patentee cites many defects in the plant at present employed to form cords of explosive gelatine. In the machine described in the patent the packing screw which forces the explosive through the nozzle is cooled and is automatically stopped by abnormal reactionary pressure of the explosive so that chance of accident through the presence of foreign matter or too much friction is eliminated. The patentee claims also to have simplified the construction of the machine so as to make it easily accessible for cleaning. Accepted Feb. 24, 1909.

5,213 (1908). **Recoil Brakes for Ordnance.** Major L. M. Fuller, U.S.A. Army. A method of checking the recoil of ordnance which consists first in determining the velocities of retarded recoils for the recoiling parts at each instant of recoil and deducing by the aid of curves the velocities for each unit of the length of recoil. Then the parts are retarded to a degree proportional to the determined velocities. The effective throttling area at each instant of recoil is made to correspond with the ascertained velocities of the retarded recoil at each instant. Accepted Feb. 4, 1909.

5,500 (1908). **Range Finders.** Sir W. H. H. Christie, Greenwich. Range finders of the type dealt with in patent No. 12,404, 1886, are rendered less susceptible to distortion due to changes of temperature by the use of a hollow instead of a solid metallic base. Non-conducting material is used between this shell and the mounting proper. Accepted Feb. 4, 1909.

6,151 (1908). **Travelling Targets.** Capt. Whitney, Melbourne. A truck or trolley, oil or electrically propelled, carries a target representing say a man. The truck is protected by armour and during its travel additional movement is given to the dummy by bars which stand on the track in its road. Accepted Feb. 4, 1909.

6,680 (1908). **Report Silencer.** Sir H. S. Maxim, West Norwood. (*See Selected Patents*).

6,843 (1908). **Automatic Small Arm.** H. W. Holland and T. Woodward, London. The front part of the stock of this arm telescopes into the rear, the two members being forced apart by a spring. When the gun is fired the front part of the stock is driven into the rear and a rod on the latter is caused to operate a toggle joint in the breech. In this way the breech is opened and the usual cycle of operations ensues. Accepted Feb. 4, 1909.

7,889 (1908). **Sear Check.** J. Leedale. This sear check is designed to prevent the vibration, due to firing of the first barrel, firing the second in a double-barrelled sporting gun or rifle. A spring controlled rod is brought into position so as to form a latch for the tail of the sear of the second lock. The pulling of the trigger of the second barrel puts this latch out of action. Accepted Feb. 18, 1909.

8,872 (1908). **Aperture Sights for Rifles.** W. J. Jeffery, London. (*See Selected Patents*).

8,892 (1908). **Automatic Falling Target.** Capt. G. Breszt-ovszky, Hungary. The target is held up by a "suspension eye." When the target is struck vibration is set up and a spring is caused to strike the eye and release the target so that it falls backwards. Accepted Feb. 4, 1909.

8,919 (1908). **A Car for Machine Guns.** G. A. Strutt, Cromford. The car described in this patent is designed to carry conveniently a machine gun, its appurtenances, the necessary operators and a sledge for conveying the gun on ground where the cart could not be used. The car is comprehensive even to the extent of the provision of a box for corn, etc., and a locker for empty cases. Accepted Feb. 25, 1909.

9,460 (1908). **Cartridge Loading Devices.** Nobel's Explosives Co., Ld., Glasgow and H. D. Hodge, Waltham. This patent covers an arrangement for facilitating the insertion of caps and anvils into the bases of sporting cartridges. Three plates are employed. In the bottom one the primers are arranged in evenly distributed holes. The centre and top plates have holes capable of super-imposition over the holes in the plate beneath. The anvils are strewn on the top plate and rest, when each finds a recess, with noses pointed one way. A slight movement of the top plate allows the anvils to drop nose downwards through the holes in the middle plate into the primers below. A machine afterwards presses the anvils home. Accepted Feb. 4, 1909.

9,462 (1908). **Cartridge Loading Machinery.** Nobel's Explosives Co., Ld., Glasgow and H. D. Hodge, Waltham. Empty cases are presented to the loading machine in proper order by means of the apparatus described in this patent. The cases are placed head downwards on an inclined table; they are carried on to a revolving disc and thence into a guideway; and are allowed to leave the guideway only one at a time in proper sequence. The feed arrangements for presenting the cases to the guideway are fully described. Accepted Feb. 4, 1909.

10,505 (1908). **Ordnance Setting Apparatus.** Sir W. G. Armstrong, Whitworth & Co., Ld., and J. Richardson, Newcastle-on-Tyne. In combination with the range dial, mechanism is arranged to allow for effecting correction not only for changes of muzzle velocity or temperature, but also for changes of air density at different ranges and for different kinds of projectiles.. Accepted Feb. 11, 1909.

13,703 (1908). **Ordnance Loading Apparatus.** Lt. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. An auxiliary rammer is provided for pushing the powder charges into heavy ordnance. It is lighter than the rammer used for the heavy projectiles and can consequently be operated more quickly and seats the charge more correctly. It consists of a series of links hinged together on the lazy tongs or toggle principle. Accepted Feb. 25, 1909.

11,295 (1908). **Projectile Points.** P. M. Justice, London. (Agent for *Lieut.-Com. Cleland Davis, U.S.A. Navy*). This projectile has the right kind of head for piercing armour, but the patentee covers it with a sheath of the proper shape, according to accepted ballistic laws, for getting through the air. Accepted Feb. 4, 1909.

11,381 (1908). **Range Finders.** R. Rodger, Armadale. Improvements are described in single telescope range finders. When readjusting the sight on the object after the prelininary movement of the telescope the patentee arranges that a pointer shall be actuated to indicate the range. Accepted Feb. 4, 1909.

11,893 (1908). **Target Apparatus.** E. J. Solano, London. Moving and disappearing targets are arranged on a series of steps backed by canvas representing actual landscapes. The whole arrangement is built up to scale so as to give as lifelike a representation of a battlefield as possible to the marksman practising on a miniature range. The figures are actuated by cords running over wheels from the firing point. Accepted Feb. 11, 1909.

13,085 (1908). **Ordnance Laying Device.** Lieut.-Col. L. K. Scott, C.B., late R.A., Farnborough. The device described in this patent is for use in laying guns from behind cover when the target is not visible and is an improvement on that set out in patent No. 20,203, 1904. All data are obtained by mechanical adjustment instead of as heretofore by a certain amount of complicated mental calculation. The patentee is aware of the contents of Specifications Nos. 14,903, 1906, 11,695, 1905, 8,693, 1905, 15,147, 1902, and 9,033, 1890. Accepted Feb. 18, 1909.

13,746 (1908). **Range Finder.** Major R. E. H. Dyer, India. This range finder is the subject of other patents dealt with in the last issue of *Arms and Explosives* and consists of a telescope mounted on a bar, parallel to it, and a second bar at right angles sliding on the main bar. The sliding bar carries a mirror at 45° to the axis of the telescope. The range is determined by the distance of the mirror from the telescope when the object is correctly seen in the apparatus. Accepted Feb. 11, 1909.

14,676 (1908). **Cartridges for Automatic Arms.** H. Borchardt, Germany. In order to make easy the extraction of cartridge cases from the chambers of automatic arms without the aid of grease the patentee proposes to coat the cases with a deposit of nickel. Accepted Feb. 11, 1909.

15,012 (1908). **Aiming Tube.** R. E. Reardon and S. W. Graham, Canada. A tube somewhat similar to the well-known Morris is modified by sweeping the bore upwards from a point two inches or so from the breech so that the miniature rim fire cartridge lies in a position where the extractor of the ordinary full charge cartridge can catch hold of it and where the ordinary central fire striker will strike the opposite edge of the rim. Accepted Feb. 4, 1909.

19,620 (1908). **Electrical Firing of Small Arms.** H. Whittington, Birmingham. In the place of the ordinary primer of a small-arm cartridge an incandescent electric wire and an insulator are arranged. The cartridge is used in conjunction with the electrical firing apparatus dealt with in patent No. 2,629, 1908 above. Accepted Feb. 11, 1909.

22,823 (1908). **Fuse Safety Devices.** Fried Krupp, A.-G., Germany. Fuses with two or more parts in the locking or safety device are arranged so that they are not "un-safed" until some way on their journey after leaving the muzzle. Centrifugal force disengages the safety, but one piece holds another in place until the lapse of a certain period. Accepted Feb. 18, 1909.

25,432 (1908). **Greasing Military Cartridges.** R. Frommer, Hungary. Cartridges are stored in the usual way in cases but a device is introduced through which they may automatically be greased when they are removed. The merit of the invention is said to lie in the fact that as the grease is only applied when the cartridges are about to be used it cannot attack the metal of the cases. Accepted Feb. 18, 1909.

26,679 (1908). **Projectile Fuses.** Fried Krupp, A.-G., Germany. The fuse is connected to the body by means of a mouth bush, so that the space for the reception of the shrapnel shell may be as large as possible. The bush in the mouth is provided with a pin turned towards the point of the projectile and the fuse with a recess to receive the pin. Accepted Jan. 28, 1909.

27,366 (1908). **Loading Cartridges.** R. B. Ransford, London (Agent for *H. A. Stillwell, U.S.A.*). This device is adapted to hold cartridges during loading and consists of a number of leaves having complementary semi-cylindrical recesses therein. Means are provided for closing the leaves up to grip the cartridge cases and for separating them. Accepted Feb. 25, 1909.

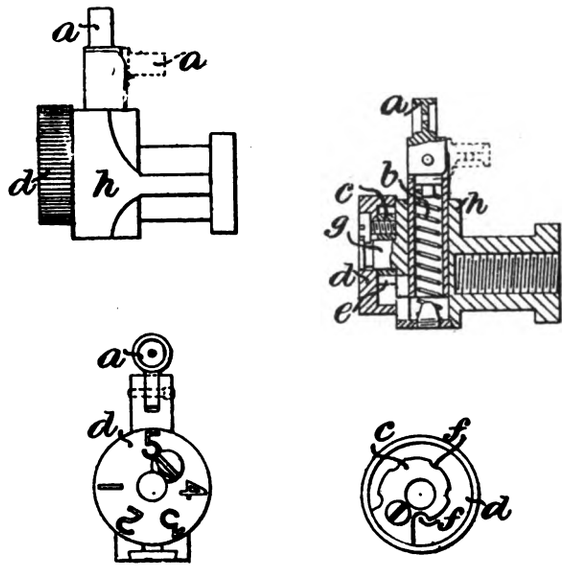
27,598 (1908). **Balloon Explosives.** A separate balloon attached by a cable to the main airship is adapted by its own buoyancy to carry the explosive charges. The balloon is destroyed by the airship when the explosive is to be discharged on anything beneath. Accepted Feb. 4, 1909.

455 (1909). **Report Silencers.** H. P. Maxin, U.S.A. In patents Nos. 14,310, 1908 and 25,269, 1908 a report silencer is described. The patentee finds that the gas intercepting blades need to be stouter near the muzzle than those near the other end of the device and therefore he modifies accordingly. Accepted Feb. 4, 1909.

SELECTED PATENTS.

APERTURE SIGHTS FOR RIFLES.

8,872 (1908). W. J. Jeffery, London. The sight dealt with in this patent is designed to be attached to the cocking piece on the rear of the breech bolt, or it may also be adapted for attachment to the stock of a rifle.



It is illustrated by the drawings here reproduced. The aperture or sighting hole is drilled in the part *a* which is always urged in an upward direction by the spring *b*. This part *a* is pivoted so that it may be turned down out of the way as is indicated by the dotted lines. The vertical position of the sight is regulated by the cam *c* contained in the milled hollow disc *d*. At the bottom of the sight-carrying stem the spur *e* projects into the milled head and is forced by the spring *b* into one or other of the notches *f* of the cam *c*. The deeper the notch the higher the sight is allowed to rise. The ranges are marked as illustrated on the face of the disc *d*, which turns on the stem *g* of the fixed housing *h* carrying the sight stem *g*. Accepted Feb. 18, 1909.

REPORT SILENCER.

6,680 (1908). Sir H. S. Maxim, West Norwood. This invention relates to guns and more particularly to guns included in the term "small arms," and has particular reference to silencing devices of the kind in which annular chambers are disposed around or at the end of the gun barrel and the projectile operates as a valve in its passage through the said device and controls the escape of the gases from chamber to chamber and to the atmosphere. According to one construction of the present invention the silencing chamber comprises two compartments of comparatively large volume each of which encloses slots cut in the rifling of the barrel of the gun. The gases escape at the slots in the barrel and are trapped in the first compartment until the projectile has completely cleared the perforations, when the gases re-enter the barrel and are drawn through the same to another set of perforations where they again escape into the second compartment, finally escaping into the atmosphere through perforations formed in the casing of the chamber.

Fig. 1

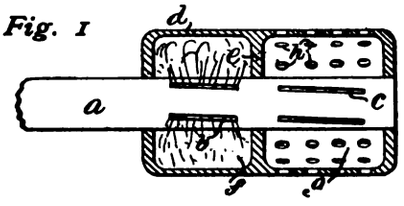
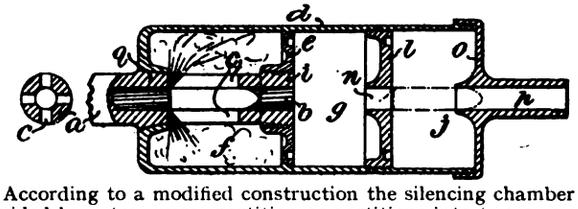


Fig. 2



According to a modified construction the silencing chamber is divided by a transverse partition or partitions into two or more compartments of comparatively large volume the first of which encloses the slots formed in the barrel of the gun. The end of the barrel is screw-threaded and the first partition is adapted to screw thereon to retain a coaxial conical opening in the casing of the chamber in engagement with a conical portion of the barrel whereby the said chamber is retained in accurate alignment with the bore of the gun.

The two forms are illustrated by the drawings appended. The barrel *a* Fig. 1 is provided with two sets of slots *b* and *c* which are formed by cutting through grooves of the rifling. The slots are enclosed by a chamber *d* which is divided by means of a partition into two compartments *f* and *g*, the latter compartment being provided with perforations *h* through which the gases escape. After the projectile has passed the slots *b* the gases escape into the compartment *f* and after the projectile has cleared the second series of slots *c* the gases pass into the compartment *g* and thence through the perforations *h* to the atmosphere.

In the modification illustrated in Fig. 2 the perforations in one of the compartments of the chamber are dispensed with. According to this construction the barrel *a* is formed with a single series of slots *c*, the end *i* of the barrel being screwed to receive the chamber *d*. The chamber is preferably formed as shown with three compartments *f*, *g* and *j*, of which the compartment *f* encloses the slots *c*. The portion *e* of the chamber screwing upon the end *i* of the barrel forms the partition between the compartments *f* and *g* and a screwed partition *l* separates the compartments *g* and *j*. The said partition *l* has an aperture *n* which is in alignment with the bore of the gun and the forward portion of the chamber which is composed of a screwed-on portion *o* also has an aperture *p* in correct alignment. The rear portion of the chamber *d* is provided with a conical hole which bears upon a conical portion *q* of the barrel *a* whereby the chamber can be held accurately in alignment with the bore of the gun.

The distance between the partitions *e* and *l* and between the partition *l* and the screwed-on portion *o* is such that the projectile shall always be within the aperture next ahead before it has left the bore or aperture immediately behind it, and the length of the slots *c* is such that the front and rear ends of the said slots are never uncovered by the projectile at the same moment.

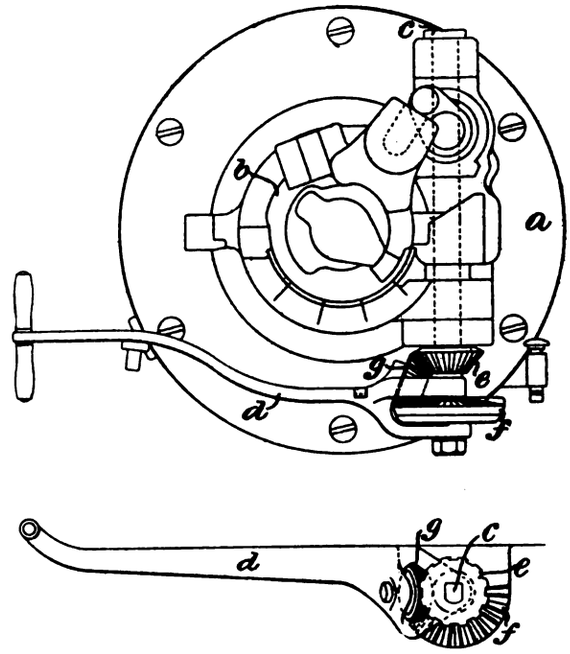
The projectile after passing the slots *c* uncovers the same and allows the gases to escape and expand into the compartment *f* from which they cannot escape until the projectile leaves the end of the bore *b* and enters the aperture *n*. The gases then pass into the chamber *g* from which they cannot escape until the projectile has left the aperture *n* and entered *p*. Finally when the projectile has passed through the aperture *p* the gases escape at a considerably reduced pressure into the atmosphere.

By means of the devices described it is claimed that not only is the noise of discharge silenced, but the projectile is ejected on a truer path than is the case with guns as at present in use, for after the gases have ceased to act upon the projectile it is guided for some distance in the chamber, thus correcting any deflection which the gases may have imparted to the projectile at the moment of its leaving the gun. Accepted Feb. 11, 1909.

ORDNANCE BREECH MECHANISM.

3,587 (1908). Col. H C. L. Holden, F.R.S., Woolwich. This invention relates to breech mechanism of heavy ordnance and to that class of mechanism which is operated by a hand lever which serves through the medium of suitable gearing to rotate the hinge pin upon which the breech block swings at an accelerated speed relatively with the breech block to perform through suitable devices—the various operations of unlocking the screw, releasing the obturator or elastic pad from its seat, withdrawing the breech screw, and swinging it round out of the way for loading.

The object of the invention is to provide mechanism of this class whereby the opening and closing of the breech by manual labour may be effected more easily than at present, and to this end it consists in the provision of means whereby the operating lever may be moved through an angle of about 180°.



In the accompanying drawings, *a* indicates the breech of th gun, *b* the breech block and *c* the pivot pin or shaft carrying the said block. As shown the pin is extended downwards and has mounted on its lower end the lever *d*. The bevel wheel *e* fixed to the shaft *c* and *f* is a toothed segment fixed to the lower lug on the end of the frame of the gun. Carried upon the lever *d* is the bevel wheel *g* which engages with the bevel wheel *e* and the segment *f* in such a manner that when the lever *d* is rotated through say an angle of 180° the intermediate wheel *g* rolls round the fixed segment *f* and rotates the bevel wheel *c* at an accelerated speed equal to the sum of the rotary movement of the hand lever *d* and of the intermediate wheel *g*.

A modification is also described and illustrated in the patent. The levers in this arrangement is mounted on an axis independent of the axis pin *c*. A toothed wheel and pinion are employed instead of the bevel wheels. Accepted Feb. 17, 1909.

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CONTENTS.

CURRENT TOPICS.

The Forthcoming Chemical Congress——Mr. William Macnab and his committee have arranged a most interesting programme for the entertainment of the visitors to the Seventh International Congress of Applied Chemistry, which will take place this year in London from the 26th of this month to the 2nd June next. The explosives industry, though by no means the largest purely chemical trade in the country, is particularly well represented in all the chemical organisations, which provides a most welcome tribute to the technical attainments of its members, and their interest in public matters. Though Germany is in many respects entitled to rank as the chemical laboratory of the world, there are certain directions in which this country has been able to do even more than to keep its own end up. In explosives particularly the conditions are especially favourable for attaining a high state of development. The system of Government inspection combines breadth of view with constant examination of detail, and when each section of the industry is separately examined it will be found that there is a happy juxtaposition of well-informed critics amongst the users, and highly skilled scientific men amongst the producers. The altogether exceptional efforts which are being made by the explosives section of the congress, are thus clearly justified by the status of the industry and the share it has taken in past developments. When the history of the trade is reviewed, it is apparent than even where foreign chemists have originated new ideas, this country has frequently contributed towards the subsequent development which bridges the gap between the product of hard thinking and its realisation as a commercial asset. Much money has been sunk in providing a business backing to new recipes for explosives. The industry as it stands to-day shows by its vigour and general soundness that the process of elimination has at any rate left a healthy stock. Therefore, when our friends and correspondents from abroad visit London for the purpose of taking part in the congress, the welcome extended to them will be hearty and sincere. In the discussions which will take place, information will be imparted as well as received, and all concerned will benefit from the ventilation of ideas on subjects which press for solution abroad as well as at home. Mr. Macnab especially asks that applications for membership, also for tickets for the banquet at the Crystal Palace, shall sent in as early as possible. A very few weeks now remain for making the final arrangements, and the anxiety is much lessened by having early knowledge of the probable total of guests.

The Service Cartridge.—An extremely interesting article in the *Times* of the 14th. ult., raises once again the subject of settling at an early date the very serious problems incidental to the obsolete design of the present service cartridge, and the virtual impossibility of making any substantial improvement without first modernising the rifle which fires it. The theoretical aspects of the subject are fully understood by those whose business it has been to make the necessary experiments and calculations. Politicians compare the pressure produced by the cartridge and the resisting power of the rifle, without taking expert account of the margin of safety which must exist between the two. The well known defects of the British service rifle allow a very small margin compared with what exists in the rifles of other nations. Misleading statements on the subject are frequently made for political reasons. The present minister of war,

as a late member of the Explosives Committee, must be recognised as possessing an exceptional grasp of technical problems, and yet as regards the vital question of the rifle and cartridge with which his beloved army may at any time be called upon to fight, he obediently circulates whatever fallacies are suggested to him by the permanent officials. The money question is the most considerable factor in the situation, and tactical considerations appear to stand in the way of the gradual introduction of a new design. A great and monumental error was committed when the short rifle, which was virtually a new arm, was allowed to be introduced into the service, so perpetuating the structural defects of the old weapon. The committee responsible for its production pusillanimously shielded themselves behind the restricted scope of their instructions. Had they understood the task they were set to perform they would have resigned in a body rather than commit the country to an objectless expense. Nobody can estimate the probable extent of the calamity which would inevitably follow, if the present service cartridge ever came into competition with modern small-bore ammunition containing all the recently devised means for flattening trajectory.

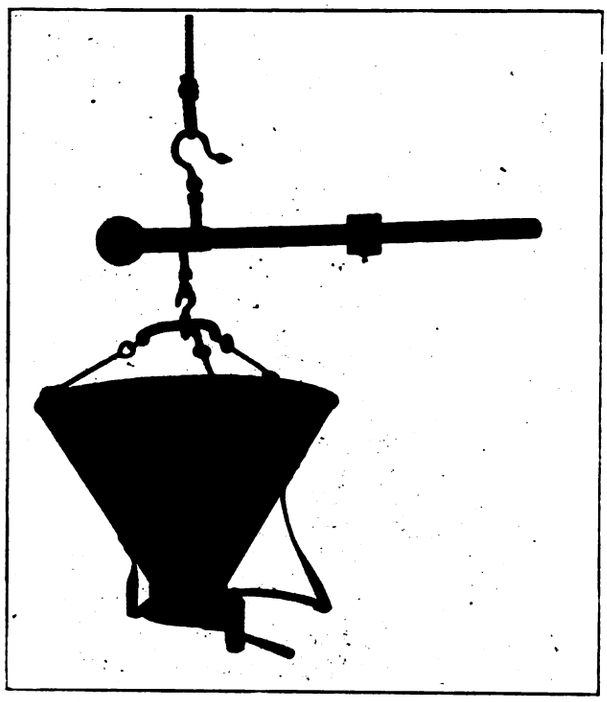
The Miniature Bisley.—The National Rifle Association will this month hold its miniature Bisley meeting. Just what is the number of the previous meetings is a difficult matter to decide. Last year's gathering of miniature riflemen, was held in the month of January in the Bunhill Row drill hall. In 1907 there was no meeting at all, due to the 15 months jump from the meeting of November 1906. Previous to that the R.N.A. held a modest show at Exeter, viz., in April 1905, which aroused a certain amount of local interest, but could not rank on the level of a gathering held in London. Before that was the Olympia meeting in April 1904, which was run jointly with the Society of Miniature Rifle Clubs. Going back still further there was the meeting at the Crystal Palace in March 1903, but this was held exclusively by the Society of Miniature Rifle Clubs, with Major Oxley, representing the N.R.A., as chief range officer. The future of these meetings is by no means assured. Hitherto, the necessary funds have been provided by the Astor trustees, whose resources are rapidly disappearing. The obvious need is to establish a miniature meeting on a permanent basis, and under conditions which will ensure a minimum of change from year to year, as regards place and date. This time fourteen consecutive weekdays indoors from 5 p.m. till 10 p.m. will severely tax the health and, possibly also, the loyalty of the range officers and other members of the staff. Experience will of course be gradually gained concerning the best system to adopt. At the present time it is a marvel to those who are aware of the immense amount of preliminary work which the ordinary Bisley Meeting involves, that the National Rifle Association should find time to run this offshoot meeting, and still fulfil its other obligations. There are many arguments in favour of making the miniature meeting an outdoor function with a sufficient number of targets to get through the requisite programme in a much smaller number of days.

The Pistols Case.—The decision of Mr. Justice Darling, that the most carefully considered judgment of the Clerkenwell magistrate was wrong, comes as an absolute surprise to those who felt assured that the defence had only to be properly presented to ensure a repetition of the previous success. However, this was not to be. The counsel, on whom the gun trade depended for the presentation of their case, was obliged to throw up his brief at the last moment. The case was, moreover, heard before a judge whose previous utterances showed that he held very strong views concerning the indiscriminate sale of pistols. Gunmakers cannot help feeling that the law has been strained against them, for the purpose of throwing fresh difficulties in the way of pistol buyers. In such circumstances, they are morally and legally justified in adopting the remedy which the law itself provides. The definition of a pistol is specifically restricted to weapons having a length of barrel not exceeding nine inches. Consequently it is only necessary for the manufacturer to introduce a 9½in. model for household protection, for retailers to be entirely free from the burden of obligations which the Act imposes. The law when specific as regards interpretation cannot be changed except by Act of Parliament, and by the time the Government has marshalled its forces to raise the limit to 10ins., the gun trade can respond with a pistol having a further inch of barrel. Law and manufacture might continue this interesting competition till the Pistols Act included all species of firearms. The main purpose of the Act was to discourage the promiscuous carrying of pistols by irresponsible persons, and it has always been pointed out that it could never be expected to act as an efficient deterrent of suicide, which is apparently what the police are now endeavouring to make it.

The Late Mr. W. J. Jeffery.—The news that Mr. W. J. Jeffery had succumbed from the effects of an attack of pneumonia came as a severe shock to all who knew him and had become accustomed to regard him as one of the younger and more energetic members of the gun trade. A man of exceptionally strong personality the opinions he held were vigorously asserted at the point of the sword. Controversy he undoubtedly enjoyed for its own sake, but looking back on the many years of his occupation of a prominent position in the trade no instance can be recalled where his methods of disputation led him into mean or unworthy actions. Essentially a modern type of business man he scandalised his rivals by reducing prices to a level which benefited the buyer at the expense of the seller. On the other hand the immediate effect was the creation of a large and important business which those of less enterprise could not help but envy, whilst admitting they had not the genius to follow in the same footsteps. Those who knew Mr. Jeffery away from business found in him a charming and entertaining companion, keenly interested in all forms of shooting from the sporting point of view. In him the trade has undoubtedly lost one of its most prominent members, a man be it understood who gained his position from sheer force of character and was entirely unassisted by inherited position or influence.

A GUNPOWDER WEIGHING MACHINE.

THE firm of W. and T. Avery, Ld. recently invited our attention to the special machine here illustrated for measuring off into bags 50 and 100 lbs. charges of smokeless powder. The presence of explosives necessarily involves the taking of very particular pains to avoid the jangling together of metal parts, even where iron is rigorously excluded. Any ordinary system of scales, with the usual loose weights and pans coming down with more or less of a bang as the beam throws one way or the other, is in many ways unsuited for use in buildings where powder dust is floating around. The balance here illustrated has been specialised for these particular surroundings, and it embodies many points of exceptional merit. Being suspended in mid air, places for the harbouring of dust are minimised to the greatest possible extent. The well-known steel-yard principle, one of the oldest forms of weighing, is here wholly carried out in gun metal, including the knife edges. The powder pan consists of a suspended hopper 26ins. in diameter, and 18½ins. high. Delivery is made from the top, and when the proper weight has been reached the steel-yard floats within the hole provided in a carrier fastened to the ceiling, but not shown in the photograph. All the operator has to do is to set the sliding weight in the 50 or 100lbs. notch, according to the amount of powder required, and to arrest delivery when the balance turns. The lower portion of the hopper consists of a brass powder tap designed on lines made familiar by the powder flasks of long ago, also by the Accuratus and other loading machines. The moving of a lever thus enables the contents of the hopper to be drawn off into the receptacle placed beneath. The tap being once more closed, the machine is ready to weigh the next charge.



In connection with the visit which was paid for the purpose of gathering the foregoing particulars, an invitation was extended to inspect the extensive works of this well-known firm. A small town, comprising streets, factories, wharfs and railway sidings exists within the boundaries enclosing the 25 acres which the works occupy. Each section as far as possible represents a separate factory, and although commercial scales form a large proportion of the output and may be regarded as by no means delicate instruments, the fact remains that in certain details the very highest grade of manufacturing skill must be exercised to enable them to survive the rough and tumble conditions of daily use. The whole things turns, so to speak, on the knife edges. There are more secrets of material and manipulation in securing a dead hard edge with relative softness around than can be grasped by any except those familiar with the peculiar problem involved. Whether a set of scales is intended to turn on a small or a large difference, and no matter what may be the quality of the external finish, the beam and its knives must comply with certain scientific requirements to a degree of precision which leaves very little margin for toleration.

In the section of the factory devoted to the turning out of weights, considerations of cost of output exercise a more dominant influence than the necessity for any elaborate grade of exactitude and finish of workmanship. Government lays down with precision the lines upon which weights must be made, and the manufacturer is left very little margin for the exercise of individuality. This is certainly the very worst side of standardisation. In reply, for instance, to the very natural enquiry as to why ounce weights were never made except in the form of the absurd little piles of flat discs with which everyone is familiar, it was explained that no other shape or design would be accepted for stamping. Therefore by the stupid restrictions of the Board of Trade the British subject is denied the convenience of a handle on his small weights. Notwithstanding the safeguards and penalties which have been devised for ensuring the maintenance of weights at their proper value, their finish is invariably crude and rough, whereby sharp edges and unpolished surfaces invite the erosion processes which would certainly proceed more slowly on well finished articles. Another item of criticism, which will appeal to nearly every user of weights, is the inadequate legibility of the different markings, probably another example of the stifling effects of grandmotherly legislation.

Concerning the small delicate weights which are used for chemical balances, not the kind which the analytical chemist employs, but those the druggist favours for the preparation of medicines, a very large department is employed slicing up the funny little squares and oblongs of brass, out of which

the old fashioned grain and apothecaries' weights are made. The use of aluminium, on the lines of the highly finished but inxepensive chemical weights which are made on the Continent, has not yet been introduced at the Soho Foundry, nor also has the demand for the little boxes of highly finished lacquered weights proved sufficiently active to justify modernising the designs and methods of a century or more ago.

This disquisition on the subject of weights and measures is in no wise intended as a reflection on the efficiency of Messrs. Avery's methods. The firm exists to supply a demand, and evidence of their enterprise is apparent on every side. Accordingly, if the methods pursued are ultra-conservative in certain directions, outside causes must be held responsible. These would include on the one hand the influence exercised by the Weights and Measures Department of the Board of Trade, and on the other a disinclination for change on the part of those customers of the firm who are wedded to a particular style of weight.

ABEL ON GUNCOTTON (1866).

PART I.

BY GEORGE W. MACDONALD, M.Sc. F.C.S.

The first of Abel's classical researches on guncotton was communicated to the Royal Society in 1866. (*Trans. Roy. Soc.* (1866) 269–308.

He deals, first of all, with the work which had been done both in Great Britain and on the Continent on the composition of guncotton, and gives the various formulæ proposed for this body.

His own work first devotes attention to the moisture absorbed by guncotton. He found it to be very uniform; the average proportion being about 2 per cent. The average amount of ash was found to be about 1 per cent. The solubility of guncotton in a mixture of ether and alcohol is treated at considerable length, and the following was his method of analysis. The weighed guncotton (between 2 and 3 grms.) was packed closely into a tube of about 12 mm. diameter and constricted to a fine opening at the lower extremity. The mixture of ether and alcohol which was poured on to the guncotton in the tube filtered through it very slowly. When the filtrate furnished what appeared an unimportant quantity of residue, the cotton in the tube was dried, and its loss in weight determined. Upon examining the samples of guncotton thus treated, they were found, however, still to contain matter soluble in the ethereal mixture, and it was evident that, by this mode of treatment, either the soluble matter could not be separated from the insoluble fibre, or only the most readily soluble portions (which furnish a tolerably limpid solution) were carried through by the liquid; while those less easily dissolved, and which were, indeed, more glutenized than actually dissolved, remained in the tube. A different mode of operating was therefore resorted to. From 8 to 10 grms. of the guncotton were digested in a stoppered bottle for from thirty to fifty hours (according to the apparent extent of action of the solvent) with from 60 to 100 c.c. of ethereal mixture. At the expiration of this digestion the contents of the bottle were agitated slightly, a small portion of the guncotton was removed and placed as a plug in the apex of a funnel, through which the liquid was filtered into an evaporating dish. The guncotton was then transferred to a suitable instrument, placed over the funnel, and the liquid expressed; it was afterwards returned to the bottle, in which it was digested for a second (and sometimes a third) similar period with fresh solvent, the washings of the funnel, etc. being returned to the bottle. When the guncotton had been two or three times digested and expressed, it was washed upon the funnel. The liquid thus obtained never contained more than two or three minute fibres of the guncotton; it was generally of a very pale straw colour, and slightly opalescent. When evaporated nearly to dryness it became gelatinous, and gradually dried to a yellowish substance of somewhat resinous appearance.

The examination of 20 samples of guncotton manufactured at Waltham Abbey from 1863 to 1865 gave as the lowest result 1·3 per cent., as the highest result 2·6 per cent. and a mean of 1·99 per cent. On prolonged immersion of cellulose in the mixed acids the following percentage solubilities in ether-alcohol were obtained. Twenty-four hours (1·99); forty-eight hours (2·4); seventy-two hours (2·3).

Somewhat higher results were obtained by submitting the material to long-continued agitation with ether and alcohol, and repeating the digestion and agitation several times with fresh solvent; but the guncotton became so disintegrated by this treatment, that it was very difficult to filter the liquid so as to obtain it free from fibres; it was moreover found that a considerable proportion of the finely-divided mineral matter attached to the guncotton became suspended in the liquid and could not be separated. Repeated experiments showed that, after the second digestion of Waltham Abbey guncotton, there were only very small quantities of soluble matter extracted, which it appeared almost impossible to remove perfectly by this mode of treatment; the above numbers may therefore be accepted with confidence, as representing a close approximation to the average proportion of matter soluble in ether and alcohol contained in the normal products of guncotton manufactured according to Von Lenk's prescription. In fifteen samples of guncotton prepared at Stowmarket in 1864, the lowest solubility was 2·85 per cent., the highest 12·55 per cent.

The variations exhibited by these numbers, and the comparatively large proportion of soluble matter existing in some of the samples must unquestionably be ascribed to some irregularity in the treatment with acids, as practised at Stowmarket, due perhaps to exceptional circumstances existing at the time these samples of guncotton were manufactured: the examination of several products of more recent date obtained from Stowmarket, furnished much more uniform results, the majority of which correspond nearly to those obtained with the Waltham Abbey guncotton.

Several of the specimens of guncotton obtained from Hirtenberg were also found to contain comparatively large quantities of soluble matter, and the proportions in two

or three samples were very high. In nine samples the lowest solubility was 3·02 per cent. and the highest 14·21 per cent.

The character of the soluble matter extracted from the Waltham Abbey products by ether and alcohol was very uniform. The dry extracted matter, when digested with hot alcohol alone, dissolved to a very considerable extent, and a light yellow solution was obtained, which, on evaporation, furnished a yellow amorphous residue, almost entirely soluble in ammonia or sodium carbonate; the neutral liquids furnishing precipitates with lead and silver solutions. When the substance was heated with potassium hydrate, ammonia was evolved. When gradually exposed to heat on platinum or bibulous paper, it first fused and then deflagrated. The portion insoluble in alcohol dissolved in the ethereal mixture, the solution furnishing on evaporation a semi-opaque film, which contracted and split up into small horny particles when quite dry. The extracts from Stowmarket and Hirtenberg guncotton contained the same product soluble in alcohol alone, and generally in about the same proportion; but in most of those instances in which the specimen had furnished a considerable proportion of soluble matter, the part insoluble in alcohol yielded by solution in ether and alcohol, a liquid which approached in its character to photographic collodion; the film left by its evaporation being more or less tough, and nearly transparent. In two instances very good photographs were obtained with the collodion extracted from specimens of Austrian guncotton.

The percentage of matter soluble in alcohol alone was also determined. The lowest result being 0·72 per cent., and the highest result 0·95 per cent.

The foregoing results show that, in the general products of manufacture obtained by properly following Von Lenk's instructions with regard to the conversion of cotton, the proportion extracted by alchol alone is somewhat below 1 per cent., and consists of nitrogenized matter, of acid character, which has evidently been produced by the action of nitric acid upon the resinous or other foreign substances contained in the cotton at the time of its conversion. The portion soluble in ether and alcohol, but insoluble in spirit, varies in amount between 1 and 2 per cent. and consists of the very small proportion of guncotton which has escaped conversion into the most explosive product. The occurrence, in a few quite exceptional instances, of comparatively large proportions of soluble guncotton, of the kind produced by the action of a warm somewhat dilute acid mixture upon cotton, affords important evidence of the necessity for adhering strictly to the mode of treatment, and the precautions, which considerable experience and a careful examination of products have proved to be indispensable to the attainment of uniform results in the manufacture of guncotton.

With regard to the matter soluble in ether and alcohol found to exist in guncotton, the following observations possess some interest, as bearing upon the cause of its production in the manufacture of the substance.

(1.) The mean proportion of soluble matter furnished by the very concordant results of examination of guncotton manufactured at Waltham Abbey in 1863, in the preparation of which the acids, left in contact with the guncotton, were in the proportion of 18 parts by weight to 1 of cotton, is 1·62 per cent.; while the mean proportion furnished by the result of examination of sixteen samples of Waltham Abbey products, in the manufacture of which only 10 parts of the acid were left in contact with the guncotton, is 2·13 per cent. All the results obtained with the first guncotton were below 2 per cent., while out of sixteen results, obtained with the last, eleven were above 2 per cent. Here we have a decided indication that the prolonged contact with acid has some influence upon the composition of the product; the emplyoment of the higher proportion of acid furnished results more nearly approaching perfection than those when the guncotton was left in contact with a smaller proportion of the acid mixture. As far as can be judged at present, however, from the general properties of the products, the difference observed when the larger or the smaller proportion of acid is used, is not of sufficient importance to render necessary the consumption of the larger quantity of acid in the manufacture.

(2.) The following experiment was instituted with a portion of one of the specimens of guncotton from Stowmarket, which had been found to contain 11·5 per cent. of matter soluble in ether and alcohol (after removal of the portion soluble in alcohol only). The guncotton, having been perfectly dried and carefully weighed, was digested for three hours with mixed nitric and sulphuric acids, of the kind always employed. It was afterwards submitted to long-continued washings with distilled water; precautions being taken to prevent mechanical loss. The dry guncotton was found to have increased in weight 0·3 per cent. But the original guncotton contained 1·71 per cent. of mineral matter, while, after having been disgested with acids and washed, it furnished only 1·01 per cent. of ash. The difference between these numbers had therefore to be added to the increase in weight which the guncotton sustained by this second treatment with acids, which consequently amounted to 1 per cent. The substance now no longer contained any appreciable amount of soluble matter. Assuming that the soluble guncotton originally existing in the sample was either one of those whose composition had been determined by Hadow,

$$C_{18}H_{22}O_{15}\ 8\ (NO_2) \text{ or } C_{18}H_{23}O_{15}\ 7\ (NO_2),$$

the increase sustained by the imperfect sample, if completely converted into the most explosive and insoluble product, should have amounted in the one instance to 0·61 per cent. and in the other to 1·29 per cent. Considering that neither of these substances would be likely to exist alone in the imperfectly converted material, the actual increase of 1 per cent. sustained by the guncotton, must be regarded as a close approximation to the theoretical proportion of imperfectly converted guncotton, and proves decisively that, on the one hand, the treatment of the cotton with the acids had not in the first instance been quite perfect, while on the other a further digestion of imperfectly converted guncotton with acids will convert soluble guncotton which it contains, into the most explosive or insoluble variety.

THE PISTOLS ACT CASES.

THE case against Mr. Robert Gray, director of Messrs. Cogswell and Harrison, Ld., came before Mr. Justice Darling and Mr. Justice Jelf in the King's Bench Division on the 2nd ult. The proceedings consisted of an appeal from the decision of Mr. D'Eyncourt, the Clerkenwell magistrate, who gave detailed reasons for holding that the production under the Pistols Act 1903 of a statement signed by a police inspector or J.P. applied only to persons proceeding abroad, and not, as argued by the police, to the whole of the other persons who are entitled under the Act to purchase pistols without producing a licence.

Mr. Justice Darling, in giving judgment on March 30th last, said he thought the appeal must be allowed. The section was certainly very obscure, but sense could only be made of it by reading the words introduced at the end of the section "and produces a statement to that effect" as governing each of the three alternatives of which the purchaser was to give reasonable proof. He could not himself see that the statement of the policeman or justice of the peace could be any more definite about the fact that the purchaser intended to go abroad and the highly hypothetical fact that he intended to remain abroad for six months than their statement would be about either of the preceding matters. He thought that the meaning of the section was what he had stated, although it might appear singular that a person who had to give reasonable proof of a fact should have to produce a statement by a police constable in addition. That observation would, however, apply equally to the requirement of such a statement in regard to any of the three alternatives, and it would apply with no greater force to the first two than to the third, to which alone the magistrate had held that the requirement as to the statement referred. For the reasons he had given the appeal must be allowed. Mr. Justice Jelf concurred.

The case then went back to the magistrate with an instruction to amend his previous decision in view of the interpretation now given to the law on the subject. In the result, Mr. Gray was fined a nominal 5s. with 2s. for the cost of the summons, which was again on a very minimum scale.

The law now has it that the three categories of persons who are entitled to purchase pistols without producing a gun licence are, first, those who are exempted from the necessity to take out a gun licence under the Act of 1870, second, the householder who proposes using the pistol in his own house or curtilage, and third, persons about to proceed abroad for a period of not less than six months. The exemptions of the Gun Licence Act are summarised as follows in Messrs. Curtis's & Harvey's *Shooter's Year Book* :—

(1) Soldiers, etc., when on duty or at target practice.
(2) Holders of game licences.
(3) Persons carrying a gun by order of, and for the use of, any authorized person, address to be supplied on demand.
(4) Persons scaring birds or destroying vermin under proper authorization.
(5) Gunsmiths or their servants for trade purposes.
(6) Carriers in the ordinary course of their trade.
(7) Members of rifle clubs duly affiliated to the N.R.A. or S.M.R.C. in connection with range practice.

The last clause forms no part of the Act, but the tax is remitted as an act of grace to members of rifle clubs. It is difficult to see how any of the persons, other than say soldiers, etc. could expect to purchase a pistol on the ground that under certain peculiar conditions of their calling they may carry a gun without a licence. Therefore the whole series of exemptions boil down practically to the soldier, and possibly also to the rifle club member ; but even so it might be argued that as the exemption only exists during performance of certain duties, the purchase should only be effected, and the police or magistrate's signature be obtained, whilst the exemption is operative. It would, moreover, be interesting to know just what reasons a police inspector would advance for refusing to sign the necessary statement in favour, say, of one of Carter Paterson's carmen.

THE KYNOCH CASE.

THE appeal by Messrs. Kynoch, Ld. against the judgment of Mr. Justice Pickford, as reported in the issue of January last, was heard by Lord Justices Fletcher Moulton, Farwell and Joyce. Lord Justice Fletcher Moulton, in dismissing the appeal, laid stress on the important admission at the last hearing by Sir A. Cripps, on behalf of Messrs. Kynoch, that they did not contest the right of the Government to reject the cordite which contained mercuric chloride. The Court of Appeal had, therefore, to deal with the legal issues arising out of that fact.

In March 1907 the Government insisted on their right to reject the cordite, and Kynoch's refused their sanction to that proceeding on the ground that the presence of mercury did not deteriorate the quality of the material. No settlement was reached, and a letter was sent to Kynoch's wholly determining, on the grounds of non-delivery of proper material, the contracts under which the cordite had been supplied. Reviewing the terms of the contract his Lordship laid down that where a delivery had been made and the material had been rejected the delivery was wiped out, and the parties were in the same position as if there had been no delivery. He also reviewed the position with regard to the purchase of cordite to replace what had been rejected, and held that though the Government had allowed Kynoch's to re-invoice certain of the material which had been delivered and rejected under the cancelled contract, at the same time such action, whilst diminishing the default, could not galvanise a dead contract into life again. Concerning the actual measure of damages which the Government claimed in connection with the purchase of cordite to replace that in default he held that as the actual difference of cost on such repurchase had not been called into question in the lower court the figure put forward by the Government must stand as the measure of the damages. If any point was intended to be made concerning the difference of date of the two purchases, evidence upon the subject should have been put forward. The other Justices concurred.

ROUND THE TRADE.

A curious oversight in the marking of ·22 cartridge boxes was recently pointed out by a well-known retailer, viz. the omission by both Messrs. Kynoch and Eley to mark on the boxes the information that the contents are "long" or "long rifle" as the case may be.

The report of the American "E.C." and "Schultze" Gunpowder Company, Ld. states that, after allowing for the dividends paid to the shareholders on March 31st and September 30th last, there remains at the credit of profit and loss account a balance of £1,672. The directors propose a dividend for the six months to December 31st last at the rate of 4 per cent. per annum, carrying forward £172.

Mr. Charles Whitehead was the subject of a most inspiriting ovation on the occsaion of his departure from Cape Town on the 31st of March last by the "Kildonan Castle." For the previous twelve months or so he had been travelling the South African colonies on behalf of Eley Bros., Ld., and the many friendships he has cemented during this period amongst the members of the arms and explosives trade generally were well represented by the party who gathered on the quay in order to wish him a successful journey. In particular there were Mr. W. Rabone, the well-known gunmaker of Cape Town; Kynoch's and Westley Richard's representative, Mr. F. Corder; King's Norton and Greener representative, Mr. H. W. Allkin, also Mr. A. S. Ratcliffe, representative of the B.S.A. Company.

Rifle sights under Bisley Rules 1909 is the title of a pamphlet, price 2d. post free which has been issued by the Birmingham Small Arms Co., Ld. in connection with the new sights which are permissible under this year's Bisley regulations. The Company's own printing staff have evidently been put upon their mettle to do something really worthy of a great occasion, for the intermixture amongst the text of thumb nail sketches of minute illustrations printed in green ink represents a difficult operation when carried out with the perfection which has here been attained. The booklet is more an advertisement of the aperture sight as such than of any particular make. When the design which the B.S.A. Company have to submit comes to be mentioned there is evidence of strong maternal feeling, but then everyone knows that what this firm makes has a refinement of mechanical finish which raises the status of the original design to a higher plane. Good manufacture may not succeed in making a bad design effective, but it is a wonderful help when coupled to a good idea, and the idea does seem good in the matter of the sight upon which the B.S.A. Company have put their money.

The programme of the Seventh International Congress of Applied Chemistry, referred to elsewhere, is as follows: May 26, reception by the Lord Mayor and Corporation of the City of London at the Guildhall; May 27, at 10 a.m. meeting of the joint organising committee; 3 p.m. inaugural meeting opened by the Prince of Wales in the Albert Hall, evening, reception by the Foreign Office; May 28 at 10 a.m. to 1.30 p.m., sectional meetings, 2.30 p.m., general lectures by Profs. Haller and Paterno; evening, banquet at the Crystal Palace; May 29, at 10 a.m. to 2 p.m., sectional meetings; afternoon, garden party at the Botanic Gardens by the ladies' committee, evening, reception by the London section of the society of chemical industry at the University of London; Monday, May 31, at 10 a.m. to 1.30 p.m., sectional meetings, 2.30 p.m., general lecture by Prof. O. N. Witt, 4 to 6 p.m. sectional meetings, evening, private receptions; June 1, at 10 a.m. to 1.30 p.m., sectional meetings, 2.30 general lecture by Sir Boverton Redwood, 4 to 6 p.m., sectional meetings, evening, reception at the Natural History Museum; June 2, 10 a.m., official closing of the congress, afternoon, visit to Windsor Castle by permission of the King.

The sales of guns, rifles, and other sporting effects at Debenham's rooms are now due to commence for the coming season, and Friday the 7th inst. is the date fixed for the first sale.

The directors of Holland and Holland, Ld. have recommended a final dividend of 5½ per cent. on the ordinary shares, making, with the interim dividend already paid, 9½ per cent. for the year.

Messrs. L. Paechtner & Co. of 40 Queen Street, Cheapside, E.C., have written to this office giving notice that they have been appointed agents for the Savage Arms Company of Utica, U.S.A., in place of the South British Trading Co., Ld. in liquidation. The firm will hold a stock of Savage repeating rifles and automatic pistols, and will conduct the agency generally on the lines mapped out by their predecessors. Messrs. Paechtner were already sole agents for Great Britain for the well-known Iver Johnson safety revolvers and single-barrel guns, as well as for several important Continental manufacturers of sporting guns, rifles, air-guns, etc.

The Cotton Powder Co. have forwarded a leaflet illustrating an improvement in the Hale rifle grenade. The tail rod, which permits the grenade to be projected from the ordinary infantryman's rifle, is made removable, so as to be interchangeable with a flexible rope tail of the kind which enables the grenade to be thrown by hand without the use of a rifle. It will be remembered that the device took this form originally, and that the projection by rifle was a later improvement increasing the range of effectiveness. The stage now reached is a further improvement, in that either system of propulsion is available for the same grenade.

The firm of Hill and Smith of Birmingham recently invited special attention to the detachable lock mechanism which was described in the list of selected patents in the issue of last March. The firm's recently perfected system of body was described and illustrated in the patents column of the issue of May 1907. It consisted of a re-arrangement of parts by which the underneath part of the body is wholly covered with wood, making a compact grip for the hand combined with a very substantial allowance of metal to guarantee stability. The latest improvement is the provision of means for enabling the shooter easily to remove the lock for inspection and cleaning. This important additional convenience is arranged by mounting the whole of the lock work as well as the triggers on the trigger plate, the latter being removable from the gun together with the trigger guard and other attached parts. This invention affords yet another proof of the growing importance which is attached to the ability to keep the lockwork of a gun in an efficient and smooth working state.

A correspondent has addressed a letter to this office on the subject of Mr. Crossman's article entitled "The American Sportsman and his Rifle," the two parts of which appeared in the last and previous issues of this journal. He referred particularly to the following statement in the article in question. "The German factories are quietly taking in this trade, in spite of the fact that English made guns are very favourably known in America, and German guns are known not at all." The last statement fails to take account of the large trade carried on in shot guns manufactured by the very important firm of J. P. Sauer & Son, Suhl, Germany. At the store of Shoverling, Daly & Gales, in Broadway, New York City, a row of about 300 high-grade hammerless guns and rifles manufactured by the above firm are open for inspection and purchase. Further corroboration of the standing of this firm's goods in the American market was provided by an article in the January *Sporting Goods Dealer* entitled "Firearms in Mexico" which contained various references to the number of Sauer guns sold in the States.

Notice has been given that the explosives, Saxonite and Celoxite have been removed from the list of permitted explosives for use in mines to which the Explosives in Coal Mines Order of 17th December, 1906, applies, The order takes effect as from the 3rd inst.

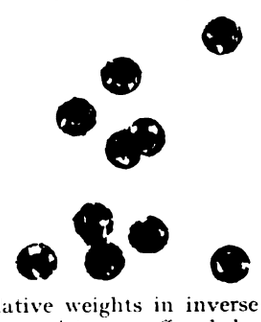
The annual revolver and pistol shooting matches, held at Gastinne-Renette's ranges at Issy-les-Moulineaux, near Paris, are due to take place on the 27th and 28th insts. The first day is devoted to the international competition with duelling pistols supplied to the shooters on the spot, without liberty to make any species of selection, and the second day to revolvers, also supplied on the spot, but the shooter is at liberty to choose the one he fancies most.

Under the new management of Henrite Explosives, Ld., the plant of their Dartford works has been greatly enlarged so that the rate of output has been more than trebled. Mr. C. E. C. Luck, who was manager under the late Company, and has had charge of the manufacture of Henrite for some years, retains this post, and the directors have appointed Mr. S. D. Smith, who has also had several years' experience of the sporting powder trade, to assist Mr. Lorenzo Henry, the managing director, in looking after the commercial interests of the Company. The vogue which Henrite enjoys in various sporting circles is shown by its successful use by several shooters so recently as last February at the Monte Carlo Grand Prix Meeting.

From a correspondent :—A writer in the *Novoe Vremya* having criticised very severely the Russian rifle saying that it was neither good for war service, nor training in time of peace, the *Russky Invalid*, the Russian military paper, replies that the three-line rifle, namely the 1891 pattern, has creditably stood the test of two campaigns and may be considered thoroughly reliable and in no way inferior technically, or for fighting purposes to that of any other army. A long extract is then quoted from the report on the inspection of the infantry regiments of the army in 1908, which states that the three line rifle and revolvers are quite good for fighting purposes, subject to the necessity from time to time to repair or renew certain parts. Most of the difficulty experienced arises from defective cleaning of the barrels after use. According to the same source, not a single rifle inspected last year could be regarded as unfit for use in war, and no staff officer has complained of any unfitness of the rifles for fighting. The same journal sums up the situation by saying that notwithstanding the sixteen years' service of the three line rifle, the army is still in possession of a good efficient weapon. The writer is not very explicit as to whether the alleged efficiency of the rifle is based on the state of repair of the weapons in use by the troops, or to the efficiency of the type of rifle, as compared with the Service arms of other nations.

A curious situation appears to have arisen in connection with the sights regulations for the coming Bisley Meeting. The rules and conditions were issued last autumn with a view to giving manufacturers the opportunity to supply the season's demand without undue rush at the last moment. It was very wisely decided that designs submitted for authorisation could not be accepted later than the 1st of January. In due course the authorised designs were published, and everyone supposed that the thing was settled. By some extraordinary mischance sights appear to have been authorised which do not comply with the published rules. Reference is made to sights like the Fraser which are attached to the firing pin nut, and, therefore, are not, in the words of the rule, "attachable to the rifle as issued, by the withdrawal of the hinge-pin or screw of the existing sights and its re-insertion only." Of course if a shooter makes a mistake he pays the penalty, but the N.R.A. have been forced to decide that they must keep faith with those who acted on their authorisation. To set right the others, who complain that if they had only known that sights could be fixed otherwise than according to the rules, different models would have been submitted, the N.R.A. have announced that the whole question shall be thrown open afresh and that designs may be submitted up to the 1st of June. The policy of settling the season's arrangements once and for all on the 1st of January has been so strongly approved in these columns that it is impossible to express anything but regret for the altered course which has now been taken, no matter what may be supposed to be its justification.

Messrs. Hupfield & Co., of 3 New Union Street, Moorfields, E.C., have submitted, on behalf of their principals the Anciens Etablissements Pieper, a new rifle which contains novel features of design likely to arouse great interest. Briefly stated the idea consists in making the breech action semi-automatic, in the sense that the discharge of each cartridge causes the bolt to fly back, and in so doing throw out the empty case. At this stage the parts come to rest, the bolt remaining open, and so presenting an orifice, into which the next cartridge is thrown by the shooter. He then touches a button which releases the bolt, thereby closing the action, cocking the firing pin, and otherwise placing the parts in a position to fire the next cartridge. The weapon itself is a wonderfully neat piece of construction representing, so far as it is possible to judge, the highest standard of machine-shop methods. The total weight is 3lbs. 9oz., and the over-all length is 38½ inches, of which 19 inches is barrel length and 13½ inches distance from trigger to butt. This leaves six inches for the bolt and other portions of the loading mechanism. The bolt is removable by unfastening a knurled nut, which exposes the firing pin spring and the main bolt spring, in other words making most of the parts accessible for cleaning. To resolve the bolt into its component parts it is necessary to remove a coarse slotted screw, which can be turned by using a bronze coin. The component parts are then found to be few in number, viz., eight, and simple in design. This does not include a part called the extractor, whose purpose in the scheme of mechanism is not very apparent, since the empty cases are not drawn back by an extractor claw, but themselves force back the bolt under the impulse of the powder gases in the barrel. These words indicate that the rifle is of the automatic type in which the barrel is fixed, and, therefore, does not participate, with the bolt, in the first stage of recoil movement which lasts as long as the bullet remains in the barrel. At the precise moment, therefore, that the bullet commences to move forward, the unlocked breech bolt moves backwards, and their relative rates of movement are determined by their relative weights in inverse ratio, with an allowance for the resistance offered by the compression of the springs. At a particular moment the cartridge case is wholly free from the chamber, and it continues its backward movement in contact with the bolt face until the time comes for ejection. The striker itself acts as ejector, a process which is no doubt assisted by the puff of gas which comes out with the empty shell. The noise of discharge of this weapon is about as great as that produced by a pistol firing the same ·22 short cartridge, an effect which can be explained by the escape of gas from the breech at a higher pressure than would exist if the escape were delayed till the emergence of the bullet uncorks the muzzle. That the principle of the mechanism is not destructive of accuracy is proved by the accompanying almost phenomenal 50 yards diagram. The rifle was held in a vice rest, and ordinary ·22 black powder cartridges were used without cleaning out between rounds. Rifles have lately been fitted for firing the ordinary long-rifle ammunition.



LECTURES TO YOUNG GUNMAKERS.

LVI.—THE ALPHA AND OMEGA OF CARTRIDGE LOADING. PART II.

The only important measurement which was recorded in last month's lecture was the tabulation of the amount of space to be allowed for the height of the paper lump, etc. comprising the head of the ordinary sporting cartridge. It was found that all the calibres from 10-bore to 32-bore gave a practically identical reading for the thickness of head. The exceptions were 4-bores and 8-bores, in which a proportionately greater amount of paper is used; but when the time comes for preparing the final tables even these differences may be ignored on the ground that 4-bores and 8-bores are exceptionally long cartridges, and, therefore, will take a greater amount of compression, in fact just the extra amount which is represented by assuming their head thickness at the average value which suits the other sizes. This month's contribution to the subject of the interior capacity of sporting cartridge cases comprises a most interesting series of measurements, followed by a new system of mathematically checking the results, which is most useful as a means of eliminating the errors and differences due to the particular sample cases used for the tests.

For tabulating the space occupied by smokeless powders the first requirement is a standard series of samples, from which one or more may be selected for the actual experiments. An Accuratus loading machine, permanently set to throw a standard three-dram measure of powder, was utilised for a preliminary examination of the six available samples of powder. The hopper was filled with each in turn; and, after two charges had been drawn off to enable the machine to settle down to regular work, five were then passed into a single receptacle. The aggregate weight of these five charges was then taken, and an average was struck, giving the weight of the three-dram bulk. The results were copied down in the following form :—

Name of Powder	Weight of five 3-dram Charges.	Average Weight per 3 dram Charge.	Average for each Group.
E.C.	165·2 grs.	33·04 grs.	
Red Star	163·8 ,,	32·76 ,,	32·67 grs.
Smokeless Diamond ..	161·0 ,,	32·20 ,,	
Amberite	214·5 ,,	42·90 ,,	
Felixite	216·6 ,,	43·32 ,,	42·53 grs.
Schultze	206·9 ,,	41·38 ,,	

The agreement of the powders with the setting of the machine seems to have been singularly fortunate in that the 33-grain powders were exactly one per cent. in error on the minus side, and the 42-grain powders practically the same percentage in the other direction. Now it would be obviously wrong to devote any elaborate amount of care to measuring the space occupied by a powder having a known variation from the three-dram relation of bulk and weight. The powder maker may construct his powder to a particular density based on the measuring standards which are well-understood in his own factory and produce the required result; but it does not follow, and there is no guarantee, that any two methods of measuring density will give precisely the same result. Therefore, for the purposes of arranging tables for all powders an average value must be taken, and the above figures indicate that the sample of E.C. (at most two or three ounces), which gave within half per cent. of the standard value, is a valuable asset for the work to be undertaken. Any of the other powders could of course equally well be used by disregarding the theoretical 33 grains or 42 grains as the case may be, and utilising instead the odd weight which fills the three-dram space. Having selected a suitable powder the cubics of the various calibres of cartridge were examined in reference thereto. The separate treatment of 42-grain and 33-grain powders will be introduced at a later stage, but it will not involve fresh measuring processes. For instance, if the new 30-grain class of powder ever requires a special set of tables the values introduced below contain the whole of the necessary experimental information.

For the purpose of arriving at the height of column of any given charge of powder in any given bore of cartridge case 33 grains of the above sample of E.C. and fractions or multiples thereof were measured out as required. The base of each cartridge was sealed internally by a card wad, in the manner that was described in last month's lecture with reference to shot charges. Thus no powder occupies no space, 33 grains occupies an ascertained height, 66 grains twice that amount, and so on through the whole range of quantities and calibres examined. It would be tedious to deal in detail with the precautions which were taken for ensuring extremely accurate measurements, also the check tests which were made with alternative samples of each bore of cartridge, in order to arrive at true average values. From the various measurements which were taken, the number averaging six per calibre, those most consistent were finally selected and will be found in the following table :—

TABLE I.—*Height of Powder Column in various Bores of Cartridge Tube, not including any allowance for the base.*

4-bore.	Height of 33	grs. = ·47 in.	66 grs. = ·94 in.
8-bore.	,, 33	grs. = ·57 ,,	66 grs. = 1·14 ,,
10-bore.	,, 33	grs. = .68 ,,	66 grs. = 1.36 ,,
12-bore.	,, 33	grs. = ·77 ,,	66 grs. = 1·54 ,,
14-bore.	,, 33	grs. = ·85 ,,	66 grs. = 1·70 ,,
16-bore.	,, 33	grs. = ·91 ,,	66 grs. = 1·82 ,,
20-bore.	,, 16·5	grs. = ·55	33 grs. = 1·10 ,,
24-bore.	,, 16·5	grs. = ·62 ,,	33 grs. = 1·23 ,,
28-bore.	,, 16·5	grs. = ·69 ,,	33 grs. = 1·38 ,,
32-bore.	,, 16·5	grs. = ·80 ,,	33 grs. = 1·60 ,,

Notwithstanding the extraordinary degree of consistency observable throughout the whole of the measuring processes which resulted in the above table, it was felt that the task could not be regarded as satisfactorily accomplished until the powder measurements had been related in some simple arithmetical fashion to the interior diameter of the tube. In other words, by taking a given amount of powder, and measuring its height or "thickness" in various cartridge tubes (the base complication being excluded by measuring from a false bottom formed by a card wad), the whole process, so to speak, resolves itself into a very cumbersome measurement of cubic capacity. On the other hand smoke-

less powder has no settled or permanent density, and it is loaded into a cartridge case of peculiar formation and irregular shape. Thus, whilst the merest schoolboy could calculate the cubic contents of a given length of cartridge tube of known diameter, the answer would not tell the cartridge loader anything he wanted to know. Some kind of relation obviously must exist, between the powder and the cubics of the shell, and the connecting link may be defined as follows :—*The height occupied by* 33 *grains of powder, multiplied by the cross section of the cartridge case should give a constant result for all calibres.* The necessary measured lengths are shown in the Table I. The cross section of the cartridge tube may be derived from the table of chamber sizes of the Gunmakers' Association. These do not actually specify the interior diameter of the cartridge case, but the bore of the cartridge tube may be obtained by deducting a few points from the wad diameters which are given. The arithmetical process being purely of a comparative nature absolute area may be disregarded, diameter squared giving all that is required. The various stages of the calculation are fully expressed in the following table :—

TABLE II.—*Process of checking the Observed Values of Table I. by introducing the element of Cartridge Diameter.*

Bore of Gun.	4	8	10	12	14	16	20	24	28	32
Inter. Dia. of Case ...	·945	·843	·782	·736	·700	·669	·621	·585	·555	·508
ditto squared (d^2) ...	·893	·711	612	·542	·490	·448	·386	·342	·308	·258
Height of 33 grs. ... (*Height* × d^2)	·47	·37	·68	·77	·88	·91	1·10	1·23	1·38	1·60
	·420	·405	·416	·417	·417	·408	·425	·420	·425	·418
Cubics of 33 grs. ...	*Assume mean value.* ·417.									
Corrected Height ... (·417 ÷ d^2)	·47	·58	·68	·77	·85	·93	1·08	1·19	1·35	1·62

All measurements are in inches.

NOTE.—The 3 dr. charge thus occupies ·0327 cubic in. $= \frac{1}{3 \cdot 052}$ *cubic in.*

1 cubic in. of water weighs ·036 lbs. = 252 grs.
do. 33 grain type of nitro = 100·7 grs.
do. 42 " " = 128·2 "
Specific gravity of water ... = 1·000.
Gravimetric density of 33 gr. nitro = ·400
" " 42 " = ·509

Here it will at once be seen that the measurements of height of powder column, which were put forward in the previous table without any definite check as to their relation with the standard published diameters, are now proved to agree most closely therewith. Accidental differences due to errors of measurement and idiosyncracies of samples are excluded by working backwards from the assumed mean value, all as shown in the table, and carrying forward for future use the final corrected lengths which have survived the elaborate checks and counterchecks which have been surveyed in the course of the present lecture.

The final stage of powder analysis comprises the association of the three-dram charge and the space given it in Table II. with specific gravity. Black powder is always understood to occupy the same space as its own weight of water. Powders of the Schultze class being roughly half the weight for the same bulk have a gravimetric density of 0·5. The 33-grain powder, with which the measurements have been made, works out at 0·400. This makes the 42-grain powder by proportion 0·509, a truly remarkable confirmation of the relationship usually assumed. Nobody would accept a set of loading tables which were based upon an assumed value for the gravimetric density of smokeless powder ; but it certainly represents an addition to the common stock of knowledge to know that the singularly round number value 0·400 is the density of the powder upon which the tables now in process of compilation have been based.

The same system of original measurement and subsequent check can be applied in regard to the space occupied by various charges of shot in the calibres of cartridge under treatment. For shot the round number value of one ounce naturally suggests itself. In the very large bores, such as 4 and 8, a measurement based upon the space occupied by a single ounce might not provide satisfactory results. On the other hand in all the cartridges various quantities of shot were examined so as to avoid reliance on a single measurement, and the ounce allowance may thus be based on a larger or smaller quantity. The following table contains not only a digest of the previously published values, but also the new measurements which have been made with the same calibres :—

TABLE III.—*Height of Shot Column in various Bores of Cartridge Tube, not including any allowance for turnover and top wad.*

Calibre.	Diff. per ¼ oz. in old Table	Measurements of Height.		Selected 1 oz. Heights.
4 bore	—	2 oz. = ·78 in.	3 oz. = 1·15 in.	·40
8 bore	·12	1 oz. = ·48 in.	2 oz. = ·96 in.	·48
10 bore	·14	1 oz. = ·56–·58 in.	2 oz. = 1·12–1·14 in.	·57
12 bore	·15	1 oz. = ·60–·64 in.	2 oz. = 1·24–1·28 in.	·63
16 bore	·19	1 oz. = ·76–·77 in.	2 oz. = 1·53–1·55 in.	·77
20 bore	·22	1 oz. = ·88–·89 in.	2 oz. = 1·77 in.	·88
28 bore	·26	½ oz. = ·59 in.	1 oz. = 1·13 in.	1·15
32 bore	—	½ oz. = ·68 in.	1 oz. = 1·34 in.	1·35

The column adjoining the nominal bore sizes represents a digest of the old table values, the same being the increase of height of shot column for each quarter-ounce increment of charge. Thus if the old table stated that one ounce in a 12-bore occupies with the top wad and turnover ·98in. of tube, with 1¼oz. 1·13in., the extra quarter-ounce clearly occupies the difference ·15in. Therefore, one ounce in a 12-bore, not including any allowance for wads or turnover, must represent ·60 of an inch of length in the cartridge. The above table shows measurements in the 12-bore varying from ·60 to ·64in. for one ounce, and 1·24 to 1·28 for two-ounce charges. From these values ·63in. was the value selected for the standard space occupied by one ounce. It represents rather a large departure from the values previously used, but the ultimate effect of any measurements now made must occupy a secondary position compared with the importance of getting them exactly right. For the 8-bore the old table and the selected new value are in absolute agreement. In the 10-bore the value ·14 per quarter-ounce equals ·56 ounce, which compares with ·57 for the recent experiments. In the 16-bore ·76 becomes ·77. In

the 20-bore the two values are in absolute agreement, but in the 28-bore the value per quarter-ounce, viz., ·26, represents 1·04in. per ounce of shot, whereas the latest measurement gives 1·15, which is the largest difference of the series. The 32-bore, like the 4-bore, was not specified in the old tables. Consequently the values 1·35 and ·40 respectively, of the new tests must stand alone on their merits.

Fortunately the final safeguard of making an arithmetic comparison with the standard cartridge diameter is applicable to the shot as well as the powder. Just in fact as 33 grains of powder occupies the same cubical space, whatever may be the size of the cartridge into which it is filled, so within reasonable limits one ounce of shot should give the same result for the product of length and diameter squared. In that buck shot sizes cannot be loaded without having due regard to how the pellets pack in the bore of cartridge to be dealt with, so it might be argued that between 4-bore and 32-bore the degree of close packing of the shot pellets would show a definite difference. Things would tend to equalise themselves by the general practice to use large shot in large cartridges, and small shot in the smaller ones, thereby reducing the question of close packing to a species of common denominator. What these variations amount to can be examined in the light of practical test, and no test can be more practical than the measurement of cubical capacity, all as shown in the following table :—

TABLE IV.—*Process of checking Observed Values of Table III. by reference to Cartridge Diameter.*

Bore of Gun.	4	8	10	12	14	16	20	24	28	32
Diam.of Case squared..	·893	·711	·612	·542	·490	·448	·386	·342	·308	·258
Height of 1 oz.	·40	·48	·57	·63	—	·77	·88	—	1·15	1·35
Cubics of 1 oz.	·357	·341	·349	·342	—	·345	·339	—	·354	·348
Assume mean value ·347.										
Corrected Height ...	·39	·49	·57	·64	·71	·77	·90	1·01	1·12	1·34

It will be seen at once that the measured values of length show no consistent variation at either end of the scale from the corrected values which assume a uniform quality of packing in all the bores. In fact if the originally observed values as shown in the second row of figures are compared with the finally corrected values at the bottom of the table, it will be found that mathematical treatment provides merely an intelligent means of deciding which of the sundry measurements of Table III. should be adopted as the characteristic value. Reverting to the alteration of the 12-bore length from ·60 to ·63 it is curious that the mathematical treatment should go higher still and make ·64in. the length of a one-ounce charge in a 12-bore. Such a difference cannot possibly be ignored in the tables subsequently to be pubilshed, and it is highly probable that the standard of compression which was no doubt partly based on 12-bore practice, being fixed at ·12in., may have to be amended to a lower figure, say ·10in. This, however, is a matter for consideration in a future lecture. Meantime it is interesting to note that the other calibres show extremely close agreement between the original measurements and the same values smoothed down to bring them into harmony with one another from the point of view of relative diameter of cartridge tubes.

The variable density of different sizes of shot will doubtless exert a certain amount of influence on the loading of a cartridge. For instance in the previous lecture various quantities of No. 10 shot were measured in a series of cartridge tubes to arrive at the allowance to be made for thickness of head. Three ounces in a 12-bore were registered as occupying 1·80in., which gives exactly ·60in. per ounce, as against ·63 of Table III. above, and ·64 of Table IV. In the 16-bore No. 10 shot gave ·75, and the No. 6 shot of the present experiments ·77, again showing a definite influence due to the obviously closer packing of very small sizes of shot. Large pellets would by inference pack to less advantage ; but just how the matter stands had better be postponed for further consideration in the future, when it will doubtless be possible to submit actual measurements of a variety of sizes.

This practically concludes the foundation work of the set of tables which will enable the loader to ascertain at a glance the feasibility of inserting any particular combination of powder and shot in any specified size of cartridge. The elaborately checked space values for powder and shot can be divided into graduations with any required degree of nicety to show the space occupied by a whole range of more or less practical powder and shot charges in each calibre, advancing in grains and sixteenths of ounces respectively. The necessary allowances for turnover, card wads and compression will be discussed and values provided in due course.

REVIEW.

Memorials des Poudres et Salpêtres : Parts 3 and 4. Volume XIV. Published by Gauthier-Villars, Paris.

The present issue of the Memorials consists of the concluding parts of Volume XIV., and contains the usual official reports and in addition two articles, one on Interior Ballistics and the other on Ammonium Perchlorate Blasting Explosives.

Manufacturers will find the particulars respecting the use of ammonium perchlorate both useful and interesting. Theoretically this substance is the best cheap oxydizer that can be used in an explosive mixture, on account of its available oxygen. Like ammonium nitrate it is on combustion completely resolved into gases, but unfortunately hydrochloric acid is a product and its adoption as an ingredient in explosives to be used in confined places is thus barred. The two explosives examined were submitted by the Cheddite Company and had the following composition.

	Explosive I.	Explosive II.
Ammonium Perchlorate ..	82%	50%
Dinitrotoluene	13%	15%
Castor Oil	5%	5%
Sodium Nitrate	—	30%

The report concludes by stating that the Explosive I. is one of high power and could be economically used in open

places were the presence of hydrochloric fumes would cause no inconvenience but the advantages do not balance the dangers present in its manufacture. The suppression of hydrochloric acid attempted by the introduction of sodium nitrate is not realized in Explosive II. Moreover this explosive becomes very hard and difficult to detonate on storage and its net cost gives only slight advantages over similar explosives of equal strength.

Interior ballistics is a French subject and there is at present no evidence that this right will be challenged by the scientific work on this subject in other countries. Any statement therefore, on interior ballistics from a French source should be given every consideration. The pioneer Sarrau did not complete his work on ballistics. The final volume on Sarrau's method was written by Gossot and Liouville. During recent years a school of interior ballistics has arisen in France somewhat opposed to Sarrau and the leading exponent of this school is Charbonnier. The article in the issue under review, consisting of 78 pages and written by Captain Emery, is a criticism and comparison of interior ballistics as presented by Grossot and Liouville and as formulated by Charbonnier. The article is well worth the reading of all who are interested in the subject of interior ballistics.

APPLICATIONS FOR PATENTS.

MARCH 22—APRIL 17, 1909.

6,761. Preventing Accidental Discharge. H. R. Girdlestone.
6,856. Drop-down Firearms. F. W. Perkes.
6,915. Bolt Rifle Backsights. R. E. Fenby and A. T. C. Hale.
6,960. Small Arms Carrier. J. P. Goodbun.
6,980. Machine Guns. E. Jones and Kynoch Ld.
6,983. Rifle Backsights. R. A. Rogers.
7,131.* Ordnance. H. C. L. Holden and C. H. Dewett.
7,323. Safety Devices for Explosives in Coal Mines. J. G. Patterson.
7,469.* Ordnance Elevating Gear. Fried. Krupp.
7,473. Cartridge Carriers. Mills Equipment Co.
7,474. Rifle Range. H. Smith.
7,628. Range Keepers for Guns. A. T. Dawson and G. T. Buckham.
7,664. Aperture Sights. W. Andrews.
7,714. Mining Cartridges. C. S. Bailey and H. L. Storey.
7,758. Cartridge Cases. G. Quick.
7,785. Carriers for Range Finders. A. Barr and W. Stroud.
7,786. Scales for Range Finders. A. Barr and W. Stroud.
7,824. Breech Loading Small Arms. H. T. Ashton.
7,829.* Explosive Projectiles. F. Keller.
7,854. Gun Sights. A. Winser.
7,933.* Targets. E. J. Solano.
7,953.* Deep-Sea Floating Targets. C. Kolbe.
8,007. Projectiles. H. C. King, A. Hern and C. Howdle.
8,065. Rifles. T. R. R. Ashton.
8,128.* Automatically Operated Guns. W. Roeder.
8,208. Bolt Action Rifles. Birmingham Small Arms Co., Ld., and G. Norman.
8,212. Cartridge Fuse Holders. J. Ford and E. E. Bonshor.
8,301. Envelope Bullets. King's Norton Metal Co., Ld., T. A. Bayliss and H. M. Smith.
8,305. Ordnance Ammunition Hoisting Gear. A. T. Dawson and J. Horne.
8,406. Rifles. E. J. D. Newitt and H. Marks.
8,526. Armour-piercing Projectiles. J. R. Hoyle and H. B. Strange.
8,549. Breech Loading Ordnance. A. T. Dawson and G. T. Buckham
8,563. Small Arms. H. White.
8,564. Small Arms. H. White.
8,645. Projectile Fuse Caps. Vickers, Sons and Maxim Ld.
8,736.* Rifle Sights. A. E. Swift.
8,809. Shoulder Pads for Shooting. J. F. Naddermier.
8,880.* Gun Sights. D. B. Harris.
8,888. Projectiles. T. Davage.
8,962.* Explosives. W. H. Pay and G. H. A. Goodricke.
9,037. Ordnance Breech Mechanism. A. T. Dawson and G. T. Buckham.
9,038. Ordnance Breech Mechanism. A. T. Dawson and G. T. Buckham.
9,043. Metal-cased Charges. A. T. Dawson and G. T. Buckham.

*These applications were accompanied by complete specifications

SPECIFICATIONS PUBLISHED

MARCH 25—APRIL 15, 1909.

COMPILED BY HENRY TARRANT.

2,198 (1908). **Straight Pull Action for L.-E. Rifles.** T. R. R. Ashton, London. (*See Selected Patents.*)

2,817 (1908). **Armour Piercing Projectile.** Sir R. A. Hadfield, and A. G. McK. Jack, Sheffield. The cap of the projectile is made of the shape best suited for the penetration of armour plates. In order to secure the best ballistic results in flight this hard steel cap is covered by a mantle of a shape designed to overcome most easily the resistance of the air. In a former specification, No. 16,901, 1898, the patentees described a mantle for this purpose. The present mantle may be applied to projectiles of the kind set out in patent Nos. 19,104, 1907, and 20,983, 1898. Accepted March 8, 1909.

3,195 (1908). **Travelling Target Apparatus.** D. H. Marrable, Dorchester. A target carrying truck is traversed from one side of the butts to the other by means of weights at the ends of cords running round multiple purchase pulley blocks. The motion of the truck may be accelerated or retarded if necessary, whilst a rising and falling movement may be given to it. Accepted March 15, 1909.

4,970 (1908). **Ammunition Hoist Apparatus.** P. M. Justice, London. (Agent for the *Lamson Consolidated Store Service Co., U.S.A.*). An improved mode of control in fluid pressure apparatus for governing the supply of ammunition to gun turrets is dealt with in this patent. The valve at the despatch station is controlled from the receiving station. The fluid pressure apparatus is not only employed for conveying the ammunition to the turret but also for driving it into the breech of the gun. Accepted March 4, 1909.

4,999 (1908). **Ordnance Barrel Casing.** W. J. Stewart, Belfast. A structural frame for the rifled inner tube of ordnance consists of layers of concrete and steel superimposed over each other. These walls are connected together so as to form spaces or pockets which are filled with sand, or liquid or semi-liquid, or gaseous bodies. Accepted March 5, 1909.

5,865 (1908). **Bolt Action Rifles.** A. W. Rogers, Melbourne. In order to prevent accidental unscrewing of the bolt head of the Lee-Enfield pattern rifle when the bolt is removed from the weapon the patentee provides a spring pawl and recess. He also alters the slots in the charger loading bridge to facilitate the removal of the empty cartridge clips. Accepted March 16, 1909.

5,966 (1908). **Shell Construction.** J. L. Brown, U.S.A. The cavity for the explosive takes the form of a circular recess running round a central shell strengthening pillar. The recess is sealed by a plug screwed into the base and the fuse is inserted in the central pillar. Accepted March 17, 1909.

6,079 (1908). **Blasting Fuses.** A. J. Jordon, Haydock. In fuse heads composed of a tube of paper loaded with the firing compound and resin or sulphur to hold the leading wires, the wires are twisted into loops to prevent their easy withdrawal from the compound in which they are embedded. Accepted March 4, 1909.

6,544 (1908). **Ordnance Firing Gear.** Lieut. A. T. Dawson and G. T. Buckham. The firing plunger is adapted to perform two functions—that of releasing the firing pin and that of retaining the breech screw against the breech face when the swinging carrier is slammed to. Accepted March 24, 1909.

6,654 (1908). **Ordnance Firing Mechanism.** Lieut. A. T. Dawson and G. T. Buckham, London. The transverse firing plunger is provided with a tripping piece or cam so constructed and arranged in relation to the firing lever that during the advance of the plunger the tripping piece clears itself from the firing lever after imparting movement to it to fire the gun. The plunger is cocked by the angular movement of the breech screw in opening the breech. Accepted March 25, 1909.

7,340 (1908). **Air Rifle Target Apparatus.** J. F. Bird and W. Bernard, Birmingham. Behind the bulls-eye hole of the usual air rifle metal faced target is a plunger which when struck by a shot is forced backwards so that a piston is released and an electrical circuit is completed. A bell rings continuously until by means of a lever the contact is interrupted. Accepted March 18, 1909.

8,078 (1909). **Ordnance Training Gear.** Sir. W. G. Armstrong, Whitworth and Co., Ld., and F. G. D. Johnston, Newcastle-on-Tyne. The backlash is eliminated from the teeth of the worm in ordnance training gear by reducing the side clearance of the worm and worm wheel teeth. Friction between the teeth is reduced by providing an oil bath. The worm and worm wheel may be readily disengaged when the training gear is to be put out of action. Accepted March 25, 1909.

8,105 (1908). **Armour Piercing Projectiles.** Sir R. A. Hadfield, and A. G. McK. Jack. Sheffield. An armour piercing cap of the shape best adapted to get through the air is applied to the point of a projectile in the usual way, but on account of the extra length recesses are cut on the inside of the cap where it is joined to the shell so that the shell as a whole is not unbalanced. Accepted March 11, 1909.

9,459 (1908). **Cartridge Making Machinery.** Nobels Explosives Co., Ld., Glasgow, and H. D. Hodge, Waltham Abbey. Cartridge shells are fed head downwards to a rocking arm which inverts them and drops them on to pins standing up from a horizontal wheel. The latter is rotated step by step and primers are fed into the cavities in the shell bases by fingers on a rocking shaft. Various punches automatically press the primers home. Accepted March 4, 1909.

10,639 (1908). **Ordnance Mountings.** A. F. Petch and R. Redpath, London. In order to enable the worm wheel to be clamped to the pedestal of pedestal gun mountings without giving lateral movement to the wheel as a whole two plates moved relatively to one another by a screw are provided. These plates are prevented from moving sideways. They grip a projection on the worm wheel, thus locking it to the pedestal. The plates adjust themselves to the position of the worm wheel so that there is no thrust on it. Accepted March 18, 1909.

12,606 (1908). **Ejector Mechanism for Break-down Guns.** F. and F. G. Rogers, Birmingham. (*See Selected Patents.*)

13,567 (1908). **Air Rifle Loading Mechanism.** C. G. Bonehill and H. Homer, Birmingham. (*See Selected Patents.*)

15,660 (1908). **Training Ordnance.** E. C. R. Marks, London. (Agent for *Societa Anonima Italiana* and *A. Armstrong and Co., Italy*). The improved controlling arrangements for elevating and training ordnance are applicable to the systems set out in patents Nos. 7,418, 1906, and 6,461, 1908. The control consists of a direct current transformer, an electric motor and reserve manual or power means, co-related so that should either of the first two become damaged the other may be utilized, whilst if both are put out of action the manual labour or power reserve may be pressed into service. Accepted March 18, 1909.

16,715 (1908). **Automatic Pistol Firing Mechanism.** N. Pieper, Belgium. An intermediate rocker or lever is arranged between the hammer spring and the sear operating limb for the purpose of disengaging the sear and its operating bar when the hammer is thrown forward so as to prevent the inadvertent discharge of all the cartridges in the pistol. Accepted March 4, 1909.

18,231 (1908). **Quick Firing Ordnance Carriages.** Société Schneider and Cie, France. By means of the arrangement described in this patent sighting of recoiling quick firing guns may be effected in a continuous manner without impairing the rapidity of the "mowing" method of firing. The gun and its cradle are laterally displaceable independently of the traversing mechanism and without affecting the sighting apparatus. Accepted March 4, 1909.

18,567 (1908). **Automatic Pistol Mechanism.** Webley and Scott, Ld., and W. J. Whiting, Birmingham. The breech slide recoil stops of pistol mechanism in which the breech bolt slides and the barrel is stationary are improved. The breech slide has forward extensions which carry the stops co-operating with corresponding stops on the barrel. Accepted March 4, 1909.

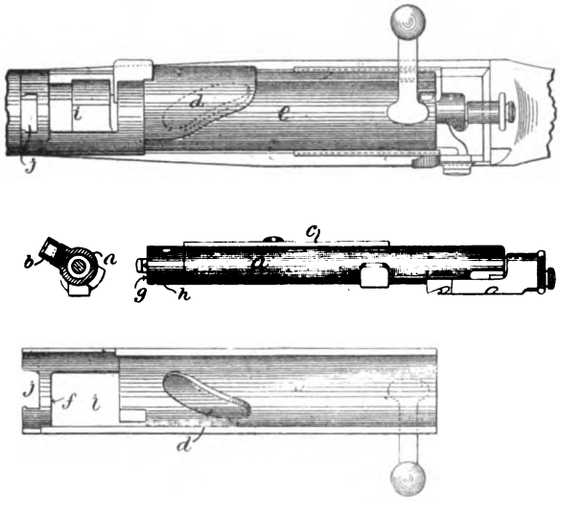
21,257 (1908). **Automatic Electric Targets.** C. W. Place, Richmond. By controlling by means of switches the circuits of electromagnets which actuate the target, the periods of exposure of the target may be varied or different figures may be made to appear. Accepted March 4, 1909.

24,875 (1908). **Automatic Pistols.** H. Rosier, Belgium. The breech bolt of this automatic pistol is adapted to slide freely on a completely open rear part of the body. The recoil is received and cushioned solely by a reaction spring, the shocks due to recoil being conveyed indirectly only to the frame or body of the pistol through the sleeve which encases the spring. Accepted March 25, 1909.

SELECTED PATENTS.

"STRAIGHT-PULL" ACTION FOR LEE-ENFIELD RIFLES.

2,198 (1908).—T. R. R. Ashton, London. The improvements described in this specification are applied to the action of the British service rifle, and are intended to adapt it for quick operation. The bolt is turned to unlock it by the action of a roller running in a cam on the cover to which the usual form of bolt handle is attached.



The improvements are illustrated in the drawings appended. The bolt *a* is of the ordinary type at present in use in the Lee Enfield rifle, but added to it is the friction roller *b* screwed into

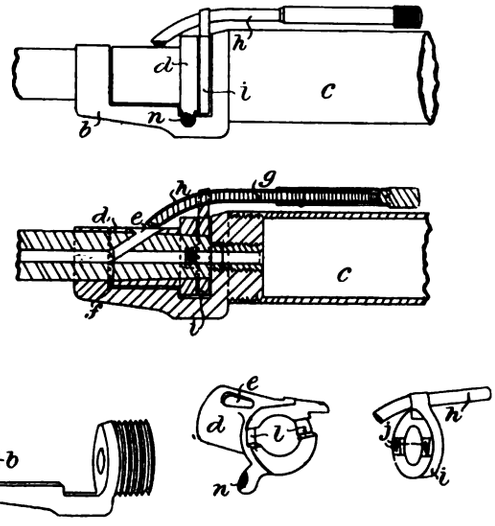
the lug *c*. This roller is adapted to work in the curved groove *d* formed in the under side of the dust cover *e*. In the closed position the roller lies in the back of this groove. When the handle is *pulled* to open the bolt the cover runs back on guides on the bolt body, and through the action of the groove *d* on the roller *b* the bolt is turned and unlocked. During this unlocking movement the slide is travelling backwards. By the time the bolt is fully unlocked the face *f* of the recess in the cover *e* has arrived at the face *g* of the bolt-head *h* and by engaging with the lateral projection carrying the extractor therein it pulls the bolt backwards, so extracting the empty cartridge case.

The projection slides in the slot *i* shown in the cover. In the forward end of the cover the recess *j* is left to accommodate the cartridge charging clip when the bolt is in its backward position.

A safety bolt is provided on the left hand side of the back of the action. This is somewhat similar to the device in existence on the Short Lee-Enfield Rifle, but it simultaneously locks both the slide *e* and the striker. Accepted March 1. 1909.

AIR RIFLE LOADING MECHANISM

13,567 (1908). C. G. Bonehill and H. Homer Birmingham. The pellet loading device and breech closure arrangements described in this patent are applied to air rifles of the fixed barrel type, i.e. those in which the cylinder and barrel form one continuous rigid piece. The gas tap form of rotary breech closure plug hitherto in general use is, it is thought by the patentees, defective in several respects. To overcome these defects they introduce the sleeve here described which fits tightly on the outside of the taper portion of the barrel end. The sleeve is forced into its air-tight position by a "pressure plate." The latter carries the flexible push rod through which the pellet is pressed into position in the barrel.

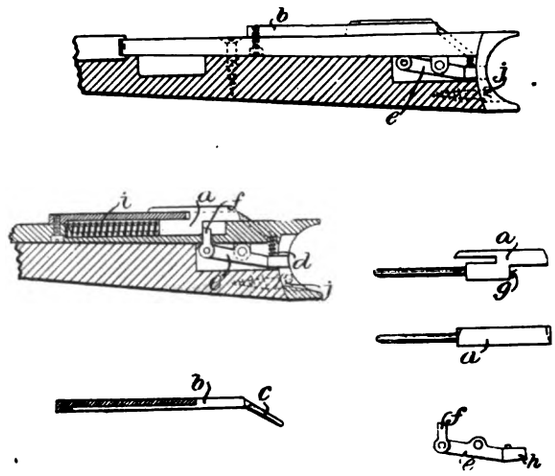


The barrel, *a*, is screwed as illustrated into the breech body *b*, which is itself screwed to the cylinder *c* in the usual way. The barrel is tapered and is adapted to carry the sleeve *d*, the hole *e* in which may be registered with the channel *f* cut in the barrel. The pellet is inserted into the barrel through this hole and channel and is forced into correct position by the flexible rod *g* sliding in the tube *h*. The latter is carried by a lug starting up from the top of the "pressure plate" *i*. This plate has a couple of projections *j* which carry spiral springs. Through these springs the pressure plate *i* is forced backwards and the breech closing sleeve *d* forwards, so that the latter engages tightly on the taper portion of the barrel. The projections *j* take into the recesses *l* on the sleeve *d* so that when the sleeve is turned by means of the lever *n* from the open to the closed position the pressure plate is forced to take part in the same movement and to remove the pellet loading tube *h* and shaft *g* away from the line of sight.

A tube is inserted in the back of the bore of the barrel so that its forward end assists the pellet into its correct position in the bore and prevents its falling rearwards or tumbling over. Accepted March 8, 1909.

EJECTOR MECHANISM FOR BREAK-DOWN GUNS.

12,606 (1908). F. and F. G. Rogers, Birmingham. The mechanism set out in this patent is introduced for the sake of simplicity and of compact arrangement. The ejector "kicker" or hammer is released during the opening of the gun by the removal of a vertically sliding sear. The mechanism is applicable to single or double barrelled guns.



It will be seen by reference to the accompanying drawings that the ejector kicker *a* lies on the fore-end iron beneath the plate *b*, whose prongs *c* project through the iron and hold in compression the small spiral springs *d*. The function of the latter is to force the ejector sear *e* downwards so that the sear nose *f* is held up in front of the surface *g* of the kicker *a*. By this means the kicker is held back against the pressure of the spring *i*.

The mechanism works in the usual way when the gun is broken down. The nose of the slipper is thrown forward when the hammer of the lock falls so that it engages with the underside *h* of the ejector sear *e* and turns it upwards on its pivot against the pressure of the spring *d*. This movement slides the sear nose off the surface *g* of the kicker *a*, so releasing that part which is impelled by its spring *i* sharply against the end of the extractor leg. In this way the spent cartridge is thrown out of the chamber and clear of the gun.

The patentees point out that the arrangement of the sear *e* in so small a space allows plenty of room for the fore-end iron fixing pin *j*. A rigid attachment, said to be not hitherto accomplished is, therefore, secured. The pivoting instead of fixing, of the sear nose *f* on the sear arm *e* is also referred to as a point of merit. Accepted March 18, 1909.

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CURRENT TOPICS.

German Shot Gun Tests.—It is characteristic of German methods of scientific research that the *Deutschen Jager Zeitung* should call a conference of experts to discuss at their shooting ground the relative merits of different systems of conducting firearms tests. The underlying idea is obviously to arrive at a standard method of testing the ordinary sporting cartridge. In this country the problem has been fairly thoroughly threshed out, and although uniformity of method does not exist in many of the details of working, great similarity of method has of late years been developed. First of all it became a recognised article of faith that the greatest possible number of measurements should be recorded in respect to each round fired, the effect of which was to save time whilst increasing the fund of information obtained. Housman contributed a most brilliantly practical method of measuring recoil by swinging a heavy gun on wires. The *Field* gun carrying out this and various other ideas was then adopted by a joint conference of experts, and all the largest firms became purchasers of the fine proof guns which were made in due course at the Webley factory. The complete success of this weapon, was, however, marred by the adoption of copper crushers. The intended improvement in the direction of greater scientific accuracy was unfortunately marred by the inherent irregularity of sporting powders, which meant that the simpler lead crusher was the better medium all things considered for making the necessary tests. Eley Bros. have designed a simple means of bushing the old hole and providing a fresh piston, suitable for use with lead crushers. The effect has been to bring out the full powers of usefulness of the *Field* proof gun, and Webley's in their turn adopted the size of piston suited to lead crushers for the gun which was last sent out from their factory. From the point of view of velocity testing the 20 yards distance seems now to have been generally adopted; and though differences may still exist concerning the precise method of breaking the circuit on the arrival of the shot charge no vital principle is affected. Similarity of standards and methods of testing provide an excellent ground work for international agreement, and if our foreign contemporary bases its methods on what has been found best in this country, then we in our turn may be glad to avail ourselves at some future date of the improvements which in the course of time it may be able to devise.

Gunmaking for Profit.—The publication within the same month of the probates of two gunmakers of curiously contrasted positions raises the general question whether the making of guns is a paying industry. Colonel Hawker spoke very frankly in the opposite sense a hundred years ago when he narrated the financial wreck of Manton's business, and the dispersal of his staff and other assets amongst such men as Purdey and Lancaster, whom he then acknowledged as the coming leaders of the trade. He concluded with the reflection that if ruin and financial mishap was the condition of the best men in the trade, how much worse it must be,

lower down. That things have improved since is certainly shown by the fortunes which have been left by many of the gunmakers who have died within the past ten years, also the known affluence of those who it may be hoped have still a considerable life in front of them. The will of Mr. Purdey shows that his total fortune was in the region of £200,000, a sum which not only implies the existence of a highly productive business, but also the ability to invest wisely the surplus sums drawn out as profit. Mr. W. J. Jeffery on the other hand, with a fortune only one-tenth as large, has disappointed those who believed him to be a well-to-do, if not actually a rich, man. The amount of business which he managed to secure almost from the earliest start caused a considerable upheaval in the trade whose established methods he sought to alter for his own benefit. It may certainly be said that his rivals would in the aggregate have made vastly more than £20,000 out of the turnover which the new comer secured by methods of acute competition. On the principle of forwarding the greatest good of the greatest number the Purdey system of gunmaking is certainly the one which should be recommended for imitation in preference to that followed by the not more enterprising younger man. The total turnover of the trade in handmade firearms is strictly limited, and the class of customer for which it caters prefers quality and personal consideration rather than starving out the last sixpence of profit. Such principles of working may break down in the presence of a young and energetic man determined to force his way to the forefront of the trade. On the other hand no harm can be done, and no unfriendly criticism is implied against either the living or the dead, when it is urged that every gunmaker should recognise in the bottom of his heart that the personal and individual advantage of lessening prices is at the best problematical, whilst the general effect on the trade as a whole is not conducive to that most useful substitute for a fortune, viz. a comfortable living for each of its members year by year. The seller of guns and rifles and even cartridges of the cheapest brand, must face responsibilities and meet claims from customers of an entirely exceptional kind, and it is useless in trafficing in firearms to fix prices on a basis which might perhaps be observed if the thing once sold was never heard of again.

The Miniature Bisley.—The unfavourable prognostications concerning this meeting which were advanced in last month's issue have unfortunately been fulfilled. For one reason and another, notably the season of the year, shooters have failed to support an indoor meeting which occurs at very nearly the most interesting period of the outdoor rifle shooting season. Just when the cyclist, the amateur gardener, the rowing man and the tennis player are throwing off the lethargy of winter's confinement, it is not surprising that a miniature rifle meeting occupying the evenings of fourteen consecutive working days should fall a trifle flat. Other causes which have operated in the same direction are the undue penalties by way of rifle definitions which the acceptance of a grant from the Astor fund implies. Rifle shooting of the miniature variety is in a most healthy and highly vitalised condition. The shooters are keen, and the extraordinary degree of skill they acquire enables them to pass at a single jump into the highest rank of service riflemen. It will need something in the nature of genius to decide what form the annual test of ·22 marksmanship shall take for the future. The Astor money has served its purpose, and is practically exhausted. Therefore the special fitting up of indoor ranges seems likely to be regarded as too costly a proceeding for future adoption. Bisley as a scene for the exercise of miniature range shooting is needlessly and inconveniently far out of town. Shadows in fact obscure the future of this class of meeting, and the National Rifle Association must not be blamed if for the future they decide to concentrate their strength on the Bisley Meeting, rather than risk the wasted effort which has characterised their most recent attempt to provide a miniature rifleman's championship meeting.

The Chemical Congress.—In celebration of the Chemical Congress, and with a view to erecting a suitable monument to the occasion, a book entitled *The Rise and Progress of the British Explosives Industry* (Published by Whittaker and Co., Price 15s. net.) has been brought out as a result of the joint efforts of certain public spirited men professionally connected with the business. The aim of the book, as implied by its title, is strictly adhered to ; and every page accordingly takes its proper place in relating the work of the early pioneers of the industry to the enterprises, large and small, which satisfy the demand of to-day. The preface very aptly describes the book as a duty to posterity which it is hoped posterity will appreciate. Each division of the history of explosives has been made the subject of a separate chapter written by one chosen on account of special knowledge. The historical treatment in due course gives place to actual descriptions of existing establishments, the Government factories coming first, and the private works following in alphabetical order. Each firm has supplied its own annals, and in the large majority of instances biographical and scientific material of the highest historical value has been compiled from records which would not have been searched, except under a very special inducement such as the present occasion represents.

The Lecture on Cartridge Loading.—For fear the mass of tabulated figures, which accompany this month's Lecture to Young Gunmakers should not be appreciated at its full value, it is necessary to mention here that the strongest confidence is felt that the figures in question will exercise a most important controlling power on cartridge loading for an indefinite number of years to come. Time and patience will admittedly be necessary in order to gain familiarity with the methods of testing and devising cartridge loads which the tables facilitate to a degree never before available. These values were originally published in October 1907, and constant use proved the soundness of the underlying idea to an extent which has justified the entire re-working of the whole series with a view to including cartridge sizes not previously dealt with, and providing the benefit of certain improved methods of tabulation which have been devised in the interval.

PROOF HOUSE RETURNS.

THE annual report of the Birmingham Proof House Guardians has been issued, and it shows that the sum total of proofs carried out last year amounts to 326,697, which, is neither very much up nor very much down on the dead level which has prevailed since the year 1892. On only one occasion within this period has the total dipped, and then minutely, below the 300,000 level, and only twice has it risen above 400,000, viz. in the years 1897 and 1903. The summarised figures for the last three years are as follows :—

	1906.	1907.	1908.
Provisional Proofs	**80,522**	**71,910**	**69,691**
Definitive Proofs			
Muzzle Loaders	30,307	32,021	11,870
African Barrels	62,632	57,431	37,244
Breech Loading Arms	74,273	91,695	80,534
Nitro Proof of Rifle Barrels ..	2,031	2,585	929
Express Rifle Barrels	520	1,660	678
Military Rifle Barrels	16,964	29,578	25,037
Chambers of Revolvers.. ..	55,479	37,703	34,586
Pistols	14,241	11,675	27,485
Sundries	1,009	683	1,267
Supplementary Proofs—			
Nitro Proof	32,190	35,219	37,168
Proved with Nitros	360	275	208
	370,528	**371,435**	**326,697**

Amongst gunmakers a general feeling exists that the number of proofs fails to tell the full story of the depression from which the trade undoubtedly suffers. The firearms trade is roughly divided into three divisions ; first, the very common garret-produced weapons intended for export to savage and uncivilised countries, secondly, the highly finished hand-made weapons intended for sporting use, and thirdly and lastly, the machine-produced weapons, which are satisfactory commercially only so long as there is a regular demand for stereotyped models. The first classification has been gradually giving way to the third for many years past, and Birmingham's loss has benefited America and the Continent. Nowadays a return movement is apparent, and the firm of Webley is especially prominent in having organised a large business in machine-made automatic pistols of high finish and excellent design. The Birmingham Small Arms Co. are similarly showing great enterprise in connection with the small rifle trade. Both firms it will be noticed owe their capacity in the line of repeat manufacture to the fact of having regularly supplied Government requirements, the former in revolvers, the latter in rifles. The firm of Greener have also achieved a prominent position in a similar style of work as makers and converters of weapons for rifle club use. Therefore, whilst the sum total of Birmingham trade has been dullness and depression, there is a gleam of satisfaction in knowing that manufacturing ability is by no means on the wane. In fact under very trying conditions, an increased turnover has been achieved in a highly competitive market.

The trade in double-barrel firearms reflects the conditions which appear to be inseparable from the sporting gun. In no other sport are the implements of such enduring permanence, and orders are only given on the rare occasions when a man decides to throw out his old gun and take on a new one. The necessity is in no way comparable with the purchase of new clothes, new boots, a new motor car, or even a new match rifle. In all these commodities the period of highest efficiency is limited, and the constant necessity to write off old stock is well understood. But with guns the case is quite different. Their effective use turns much more on familiarity of feel and a knowledge of their accustomed behaviour, than on ballistic efficiency. Mechanical perfection once imparted is practically permanent, whilst so far as design is concerned the present is certainly a period of stagnation, not be it understood stagnation of inferiority, but stagnation of perfection that cannot further be improved.

At the annual meeting of the gun trade, which was held at the Proof House on the 4th ult., Mr. W. L. Powell boldly tackled the larger issues that affect the trade's position. After making a statistical comparison of the various items comprised in the proof returns, most of which are apparent in the above table, he mentioned that the current year showed up to date no improvement in general trade. The raising of the price of foreign proofs no doubt caused a good deal of the testing to be transferred to London, but whatever might be the cause the Proof House was now being run at a loss, and the fees might have to be increased at an early date. In his opinion the main causes of slackness of trade were :—first, lack of confidence throughout the country, next, prohibitions and increasingly hostile tariffs, and finally the free importation of arms into this country at prices with which they could not compete, and of a quality which he thought they would be sorry to produce. Personally he very much regretted that the remedy for the third category of unfavourably operating causes had been allowed to become a party question. The issues involved were of a national character, and the gun trade was particularly one which needed, for the attainment of high efficiency, a properly supported home market, such in fact as their rivals possessed, and without which competition became a hard and up-hill fight.

The supplementary report on the working of the gun trade technical school shows that there were seven pupils for barrel filing, twenty-three for action filing, ten for stocking, eight for screwing and finishing, and sixteen for theory. These figures are of modest proportions, but they represent say fifty pupils continuously under training by selected masters for what it must be admitted is not a large trade. Moreover the skilled gunsmith occupies in many factories much the same position that the tool-maker does to the general machine shop staff. He arranges the work of those less skilled than himself ; and on his knowledge depends the ability to impart the right characteristics to the work turned out by labour-saving methods. The technical school committee, of which Mr. Charles Playfair is chairman, therefore deserve the highest thanks for their disinterested labours.

LECTURES TO YOUNG GUNMAKERS.

LVII.—THE ALPHA AND OMEGA OF CARTRIDGE LOADING. PART III.

THE measurements recorded in the last lecture leave very little now to do beyond their due assemblage in the form of the requisite tables. The operations involved are somewhat complicate and technical, but the result is so simple as to make it worth while endeavouring to follow the constructional processes. The point arrived at up to date is the exact length of cartridge tube occupied by a three-dram charge in all the calibres from 4-bore to 32-bore. The same also exists in regard to one ounce of shot.

In order that the powder values may be rendered available for use in table form it is necessary that the powder column should be increased by an allowance to cover the material in the head of the cartridge, thereby making the distance measure from the base of the cartridge to the surface of the powder charge. In the previous lecture but one the entire range of cartridge sizes under consideration were subjected to a strict system of measurement to arrive at the thickness of head, by which it appeared that a ·28in. allowance covered all the sizes except 4-bores and 8-bores, which were slightly thicker. It was decided to ignore these differences on the ground that being longer cartridges their contents would require more compression, a result which would follow from assuming their thickness of head at rather less than the true value.

It will be remembered that the head thickness was arrived at by measuring the length occupied in the cartridge tube by a given quantity of shot in two different ways; first, with the shot supported on a card wad forming a false bottom to the case, and second, with the same amount of shot lying in the cartridge case in the manner of a powder charge, the distance being taken from the exterior surface of the cartridge base. The difference between these two measurements gave the head thickness, but as the whole question was fully explained at the time, no further space will be occupied here in describing it afresh, beyond perhaps stating that shot evidently accommodates itself to the irregularity of the chamber into which it is poured much more exactly than is the case with powder, whereby it has been found necessary to allow ·30 of an inch for the thickness of the head instead of the value ·28 inch arrived at by the use of small shot. The following table contains details of the final measurements which have confirmed the decision to allow ·30 inch for the thickness, *i.e.*, the depth, of the cartridge head.

TABLE I.—*Relation between space occupied by powder exclusive and inclusive of cartridge head.*

Bore of Gun	4	8	10	12	14	16	20	24	28	32
Height of 33 grs.	·47	·58	·68	·77	·85	·93	1·08	1·19	1·35	1·62
do. plus ·30in.	·77	·88	**·98**	**1·07**	**1·15**	**1·23**	**1·38**	**1·49**	**1·65**	**1·92**
Special values	grs. 99	grs. 66								
	1·71	**1·46**								
Actual Measurements	**1·80**	**1·50**	**·97**	**1·07**	**1·16**	**1·24**	**1·38**	**1·50**	**1·65**	**1·91**

It will be seen that in all the sizes except 4-bore and 8-bore the measured and calculated figures are in extraordinarily close agreement, a fact which can be verified by anyone who cares to measure the height of a 3-dram powder charge in any of the specified cartridge sizes. From the figures in the above table the space occupied by every charge in every size of cartridge can be obtained. The process consists in setting out a sheet of squared paper with a scale of inches in one direction and powder grains in the other. The zeros of the two scales meet at one corner of the diagram, in other words no powder occupies no space, and straight lines radiate from this zero through each of the observation values shown in the first line of the above table. The particular range of charges required for each bore is then decided upon, and the various relations of powder grains and length of tube occupied are read off as quickly as they can be taken down. Having thus determined the net space occupied by a practical range of powder charges, the next thing is to make the necessary additions which are required for the loading table. These involve the allowance of ·30 inch for the thickness of the cartridge head, a further addition of ·17 inch for the two twelfth-inch cards, and a deduction of ·12 inch for the reduction of the length due to compression. These two additions less the deduction for compression, give a net increase of ·35 inch. The processes involved are shown in the accompanying specimen table relating to 12-bores :—

TABLE II.—*Space occupied by a practical range of charges for a 33-grain powder in a 12-bore.*

Powder Charge for 33 gr. Powders.	Net Length of Powder Column.	Corrected values, viz. :— +·30 for Cartridge Head, +·17 for two Card Wads, −·12 for Compression = +·35
30 grs.	·70 in.	1·05 in.
31 ,,	·72 ,,	1·07 ,,
32 ,,	·75 ,,	1·10 ,,
33 ,, = 3 drs.	**·77 ,,**	**1·12 ,,**
34 ,,	·79 ,,	1·14 ,,
35 ,,	·82 ,,	1·17 ,,
36 ,,	·84 ,,	1·19 ,,
37 ,,	·86 ,,	1·21 ,,
38 ,,	·89 ,,	1·24 ,,
39 ,,	·91 ,,	1·26 ,,
40 ,,	·93 ,,	1·28 ,,
41 ,,	·96 ,,	1·31 ,,
42 ,,	·98 ,,	1·33 ,,
43 ,,	1·00 ,,	1·35 ,,
44 ,,	1·03 ,,	1·38 ,,
45 ,,	1·05 ,,	1·40 ,,

An extremely interesting simplification of the comparison between 33 and 42-grain powders was fortunately struck when considering the next process for the preparation of the tables. Hitherto the whole of the work has been carried out with a sample of 33-grain powder selected because of its standard density, and, practically speaking, no other quantity than 33-grains viz., the standard three-dram measure, has been dealt with. Therefore the whole of the figures which have been given for the three drams

of 33-grain powder are equally applicable to the alternative 42-grain type. It would have been quite simple to redraw the same set of curves on squared paper varying only the powder scale. The sole result produced would be a variation of the grains column in the mathematical relation of 42 to 33. Unit differences would here and there appear as a result of approximating the last place of decimals. It however, suddenly became clear that the following table of translations was the only thing necessary to convert the whole of the 33-grain values to the equivalents in terms of 42-grain powder loads :—

TABLE III.—*For converting charges of a 33-grain powder into equivalent values for powders of the 42-grain class.*

11 grs. = 14 grs.	**31** grs. = 39 grs.	**51** grs. = 65 grs.
12 ,, = 15 ,,	**32** ,, = 41 ,,	**52** ,, = 66 ,,
13 ,, = 17 ,,	**33** ,, = 42 ,,	**53** ,, = 67 ,,
14 ,, = 18 ,,	**34** ,, = 43 ,,	**54** ,, = 69 ,,
15 ,, = 19 ,,	**35** ,, = 45 ,,	**55** ,, = 70 ,,
16 ,, = 20 ,,	**36** ,, = 46 ,,	**56** ,, = 71 ,,
17 ,, = 22 ,,	**37** ,, = 47 ,,	**57** ,, = 73 ,,
18 ,, = 23 ,,	**38** ,, = 48 ,,	**58** ,, = 74 ,,
19 ,, = 24 ,,	**39** ,, = 50 ,,	**59** ,, = 75 ,,
20 ,, = 25 ,,	**40** ,, = 51 ,,	**60** ,, = 76 ,,
21 ,, = 27 ,,	**41** ,, = 52 ,,	**61** ,, = 78 ,,
22 ,, = 28 ,,	**42** ,, = 53 ,,	**62** ,, = 79 ,,
23 ,, = 29 ,,	**43** ,, = 55 ,,	**63** ,, = 80 ,,
24 ,, = 31 ,,	**44** ,, = 56 ,,	**64** ,, = 81 ,,
25 ,, = 32 ,,	**45** ,, = 57 ,,	**65** ,, = 83 ,,
26 ,, = 33 ,,	**46** ,, = 59 ,,	**66** ,, = 84 ,,
27 ,, = 34 ,,	**47** ,, = 60 ,,	**67** ,, = 85 ,,
28 ,, = 36 ,,	**48** ,, = 61 ,,	**68** ,, = 87 ,,
29 ,, = 37 ,,	**49** ,, = 62 ,,	**69** ,, = 88 ,,
30 ,, = 38 ,,	**50** ,, = 64 ,,	**70** ,, = 89 ,,

By means of this table the whole of the charges for 33-grain powders can be converted into their equivalents in the 42-grain class. Equal bulk being equal strength as nearly as the two can be adjusted, it is interesting to bring the corresponding charges of the two types of powder into the closest possible juxtapositon. This has been accomplished to an extent never before realised in the accompanying ready-reckoner loading tables.

So far as regards shot charges the same system of setting out the ascertained ounce values in the form of curves, and reading off the fractional values, has been followed. The allowance for turnover and top wad has in each case been included in the final values appearing in the tables. Having already occupied so much space in introducing the final result, analysis and comments must be reserved for another occasion. On the other hand it would hardly do justice to the tables if some indication were not given of their potentialities for usefulness. A series of recommended charges have been selected more or less haphazard from the card of loading instructions which is issued by our contemporary the *Sporting Goods Review* under the authority of the powder makers. They analyse as follows :—

		In.			In.
4 bore	90 grs. occupies	1·63	**8 bore**	60 grs. occupies	1·40
4 inch	3oz. ,,	1·61	3½inch	2oz. ,,	1·39
=4·00	½in. felt ,,	·50	=3·25	⅜in. felt ,,	·37
		3·74			3·16
Charge entirely uncompressed.			*Undercompressed ·09 inch.*		
10 bore	40 grs. occupies	1·17	**12 bore**	38 grs. occupies	1·24
2⅝inch	1⅛oz. ,,	1·16	2¾inch	1⅛oz. ,,	1·16
=2·62	⅜in. felt ,,	·37	=2·75	⅜in. felt ,,	·37
		2·70			2·77
Compression ·08 over normal.			*Within ·02 of normal.*		
14 bore	30 grs. occupies	1·12	**16 bore**	33 grs. occupies	1·28
2½inch	1⅛oz. ,,	1·02	2¼inch	2⅛oz. ,,	1·11
=2·56	⅜in. felt ,,	·37	=2·75	⅜in. felt ,,	·37
		2·41			2·76
No compression ·03in. air space			*Within ·01 of normal*		

4 Turnover, ·38 in. Ditto, plus top wad, ·44 in. — Compression allowed = ·28 in.

42 Gr. Pdr. Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs. Inch.	Grs.	Oz.	Inch.
102—1·49—	80	2 1-2	—1·42
105—1·52—	82	2 5-8	—1·46
107—1·55—	84	2 3 4	—1·51
110—1·57—	86	2 7-8	—1·56
112—1·60—	88	3	—1·61
115—1·63—	90	3 1-8	—1·66
117—1·66—	92	3 1-4	—1·70
120—1·69—	94	3 3-8	—1·75
122—1·72—	96	3 1-2	—1·80
125—1·75—	98		
127—1·77—100		*Usual*	
130—1·80—102		*length*	
132—1·83—104		*of case*	
135—1·80—106		=4in.	

8 Turnover, ·35 in. Ditto, plus top wad, ·41 in. — Compression allowed = ·16 in.

42 Gr. Pdr. Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs. Inch.	Grs.	Oz.	Inch.
67—1·28—	53	1 1-2	—1·15
69—1·30—	54	1 5-8	—1·21
70—1·32—	55	1 3-4	—1·27
71—1·33—	56	1 7-8	—1·33
73—1·35—	57	2	—1·39
74—1·37—	58	2 1-8	—1·45
75—1·39—	59	2 1 4	—1·51
76—1·40—	60	2 3 8	—1·57
78—1·42—	61	2 1-2	—1·63
79—1·44—	62		
80—1·46—	63	*Usual*	
81—1·47—	64	*length*	
83—1·49—	65	*of case*	
84—1·51—	66	3¼in. = 3·25	

10 Turnover, ·32 in. Ditto, plus top wad, ·38 in.

42 Gr. Pdr. Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs. Inch.	Grs.	Oz.	Inch.
43—1·05—	34	1 1-4	—1·09
45—1·07—	35	1 5-16	—1·13
46—1·09—	36	1 3-8	—1·16
47—1·11—	37	1 7-16	—1·20
48—1·13—	38	1 1-2	—1·24
50—1·15—	39	1 9-16	—1·27
51—1·17—	40	1 5-8	—1·31
52—1·20—	41	1 11-16	—1·34
53—1·22—	42	1 3-4	—1·38
55—1·24—	43		
56—1·26—	44	*Lengths.*	
57—1·28—	45	3¼in. = 3·25	
59—1·30—	46	3 ,, = 3·00	
60—1·32—	47	2⅞ ,, = 2·87	
61—1·34—	48	2⅝ ,, = 2·62	
62—1·36—	49		

12 Turnover, ·30 in. Ditto, plus top wad, ·36 in.

42 Gr. Pdr. Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs. Inch	Grs.	Oz.	Inch.
38—1·05—	30	7-8	—·92
39—1·07—	31	15-16	—·96
41—1·10—	32	1	—1·00
42—1·12—	33	1 1-16	—1·04
43—1·14—	34	1 1-8	—1.08
45—1·17—	35	1 3-16	—1·12
46—1·19—	36	1 1-4	—1·16
47—1·21—	37	1 5-16	—1·20
48—1·24—	38	1 3-8	—1·24
50—1·26—	39	1 7-16	—1·28
51—1·28—	40	1 1-2	—1·32
52—1·31—	41	*Lengths.*	
53—1·33—	42	3¼in. = 3·25	
55—1·35—	43	3 ,, = 3·00	
56—1·38—	44	2¾ ,, = 2·75	
57—1·40—	45	*2½ ,, = 2·56	
		*actually $2\frac{9}{16}$	

14 Turnover, ·29 in. Ditto, plus top wad, ·35 in.

42 Gr. Pdr. Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs. Inch.	Grs.	Oz.	Inch.
34—1·04—	27	7-8	—·97
36—1·07—	28	15-16	—1·02
37—1·09—	29	1	—1·06
38—1·12—	30	1 1-16	—1·10
39—1·15—	31	1 1-8	—1·15
41—1·17—	32	1 3-16	—1·19
42—1·20—	33	1 1-4	—1·24
43—1·23—	34		
45—1·25—	35	*Usual*	
46—1·28—	36	*Length*	
		*2½in. = 2·56	
		*actually $2\frac{9}{16}$	

16 Turnover, ·28 in. Ditto, plus top wad, ·34 in.

42 Gr. Pdr. Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs. Inch.	Grs.	Oz.	Inch.
32—1·05—	25	8-4	—·92
33—1·08—	26	13-16	—·97
34—1·11—	27	7-8	—1·01
36—1·14—	28	15-16	—1·06
37—1·17—	29	1	—1·11
38—1·19—	30	1 1-16	—1·16
39—1·22—	31	1 1-8	—1·21
41—1·25—	32	1 3-16	—1·25
42—1·28—	33	1 1-4	—1·30
43—1·31—	34	*Lengths.*	
45—1·33—	35	2¾in. = 2·75	
46—1·36—	36	*2½ ,, = 2·56	
		*actually $2\frac{9}{16}$	

20 bore	28 grs. occupies	1·27	**28 bore**	20 grs. occupies	1·17
2¾inch	⅞oz. ,,	1·10	2½inch	½oz. ,,	·82
=2·75	½in. felt ,,	·50	=2·50	$\frac{7}{16}$in. felt ,,	·43
		2·87			2·42

Compression ·12*in. above normal. Undercompressed* ·08*in.*

The result certainly suggests that the charges for some of the lesser known bores and sizes have not been worked out as accurately as they might be. The gun trade looks to the powder makers for information on these points, and there is too much evidence that one copies from another without realisation that the original value may have been only a guess. For the future it ought to be understood that the holding capacity of a cartridge should be determined, not by experiments, but from tabulated measurements of the kind now presented. Firing experiments come next in deciding, as between the various combinations suited to the size of the case which gives the best ballistics. The function of the loading card for sporting nitro compounds is to specify the charges arrived at by such experiments. The present tables narrow the area of those experiments by linking up all the different cartridge sizes, and reducing them to a species of common denominator.

20 Turnover, ·25 in. Ditto, plus top wad, ·31 in.

42 Gr. Pdr.	Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs.	Inch.	Grs.	Oz.	Inch.
27	1·04	21	5-8	·87
28	1·07	22	11-16	·93
29	1·10	23	3-4	·98
31	1·14	24	13-16	1·04
32	1·17	25	7-8	1·10
33	1·21	26	15 16	1·15
34	1·24	27	1	1·21
36	1·27	28	1 1-16	1·26
37	1·30	29	1 1-8	1·32
38	1·33	30	*Lengths.*	
39	1·36	31	3 in.	=3·00
41	1·40	32	2¾ ,,	=2·75
			*2½ ,,	=2·56
			*actually 2$\frac{9}{16}$	

24 Turnover, ·23 in. Ditto, plus top wad, ·29 in.

42 Gr. Pdr.	Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs.	Inch.	Grs.	Oz.	Inch.
24	1·04	19	1-2	·79
25	1·07	20	9-16	·86
27	1·11	21	5-8	·92
28	1·14	22	11-16	·98
29	1·18	23	3-4	1·04
31	1·22	24		
32	1·25	25		
33	1·29	26		
34	1·32	27	*Usual Length.*	
36	1·36	28	*2½in.	=2.50
			**true length.*	

28 Turnover, ·20 in. Ditto, plus top wad, ·26 in.

42 Gr. Pdr.	Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs.	Inch	Grs.	Oz.	Inch.
22	1·05	17	7-16	·75
23	1·09	18	1-2	·82
24	1·13	19	9-16	·89
25	1·17	20	5-8	·96
27	1·21	21	11-16	1·03
28	1·25	22	3-4	1·10
29	1·29	23	*Usual Length*	
31	1·33	24	*2½in.	=2·50
32	1·37	25	**true length.*	
33	1·41	26		

32 Turnover, ·17 in. Ditto, plus top wad, ·23 in.

42 Gr. Pdr.	Length	33 Gr. Pdr.	Shot. Charge	Shot. Length
Grs.	Inch.	Grs.	Oz.	Inch.
18	1·04	14	3-8	·73
19	1·09	15	7 16	·82
20	1·14	16	1-2	·90
22	1·18	17	9-16	·99
23	1·23	18	5 8	1·07
24	1·28	19	11-16	1·15
25	1·33	20	*Usual Length*	
			*2½in.	=2·50
			**true length.*	

The following decimal equivalents for various well-known fractions of an inch will be found extremely useful for reference in view of the difficulty nearly everybody finds in carrying such values in the head :—

1-4 inch felt	=·25in.	7-16 inch felt	=·43in.
5-16 ,, ,,	=·31 ,,	1-2 ,, ,,	=·50 ,,
3-8 ,, ,,	=·37 ,,	9-16 ,, ,,	=·56 ,,
Two twelfth-inch cards	=·17 ,,	Two-sixteenth cards	=·12 ,,

LETTERS FROM BERZELIUS (1846), HALL AND SCHÖNBEIN (1847), ON GUNCOTTON.

BY GEORGE W. MACDONALD, M.Sc., F.C.S.

Through the kindness of Mr. C. L. Watson-Smith, of Faversham, I have received the following interesting historical letters on the subject of guncotton, and in addition some of the original intimations to miners and others on the sale and use of guncotton.

Letter from J. Berzelius to Professor Schönbein.
Translated from the German.

STOCKHOLM.
18th November, 1846.

SIR,—Your letter with which you honoured me under date of the 20th June came to my hands at the commencement of September only. Mr. Merrian, who was the bearer of it told me he had also to deliver a box of paper samples from you which he had left at Hamburgh and he was unwilling to deliver the letter before he got the box, which had however been sent with his other things to Berlin, whither he intended to proceed in a few days. I requested him to deliver the box to our Minister at Berlin, which however he has not done, although he made an aerial excursion with the said Minister in Mr. Green's balloon. As he stated to me at the same time that you had gone to England, I therefore delayed returning you my thanks for the information respecting the guncotton, until I should know where to address my letter to. I send the present to London at haphazard.

Accept my sincere congratulations on this as interesting as important discovery, the applicability of which you have at once endeavoured to show. Since Professor Otto of Brunswick made known a method of preparing the guncotton, this discovery has perhaps occupied a greater number of inquisitive persons than any other chemical discovery ever did. I have likewise engaged in experiments upon it ; I prepare it of equal parts in volume of concentrated sulphuric acid and the nitric acid of the shops at 1·45 sp. gr. I have found that it arises from the lignine and can be produced from the lignine of all vegetable substances, especially when we previously extract the encrusting substances by steeping it in a caustic maceration. I have prepared it from the sphaguum palustre, from tow, straw and best of all from decayed and rotten wood which, after removing the earthy particles by maceration, gives an excellent pulverous gunpowder. I propose for its essential designation the term nitric (nitrous ?) lignine since, being composed of these substances it cannot be called guncotton. I have also attempted to prepare it from cladonia rangiferena and letraria islandica ; but these contain a squelette which does not consist of lignine but of starch-like fibres and only produce nitrous amynline (xylodine).

The products of the combustion of nitrous lignine, which are all gaseous, contain a gas which I consider to be cyanite

(*Continued on page 79.*)

ROUND THE TRADE.

The next sale of guns at Debenham's will take place on Friday the 4th inst.

Mr. Charles McLoughlin who travelled for Charles Osborne and Co. and the New Explosives Company died on the 22nd ult. of acute pneumonia following influenza. "Mac," as he was known in the trade, had many friends among gunmakers, and was quite a personality.

We hear that Mr. F. Marten Hale has negotiated orders with two of the leading South American Governments for guncotton charges for torpedoes and submarine mines of the well-known standard types, varying from the 500 lb. ground and counter mine down to the 76 lb. naval design.

The report and balance sheet of the Gunmakers' Association provides an extremely interesting review of questions closely affecting the trade. The sum total of work accomplished necessarily varies year by year according to the opportunities that present themselves. On the other hand recent reports of the Association, and the present one in particular, show that the Gunmakers' Association is sticking to business with exemplary care and patience.

The Clay Bird Shooting Association has arranged to hold the 17th Annual Championship Meeting on the grounds of the Middlesex Gun Club at Hendon. These grounds, which were completely re-equipped for clay bird shooting competitions last year, are accessibly situated, and electric trams pass the entrance. An interesting programme of competitions is being arranged, and the management committee intends to issue a preliminary list of the events in advance of the full programme, for the convenience of competitors in distant parts of the country and abroad.

Major A. Cooper-Key has presented a most interesting report dealing with the explosion of 12 tons of gelignite, which was caused last February during the removal of a wreck near Caister-on-Sea. A combination of circumstances necessitated immediate steps being taken for its removal without first examining the nature of its cargo. It was not as a matter of fact ascertained to be explosives until the charges ignited the whole stock of explosive in the hold. The occurrence was altogether of so exceptional a nature that the Chief Inspector does not see how greater forethought could have prevented the accident. He, however, suggests that the "Trinity House Instructions" should be amplified by way of warning parties engaged in such work of the danger of firing large charges of explosive in proximity to a vessel of unknown contents.

Messrs. Kynoch write under date May 7 :—"With reference to the first paragraph on page 63 of the current number of *Arms and Explosives*. The oversight is on the part of the retailer as you will see on referring to the box that we send you under separate cover. Our present label was introduced about two years ago."—Both parties are in reality right. One of the boxes, which led to the observation in last month's issue that neither Kynoch nor Eley marked ·22 long rifle cartridges as such, contained the following wording :—"100 Rim Fire Cartridges adapted to British Government Miniature Rifle and Aiming Tube." The label enclosed with Kynoch's letter was quite differently printed and coloured. Also it cont ined the description "Long Rifle" in prominent type. The presumption is either that the retailer is working off old stock, or else that the use of the old label was not discarded simultaneously with the introduction of the new. As regards the Eley cartridge box attention has been called to the word "Rifle" printed diagonally in two places with an indiarubber stamp. This certainly existed on the box of cartridges purchased, but it was never realised that the word was to be read as part of the subject matter of the label.

The B.S.A. Company have issued a leaflet illustrating the territorial pattern sights, concerning which they wish to emphasise the very important ruling of the National Rifle Association to the effect that these sights can only be used at Bisley in combination with the whole of the other features which characterise the Territorial rifle. The latter was described in the last February issue of this journal.

A correspondent writes that :—"The import of revolvers into Adrianople increased considerably during last year, and in the course of the first four months of this year it has reached a value of £1,800. Of the imported revolvers 70 per cent. come from Spain and the remainder from England and Germany. Sporting guns are mostly of Belgian origin, and the prices paid vary from 54s. to 144s." Also that :—"By a decree dated the 10th of April last, the Servian Government has authorised an alteration in the minimum tariff with regard to cartridges, whereby every description, filled or unfilled, will in future be subject to an import duty of 20s. per cwt."

Mr. H. A. Krohn, who is prominently associated with the territorial organisation of the county of Essex, arranged for the carrying out of a combined test and demonstration of the Hale rifle grenade by members of the 5th Batt. Essex Territorials. Six of them were stationed behind a piece

of bank representing covert, from which they delivered a volley of six grenades, producing an effect which was regarded as having considerable military utility by the officers and others who attended the experiments.

A sample of the Bayard automatic pistol has been forwarded to this office for review, together with cartridges for the same. The latter contain a powder charge consisting of 6·8 grs. (·44 gramme) of an irregularly chopped leaflet powder, and a nickel covered bullet weighing 127·8 grains (8·3 grammes). The nominal calibre is nine millimetres which equals ·354in. This is practically the calibre of the bullet, therefore making the bore from land to land less to the extent of double the depth of the rifling. The bullet measures in length ·643 inch. The total weight of the pistol is 2lbs. 3½oz., which includes the magazine, but not any cartridges. It is described in the catalogue as the Mars pistol improved, though the weapon itself is stamped as having been made under Bergmann's patent. The quality of manufacture is extremely high, and nothing neater exists than the little catch which on being pressed causes the lock plate to fly out, so exposing the mechanism for oiling purposes. When the lock plate is pressed into place the catch snaps securely home, retaining the plate without screws or other fastenings. The length of barrel is 3¾inches, and the over-all length of the weapon is 10½ inches. The magazine is not, as with certain other types of weapon, situated in the hand grip, but lies forward of the trigger guard. The recoil of firing is very slight, and the muzzle velocity is given at 360 metres per second, which equals 1,181 f.s. The makers of the pistol are Anciens Etablissements Pieper, for whom Messrs. Hupfield and Co. are the English agents.

(*Continued on next page.*)

The Steelite Explosives Works of Penryhn, North Wales, have recently lost the services of Mr. W. C. Hartig.

A notice has been received from the London Armoury Company's new West End premises, 31 Bury Street, St. James', to the effect that the well-known Winchester ·22 repeating rifle, which was not previously chambered for anything but the short cartridge, has now been adapted to fire the long rifle ammunition.

Mr. S. J. F. Newbery, manager of the gun department of the Army and Navy stores has retired after many years of service, and he is succeeded by his very able assistant, Mr. F. W. Cole. A member of a well-known gunmaking family, Mr. Cole takes over the important position to which he has been appointed with tradition and experience both in his favour. He is the inventor of a number of ingenious contrivances, all of them of a practical nature.

The Fabrique National, better known by the initials "F.N." is issuing warning notices on the Continent pointing out that the custom of naming pistols as of the Browning system, model or type is an infringement of the exclusive rights granted in respect to the markets where this company controls the patent and other rights associated with the name "Browning." Objection is equally taken to the application of the word in connection with cartridges.

The accounts of the Hotchkiss Ordnance Co., Ld. show that the net profit amounts to £9,343, to which has to be added £8,064 brought forward, making £17,407. After providing for debenture interest and £2,700 for the service of the first and second mortgage debenture stock sinking funds, there remains £6,122, which the directors propose to carry forward. The ordnance trade, in common with the iron, steel and shipbuilding industries, has remained in a stagnant condition during the year, and the directors regret to state that at present there is little, if any, sign of an immediate revival in the demand.

The report of the King's Norton Metal Company for the year ended the 31st of March last shows a profit of £4,028, which makes a welcome recovery from the £26,767 loss of the previous year. The trade has continued in a depressed state throughout the year under review, and in consequence a large portion of the company's machinery has stood idle. It is proposed that the sum of £2,500, reserve for equalisation of dividends, should be added to the above profit, which with the amount brought forward, gives an available total of £7,037. From this amount £1,500 has been written off for depreciation, and £800 has been set aside for experiments. The directors recommend the payment of the preference dividend outstanding from the year 1907–8, which will leave a balance of £537 to be carried forward.

The balance sheet of the British South African Explosives Co., Ld., for the year ended October 31st last shows a net profit of £96,027 after charging £30,261 for factory depreciation, adding £4,000 to certain reserve funds, and paying £4,559 for directors' fees. The same £55,000 as last year is recommended for the payment of a five per cent. dividend, the carry forward being thus increased from £96,586 to £137,613. The report mentions that the old selling prices remained in force throughout the year, subject to a reduction of 2s. 6d. per case on about two-thirds of the sales. The new reduced selling prices did not come into operation until after the conclusion of the financial year. The company has concluded a number of new contracts mostly for a term of 3½ years at prices which are not adequately remunerative under present conditions, but the directors are hoping that the present burdensome railway rates on the carriage of raw materials will be altered to an extent enabling the Company to pay moderate dividends. The arrangements in connection with the return of a portion of the unused capital of the Company to the shareholders cannot be completed until the order of the Court, due some months hence, has been obtained.

The application of the Company, Nitro Compounds Ld., to be granted a licence for the manufacture of explosives at Wivenhoe near Colchester is under consideration by the local authorities. The usual opposition from residents is balanced by the wish that the initiation of a new industry in the district should not be thwarted.

Mr. Adolf Mans, chief in the Johannesburg office of the British South African Explosives Co., Ld., died from sunstroke on the 9th of April last. He had been with the Company 15 years, and prior to that for three years with one of the affiliated German concerns. He was much respected in the Transvaal by British and Germans alike, and apart from his personal qualities he was regarded as an exceedingly capable man of business.

The directors of the E.C. Powder Co., Ld. show in their annual report a gross profit of £16,000, which becomes a net profit of £10,773 after deducting directors' fees, office expenses and general distribution charges, etc. The sum of £2,000 is written off the buildings and machinery account, and in addition to the interim dividend, already paid, a further dividend and bonus have been declared, making altogether 3s. per share or 15 per cent. The carry forward is increased from £3,067 to £3,574.

The report and balance sheet of the Schultze Gunpowder Co., Ld. shows a loss on the year's working of £791, which the directors attribute to the period since the last report having been one of much difficulty due to a war of prices, in which cartridge firms have been involved as well as powder makers. It has been deemed necessary to take steps to render the Company independent of any possible monopoly in connection with the supply of cartridges by an arrangement with the Cogswell and Harrison Manufacturing Co., Ld., which the directors fully believe will materially improve the Company's position and prospects.

The Nobel-Dynamite Trust Co., Ld. report a net profit for the year ended the 30th of April last of £263,859, as compared with a pratically similar sum, viz., (£631 less) last year. The preference capital absorbs £49,158, which compares with £25,000 a year ago, the difference being accounted for by the issue of new shares. The balance is appropriated to a dividend of eight per cent. and a bonus of two per cent. on the ordinary shares, both free of tax, these together absorbing £228,540. The carry forward is thereby reduced from £19,404 to £5,564. The directors report that the trade in blasting explosives has been unsatisfactory in several important markets, and that the diminution in the demand for war material has shown a further decline. The profits earned by the shareholdings by subsidiary companies in cognate industries have materia y contributed to the maintenance of profits.

About a month ago the newspapers contained the extremely interesting announcement that Sir F. L. Nathan, R.A., had retired with a full pension from the position he had recently taken up of Superintendent of the Enfield rifle factory, and that he had been appointed to a like position at the Ardeer works of Nobel's Explosives Co., Ld. The remarks which were made some time back, concerning the enormous accessions of strength which the private trade enjoys by taking over the services of distinguished Government servants, are just as applicable to-day to the case of Sir Frederick Nathan as they were then to that of Capt. M. B. Lloyd. The retirement of Mr. C. O. Lundholm from the position which he has occupied for so many years with such distinguished success is a subject of great regret on the part of all those who have had an opportunity of working under him, or have otherwise come into touch with the charming personality which remained unaffected by the never-ceasing responsibilities of his strenuous life. He carries into his retirement the love and the admiration of his many friends outside as well as inside the factory in which so much of his life has been spent.

gas which I certainly did not expect in them. I have not had time to investigate the precise elementary composition of this interesting combination, but I have dissolved them in a caustic alkali which is very easily done and I have obtained from it nitric *glucine* acid, apogline acid and other products of transformation not closely examined. I was quite disappointed in the hope that the lignine would again be generated in changing the nitrous acid for water. You will greatly oblige me by communicating to me the results of your further investigations respecting the employment of nitric lignine as gunpowder.

With particular respect I have, etc.

Letter from Mr. Hall to Professor Schönbein, Basle.

LONDON, 23 LOMBARD STREET, *August* 1847.

DEAR SIR,—The circumstances attending the late awful explosion of our guncotton establishment and the awful sacrifice of life connected with the destruction of so much property, have so overwhelmed us with trouble, and difficulty, that we have hardly been able to settle our minds, so as to be able to make any detailed communication to you, on the subject.

Our Mr. P. Brames Hall wrote to Mr. Barron at Berlin and handed him the report of the inquest held at Faversham on Friday the 16th ultimo, as it appeared in the *Times* newspaper and we understood from Mr. Barron, that he enclosed this paper to you, but up to the time that he was here on the 11th instant he had not heard from you, neither have we had any letter from you on the subject. On the 9th instant the adjourned inquest was held and the jury came to the conclusion that Henry Toppin and others were killed by the explosion, of a certain guncotton factory, but how that explosion arose, no evidence appeared. Eighteen persons were killed by that explosion, ten only could be recognized, the remainder were literally blown to atoms, and scattered with the materials, in every possible direction. One other person who inhaled the fumes of the acid, and who acted incautiously by not attending to medical advice, also died on the evening of the explosion making nineteen persons. Of the survivors, fourteen in number, who suffered dreadfully by broken limbs, contusions and being burnt by the acids, one has since died, and we fear one or two more will hardly recover. Some are maimed and we are obliged by principles of sympathy to maintain them, and furnish medical advice and assistance.

We believe that arrangements that had been matured after many months of painful and hazardous personal attention, on the part of our Mr. William Hall, worked out by practical and growing experience acquired by incessant application, for it must be remembered that any small essays of illustrating the mode of preparing, stoving and packing were perfectly futile, when applied to the production of the article, in large quantities, where the control of temperature and the difficulty the men have in sustaining respiration with the drying and packing are brought into the account (without any special directions for large operations) are matters to which we must say we are indebted to our own experience and are all contingencies, we have had to work out, and what we believe no house but ourselves would have had courage to encounter, but which have been thwarted with a destruction of life and property distressing to contemplate and alarming to the surrounding neighbourhood from the fear of any similar catastrophe.

This calamity attended with all its trying and appalling circumstances has exceedingly embarrassed our position and has placed us in the situation of submitting to you the first moment we could get in the accounts, a balance sheet shewing the loss and the divisible third, which we place to your debit in this painful matter. As much of the detail must have come to your knowledge, by the public papers, you will, independant of the main facts recognize what is the feeling of scientific men regarding the manufacture of the article on a large scale. We had made preparations and provided machinery to produce the article in large quantities, but as all scientific men agree that its principles are not even yet understood no party can produce it without all those contingencies that endanger life and property and that connected with the most determined opposition of public feeling and interested parties, preventing us getting it about the country utterly precluding for the present any possibility of our concentrating any quantity in any magazines whatever of either public or private property.

For these reasons we now submit to you that the present agreement must be cancelled and that we must be left entirely free and unfettered by any conditions to do the best we can, either with respect to any operations of our own in the re-erection and organization of our establishment for the manufacture of the article either now or hereafter, or in the granting of licences to companies or individuals under such plans, directions and instructions as we feel best adapted from the experience we have ourselves acquired and this upon the *further* understanding that one-fourth of whatever profit may arise may be accorded to you, and three-fourths to ourselves. You may rest assured of the deep anxiety we have in working out this affair in the best way we can to recover some portion of the severe loss we have incurred, and that it remains with you to facilitate and promote our views in every possible way in your power, for we must confess to you that we should never have entered into any agreement or had anything to do with the matter had we not relied on your express declaration that the guncotton could be made for *tenpence sterling* per pound, a price assumed on fallacious data and wholly at variance with experience and facts. We intend to submit these accounts to Mr. Barron, who will be able to trace every item and have any explanation that may be necessary for his satisfaction.

We are, etc.

Letter from Prof. C. J. Schönbein to Rev. J. A. Barron.

BALE, *October 22nd*, 1847.

MY DEAR BARRON,—The sad accident which occurred in Faversham some months ago and of which Messrs. Hall were kind enough to give me a short account some weeks back induced me to write you some lines. Though I have already expressed to you my deep sorrow regarding that disastrous explosion, I cannot help returning once more to

that melancholy subject and assuring you that no event in my life has ever produced such a deep and painful impression upon my mind as that to which I refer. You know that my humour is rather of a cheerful turn but ever since I got that afflictive piece of intelligence my spirits have been saddened and you may easily imagine how deeply I feel for Messrs. Hall and in particular for him who had to witness the catastrophe himself and nearly fallen a victim to it. It must have been the most trying moment in which a man can be placed in this life; and the killed and the wounded! I will stop here and confine myself to expressing my heartfelt wishes that it may please kind Providence to spare Messrs. Hall a renewal of such hard trials.

Though I am rather disinclined to speak of matters of business on this occasion still my standing to Messrs. Hall renders it imperative to do so. I cannot deny that I was rather astonished at the extent of the devastations caused by the explosion and infer from it that the quantity of exploded cotton must have been very considerable. You will be kind enough to enquire with Messrs. Hall how large the quantity was. As to the cause of the explosion I feel quite sure that neither electricity nor self-combustion had anything to do with it, for the numerous experiments I have made with guncotton speak most decidedly against such a conjecture. My opinion is that the explosion took place in consequence of some inadvertence or other having occurred during the operation of drying the cotton. In other terms I think it very likely that some portion of guncotton was exposed to a degree of heat at which that substance is set on fire. Not knowing at all the manner in which the guncotton was dried in Faversham I should like very much to be made acquainted with the details of that subject and of the way in which the temperature of the drying stoves and rooms was ascertained.

Great as the misfortune of the explosion was, I trust it will not discourage men so full of spirit as Messrs. Hall from resuming the manufacture of guncotton, for I feel quite confident that the preparation of that article is not connected with danger if the process of drying be carried on in a proper manner, *i.e.*, by a current of air moderately heated. As to the transport of guncotton I think I have proved beyond any shade of doubt that it is as safe as that of any other article. You know that I carried a comparatively large quantity of guncotton in my trunk last year and that I made a journey of at least 1,200 miles on railroads, stage coaches, steamboats, etc., where my luggage was very often roughly treated and not the slightest accident happened to my cotton box. A fairer and a more decisive trial cannot be made to show the groundlessness of the fear that guncotton might explode during its transport.

Pray present my best compliments to Mrs. Barron and Messrs. Hall and believe me. Yours, etc.

The following instructions and notifications with respect to guncotton are also historically interesting.

London Gunpowder Office, 23 Lombard Street, Nov. 19, 1846.

GUNCOTTON.

Very numerous applications having been made to us for a supply of Patent Guncotton (for sporting and blasting purposes), we deem it necessary to inform the public, that extensive preparations are in progress for the manufacture of this article, which will shortly be completed, when due notice will be given to gunmakers and mine agents, who may be desirous of obtaining a supply. Persons detected in making, using, or vending any imitation of the patent article, will be proceeded against on all occasions. JOHN HALL & SON, Patentees of Professor Schönbein's Guncotton for England, Scotland, Ireland, and the British Colonies.

DIRECTIONS FOR USING SCHÖNBEIN'S PATENT GUNCOTTON, APPLICABLE FOR BLASTING EVERY DESCRIPTION OF ROCK AND MINERAL.

It is recommended that safety fuse should be used, and inserted into the cartridge to the extent of about two inches, and tied fast to the neck of the cartridge with a piece of string. There is a black dot at one end of the cartridge to shew where the fuse is to be inserted.

The hole to be tamped should be made sufficiently large in diameter, that the cartridge may reach the bottom without there being any occasion to force the same down. The hole should be made as dry as possible before the cartridge is inserted. When the cartridge is down to the bottom of the hole, put into the hole a handful of dry sand or clay, so as to cover the top of the cartridge to the depth of one or two inches, then proceed to ram or stem down, precisely as in the case of blasting with gunpowder. The fuse being cut off to the required length, according to circumstances, all is ready for firing. Where there is an absolute necessity for using the guncotton, in a loose state, a wood rammer only is to be used.

TO MINE AND COLLIERY PROPRIETORS, SLATE QUARRY OWNERS, RAILWAY CONTRACTORS, IRONMONGERS, DEALERS IN GUNPOWDER, AND OTHERS.

Messrs. John Hall and Son, the patentees and sole manufacturers of Schönbein's patent guncotton respectfully state that they are now prepared to supply the patent guncotton (compressed for the convenience of carriage), in round and square paper cases of four ounces each, packed in boxes containing 50 and 100 cases each, at the price of three shillings per pound, for ready money. Also in tubes or cartridges of 1, 1⅛, 1¼, and 1½ inches diameter, containing 2, 4, 6, and 8 ounces each, at the additional charge of 1, 1½, 2, and 2½ pence, each tube or cartridge, for blasting in slate quarries, paper tubes will be supplied three feet in length, containing one ounce of the patent guncotton per foot. Four ounces of guncotton equal in power to 24 ounces of blasting gunpowder. As proved in mortars, similar to those used by the Board of Ordnance, for the proof of gunpowder.

In connection with the notice of the gunpowder weighing machine which appeared in last month's issue, Messrs. Avery have written to say that they have just completed the design of an instrument on similar lines, but with the gunpowder hopper suspended on an ordinary beam and balanced by an ordinary flat pan for the accomodation of weights. The bar is made of gun metal, and the bearings are of agate. The capacity is 100 lbs. with a sensitiveness of 1½ drams.

ELEY'S AS MAKERS OF SHOT.

IT is certainly by way of an event in the cartridge trade that the firm of Eley Bros. Ld., should have engaged in the manufacture of shot, primarily with the view of supplying their own requirements, but with the idea later on of taking orders from the trade. A very important secondary effect of the step which has been taken is the opportunity it affords of controlling standards of size and quality much more effectively than was possible in the days when supplies were wholly drawn from outside makers. Hitherto it has been impossible to know how much, if any, of the very large error which characterises commercial samples of shot is preventable. From the logical standpoint that the sportsman's tastes vary between sizes 4 and 7, without any difference being apparent, it could be argued that accidental changes to the extent of a quarter size up or down could not possibly have any practical importance. But the inability to observe a standard argues manufacturing incompetence, which in turn suggests lack of care in the processes of sorting and weeding out the wasters. The variability of samples in the shot trade is no doubt the outcome of indifferently controlled manufacture, showing itself not only in the form of divergence from the specified size, but accompanied by what is far more serious, viz. large differences between individual pellets in the same lot. From the shooter's point of view nothing is so important as an equal pace on the part of all the pellets constituting a charge of shot, an effect which is retarded by a mixture of sizes in the charge, whilst on the other hand the simultaneous arrival of the whole charge at the bird or other object aimed at is practically assured if the large majority of the pellets are a good shape and equal in weight.

Just what standard of quality the firm of Eley Bros. have managed to attain up to date in the working of their new plant cannot be stated on the basis of the inspection of processes which has been made. The tower is there, and has been in full work for many months past. The machines for the sifting and sorting operations, which are the natural complement of the shot tower, have already lost the appearance of entire newness. Actual samples of shot, drawn from the machines while at work, showed a degree of conformity with standard sizes which is certainly a novelty, provided the same degree of exactitude is daily repeated and equally represented in all the scheduled sizes. Apart from the obvious reservations, due to inability to vouch for a factory's entire output, one thing is certain, viz., that Eley's have determined that the quality of their shot, from the point of view of strict conformity to standard size, and individual regularity, shall rank as high as skill and unstinted expenditure on apparatus and processes can achieve. With their laboratories and scientific equipment generally the firm are exceptionally well situated for getting to the bottom of the metallurgical and mechanical problems involved. As cartridge makers, and above all as experts in the behaviour of cartridges, they know better than any other shot manufacturer how important it is to reach and maintain a high standard of quality in the shot charge. First and foremost due recognition is accorded to the elementary right of the sportsman to receive whatever size he may have ordered, and not something different, because it doesn't matter.

In proof of the firm's desire to raise shot making to a level it has never before attained in this country, mention may be made of the readiness with which a modest suggestion, which was put forward in the course of the inspectional visit, was not only taken up, but has since been amplified by correspondence and the submission of models and samples. Briefly stated the suggestion was that Messrs. Eley Bros. should prepare and hold a suitable stock of extra specially sifted and selected shot for sale to gunmakers and powder-makers to be used for hand loaded cartridges intended for pattern testing and other experiments. The essence of accurate loading so far as the shot charge is concerned is a supply of standardised No. 6 size which, if weighed, gives a true number of pellets, or conversely, if counted, gives a true weight. The ordinary shot trowel necessarily represents the quickest process of dividing off an absolute quantity of shot, true, say, within a one-per-cent margin. The full development of the scheme will necessitate the issue of a specially designed shot counter, also a conveniently proportioned hopper for working in connection therewith. Incidently it was decided that the design of a special shot trowel for use in experiments can never be as satisfactorily adapted for a shot size running 270 pellets to the ounce as would be the case if 272 were taken instead as the standard count. From all practical points of view the difference is absolutely immaterial, but so far as regards the design of a shot counting trowel, each row of holes represents 17 shot pellets, and 16 such rows constitute one ounce.

Great kudos would undoubtedly be earned by the firm supplying a quality of shot of sufficient excellence to be reserved for experimental use. The ability to maintain so high a standard, even though in small quantities, would argue a power to impart superior excellence to the every-day output. That shot can be well made is proved by the high quality and finish of the American samples which from time to time reach this country, and there is no reason why the firm of Eley Bros. should not introduce a new era into a department of sporting gunnery which has hitherto shown itself exceptionally conservative and indifferent to the off-repeated demand for closer standardisation. No one can be better placed for modernising old methods than those who start uninfluenced by tradition. An immense amount of theoretical work has been carried out in connection with the initiation of the new shot department. The process of relating pellets per ounce to diameter in inches, all as published in past issues of this journal, has been closely followed, but the whole of the figures have been worked out afresh, and new methods of calculation have been devised. The mass of technical detail thus compiled forms the basis of the Eley standard sizes. Permission has been granted for certain portions of the new matter to be published in a future issue. In the meantime it is sufficient to say that Eley's shot factory rests on sound foundations, both in substance and in theory.

REVIEWS.

Artillerie Navale by Colonel L. Jacob. Two volumes of the Encyclopédie Scientifique of about 450 pages each. Vol. I., Les Canons, Les Projectiles. Vol. II., Les Affuts, Les Poudres, Le Tir. Published by Octave Doin, Paris. Price 5fr. each.

These two books by Col. Jacobs, on naval artillery, may be regarded as a continuation of Col. Paloque's work on Field Artillery, already published in the Enyclopédie Scientifique and noticed in our issue of Dec. 1908. Together the three volumes form a treatise on artillery.

The subject is treated by Col. Jacob from a general point of view, greater attention being paid to principles than mere details of construction. This certainly makes the subject a more readable one, but it may lessen the value of the books to the artillerist. A few pages are devoted to projectiles and explosives, the references being brief and elementary. These subjects are, however, dealt with more thoroughly in the books on Interior and Exterior Ballistics already published in the series. Students will find these two volumes interesting and up to date.

The Rise and Progress of the British Explosives Industry. Published under the auspices of the VIIth. International Congress of Applied Chemistry by its Explosives Section. Whit'aker & Co., London and New York. Price 15s. net.

This work has been compiled by a publication sub-committee consisting of Captain T. G. Tulloch, late R.A. (*ex-officio*), Major Cooper-Key, late R.A., H. M. Chief Inspector of Explosives, Oscar Guttmann, M. Inst. C. E., F.I.C., and W. R. Hodgkinson, Ph. D., J.S., F.I.C., Ordnance College, Woolwich. They appointed Mr. E. A. Brayley Hodgetts as editor, and the following contributed special articles :—G. W. MacDonald, M. Sc., Henry de Mosenthal, F.I.C., F.C.S., E. Wyndham Hulme, B.A., Sir George J. Smith, Colonel J. R. J. Jocelyn, late R.A., Phillip Pain, Colonel Sir Hilaro W. W. Barlow, Bart., R.A., Sir Frederick L. Nathan., R.A., and Major J. H. Mansell, R.A. Special help is also acknowledged from Professor P. Philips Bedson, Mr. Herbert Blanch, Mr. J. W. Gordon, Mr. H. Rhys Jenkins, and Mr. E. H. Stone.

APPLICATIONS FOR PATENTS.

APRIL 19—MAY 15, 1909.

9,215. Projectiles. E. Kay and Cammell, Laird & Co., Ld.
9,233. Indicating Projectile Trajectory. S. D. Cushing.
9,252.* Automatic Discharge of Firearms. A. Müller.
9,375.* Capped Projectiles. A. J. Soden.
9,411. Targets. F. G. Skerritt.
9,466.* Gun Mountings. Rheinische Metallwaaren und Maschinenfabrik.
9,478.* Safety Device for Firearms. P. Mauser.
9,490. Automatic Target. R. F. A. Hobbs.
9,639. Ordnance. W. Beardmore & Co., Ld., A. Bremberg, and A. Banks.
9,653. Target. F. Snow.
9,663.* Projectiles for Balloons. Fried Krupp.
9,728. Ordnance Sighting Apparatus. W. Beardmore & Co., Ld., and A. Bremberg.
9,763. Safety Cartridge. A. Tolley.
9,837.* Gun Sights. J. Y. Bassell and F. C. Blenkner.
9,861.* Ordnance Loading Apparatus. Schneider et Cie.
9,887. Gun Shields. Sir R. A. Hadfield and A. G. M. Jack.
10,020. Ordnance. F. Wigley and R. Redpath.
10,072. Sight Attachments. H. W. Holland and W. Mansfield
10,166.* Barrel Running-out Guns. K. Haussner.
10,204. Sighting Device. T. Gilbert-Russell.
10,220. Projectile Fuses. F. Wigley and T. A. Petrie.
10,229. Rifle Sight. J. Webber.
10,279. Projectiles. A. Westmacott.
10,300. Testing the Aiming of Rifles. E. C. Atkinson.
10,303.* Automatic Gun Supports. Hotchkiss et Cie.
10,355. Projectiles. J. Jackson and W. E. Bullock.
10,395. Projectiles. Sir R. A. Hadfield and A. G. M. Jack.
10,436.* Projecting Apparatus for Firearms. R. H. Quisling.
10,494. Projectiles. F. M. Hale.
10,569.* Automatic Firearm. P. M. Menteyne and P. A. Degaille.
10,932.* Smallarms. H. Borchardt.
10,937. Projectiles. J. R. Hoyle and H. B. Strange.
11,028.* Ordnance Gun Carriages. J. A. Deport.
11,032. Projectile Fuses. A. Mallock and Armstong Whitworth and Co., Ld.
11,037.* Machine Guns. A. F. Swahn.
11,139. Ordnance Firing Gear. A. T. Dawson and G. T. Buckham.
11,179. Explosives. F. E. W. Bowen.
11,224.* Pistols. O. Paege and R. Becker.
11,252.* Tracing Flight of Projectiles. J. B. Semple.
11,286. Carbide Cartridges. A. Barnett.
11,334.* Rifle Backsight. J. Beveridge.
11,458.* Tracing Flight of Projectiles. J. B. Semple.
11,491. Targets. J. F. H. Templer.
11,561. Projectiles. F. M. Hale.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

APRIL 22—MAY 20, 1909.

COMPILED BY HENRY TARRANT.

6,942 (1908). **Armour Piercing Projectiles.** T. R. Hoyle, Ecclesall, and H. B. Strange, Brinkburn Grange. A suitably thin metal casing is provided to enclose any irregular formation between the head of the armour-piercing cap and the body of the projectile. The cap consists of metal massed about the point of the shell so that the maximum amount of metal in any section of the cap which is taken normal of the major axis of the projectile is to be found in the section lying adjacent to the point. Accepted March 29, 1909.

7,228 (1908). **Aiming Tubes for Rifles.** L. T. Graham and H. R. Latham, London. In order correctly to centre an aiming or supplementary tube in the worn bore of a rifle a coniform washer instead of the old flat form is employed. The thin end of this new washer is adapted to wedge into the rounded inside periphery of the muzzle of the rifle. Accepted April 1, 1909.

7,262 (1908). **Gun Sight Testing Apparatus.** Comdr. H. C. J. Grant, R.N., Bedford. An ordinary sighting telescope is set in the middle of an insertion piece in the breech of a gun and is employed in conjunction with a muzzle plate having a central aperture. The special arrangement to which this patent relates is one for adjusting the telescope so that its axis may be brought into coincidence with the axis of the gun. Accepted April 1, 1909.

7,585 (1908). **Blasting Fuses.** T. M. Daniels, U.S.A. To prevent accidents due to the insecurity and want of a waterproof nature of the fuses generally used in mines the metal cap is provided with slits so that a ring sliding over it may be used to fasten it on the cartridge. At the point of connection of fuse and cap a waterproof sleeve is applied. It covers the slits and is clamped tightly against the fuse. Accepted April 1, 1909.

7,820 (1908). **Cartridge Carrier.** F. R. Batchelder, U.S.A. The process of weaving the fabric of cartridge belts so as to adapt the pockets to the shape of the cartridge boxes or clips is covered by this patent. The expanding bottom of the pocket is woven integral with the belt and the wall of the pocket. Accepted April 8, 1909.

7,921 (1908). **Nitrate of Ammonia Explosive.** A. J. Boult, London (Agent for *A. La Motte, U.S.A.*). The addition of a metallic sulphide such as pyrites to a nitrate of ammonia explosive forms the subject of this patent. The

explosive consists of 7 parts of dinitronapthalene, 5 parts of trinitrotoluene and 88 parts of ammonia nitrate to which are added 2 parts of pyrites with or without copper content. The trinitrotoluene is first melted and to it is added the dinitronapthalene to make a homogeneous liquid. This liquid is added to the nitrate of ammonia and after thorough incorporation the mixture is allowed to harden. The pyrites are then admixed, and must be done in this way for any advantage to be derived. Accepted April 8, 1909.

8,346 (1908). **Gun Fire Control.** H. J. Crossfield, Erith. In electrical apparatus for use in the transmission and reception of impulses or signals from a distant sending station to a receiving station, the armature pole pieces and field magnets are arranged in order that stresses on the armature shaft may be eliminated. Accepted April 15, 1909.

8,432 (1908). **Target for Miniature Rifles.** W. H. Hardwick, Brooklands, Cheshire. A target of the steel faced character employed mostly in air gun shooting has a clockwork motor which operates to ring a bell for a predetermined time when a pellet passes through the bullseye hole and strikes the reciprocating plunger. Accepted April 15, 1909.

8,776 (1908). **Shrapnel Shell.** Dr. F. W. F. Schultz, Germany. The bursting charge of a shrapnel is divided to secure successive actions. The way from one chamber to another is opened by the first explosion which removes metallic parts not integral with the shell. Two or more explosion chambers may be utilized. Accepted April 22, 1909

8,990 (1908). **Blasting Cartridge Loading.** A. J. Boult, London. (Agent for *T. W. Bacchus, U.S.A.*). The machinery described in this patent is intended for the automatic loading of gelatine dynamite into cartridge shells and to fold the shells and form the complete cartridge. Accepted April 22, 1909.

9,644 (1908). **Intercepting Safety Sear for Gun Locks.** F. Leedale, London. (*See Selected Patents.*)

10,146 (1908). **Locking Clip for Bolt Rifles.** R. W. Glanville, Woolwich. A spring clip is attached to the bolt cover lug of the Lee-Enfield type of rifle so that when the rifle is closed the free end of the clip engages with the bolt retaining spring on the action body and prevents inadvertant opening of the bolt. Accepted April 1, 1909.

12,791 (1908). **Range Finders.** Professor G. Forbes, F.R.S., London. The stereoscopic range finder set out in this patent is an improved form of those dealt with in Specifications Nos. 5,267, 1901, 12,422, 1902, and 4,258, 1903. The object of the alterations is to secure better illumination, a larger field of view, to make the device dust and damp proof and to decrease the cost. Accepted April 29, 1909.

13,821 (1908). **Rifle Bullets.** G. Hookham and Kynoch, Ld., Birmingham. (*See Selected Patents.*)

13,890 (1908). **Waterproofing Blasting Cartridges.** A. Larsen, London. A bonnet of indiarubber is adapted to fit over the end of the cartridge. Its front end is contracted to afford a good grip on the cartridge and its rear is provided with a tube which serves to hold the electric wire or fuse. The tube is tied round the wire or fuse with string. Accepted April 8, 1909.

15,045 (1908). **Grenade for Rifles.** F. M. Hale, London. This Grenade is adapted to be propelled from the muzzle of an ordinary rifle. The rod at its rear end fits in the bore and suitable means are provided to hold the grenade after the discharge of the bulletless cartridge until sufficient gas pressure has been generated. Impact on striking leaves a hammer free to move relatively to the grenade and to detonate the charge. Accepted April 29, 1909.

18,520 (1908). **Feed Mechanism of Maxim Guns.** Vickers, Sons and Maxim, Ld., and G. T. Buckham, London. To prevent the inadvertent detachment or change in working position of the feed pawls when the slide is removed from the feed box the patentees arrange that, whilst they will still be readily detachable by the fingers, the pawls will remain held in their working position on the pivot pin. The attachment of the pawl spring is arranged also to enable it to be easily detached without tools. Accepted April 8, 1909.

19,714 (1908). **Locking Bolts for Sporting Guns.** C. Eyring, Germany. (*See Selected Patents.*)

20,214 (1908). **Perchlorate of Ammonia Explosive.** W. H. Palmer, Norway. (*See Selected Patents*).

20,238 (1908). **Bullet Catcher.** G. Clarke, Halesworth. Behind the target is a funnel-shaped receptacle leading to a box. At the back of the box is fitted a cone-shaped projection on to inclined sides of which the bullets impinge. They are directed towards the sides, top or bottom of the box and are, it is claimed, safely caught. Accepted April 15, 1909.

21,262 (1908). **Recoiling Barrel Ordnance.** Rheinische Metallwaaren, und Mf., Germany. In ordnance in which the pivot pin (about the axis of which the barrel is turned when the gun is trained) can be brought into a vertical plane parallel to the wheel axis, the pivot pin is adapted to turn about the wheel axis and can be adjusted as desired by an elevating mechanism. Errors arising from the inclination in the plane through the barrel at right angles to the wheel axis may be corrected by this arrangement. Accepted April 1, 1909.

24,228 (1908). **Cartridge Belts.** The Mills Equipment Co., Ld. A method of attaching cartridge carriers or braces to a belt or bandolier consists in forming or mounting on the belt open ended flat sheaths adapted to be engaged by the flat ends of c-shaped members attached to the cartridge carriers. Accepted April 22, 1909.

27,004 (1908). **Sighting of Ordnance.** Fried Krupp A.-G.,Germany. A sighting device involving the use of a cam is introduced to allow for the angle which corresponds to the lateral deflection of the projectiles. Drift for all targets lying on the muzzle horizon is automatically eliminated at all elevations. Accepted April 8, 1909.

27,388 (1908). **Sighting Apparatus for Ordnance.** F. Wigley, F. Duncan, and T. A. Petrie, London. Deflection apparatus for gun sights in which for any relative speed of ship and target the deflection arm is moved to give the correct deflection to the sight as the elevation varies, by means of a bell crank carried on the traversing deflection nut, one arm of which is secured to the deflection arm and the other to a pin carried in a pivoted block. The block is rotated about its pivot by a cam groove in the sight bracket. Accepted April 29, 1909.

28,306 (1908). **Locking Device for Percussion Fuses.** La Société Schneider and Cie, France. Flexible arms fixed at one end to the body of the fuse are in the normal position adapted to hold the block containing the priming. They are held in this position by a spring ring. When the projectile is fired the ring is released from the arms and the priming block is liberated. The arms are then locked behind the ring which is moved forward by its spring. Accepted April 22, 1909.

1,243 (1909). **Safety Device for Sporting Guns.** T. B. and A. B. Ward, Birmingham. This safety device is rendered inoperative by pressure on the butt plate. The movement of a pivoted part on the butt plate is communicated through a rod running through the stock to the bolt which holds the hammers in the locks by engaging notches in the hammer bases. Accepted April 1, 1909.

2,475 (1909). **Wheeled Gun Carriages.** Fried Krupp, A.-G., Germany. Means are provided for pressing the adjustable spade against the fixed spade when in the operative position. Accepted April 29, 1909.

SELECTED PATENTS.

PERCHLORATE OF AMMONIA EXPLOSIVE.

20,214 (1908).—W. H. Palmer, Norway. The patentee's aim has been to produce an explosive which will not explode prematurely under shocks or the action of heat or cold and which will not freeze. The danger of thawing is therefore avoided.

A mixture is made up consisting of 50% of perchlorate of ammonia, 14% of dinitrotoluol and 31% of nitrate of soda or its equivalent of nitrate of potash. With this is incorporated 5% of paraffin wax that will not melt under 120° Fah. This wax it is claimed holds the constituent parts in position, keeps the composition constant and serves to protect the explosive from effects of air and moisture.

The proportions of the ingredients may be varied. If a very quick explosive is required 70% of perchlorate of ammonia is

used to 13% of dinitrotoluol, 10% of nitrate of soda, and 7% paraffin wax. It is claimed that this compound may be made cheaply, is non-hygroscopic and does not freeze at even 80° below zero. Accepted April 22, 1909.

LOCKING BOLTS FOR SPORTING GUNS.

19,714 (1908). C. Eyring, Germany. An improved method of locking the double barrels of the break-down sporting type of gun is described in this patent. Besides the usual locking bolt which engages with a slot in the barrel lump, the patentee arranges a member sliding along the breech face, which turns two arc-shaped ended limbs into locking engagement with recesses formed in the barrel ends. The usual top-lever movement operates these locking parts.

A clearer idea of the invention will be gained by reading the short description following, and by referring to the patent drawings here reproduced. The slide or key *a* is moved from right to left by the usual movement of the top lever *b* when this is turned to open the gun. The key *a* is slotted, and each of the slots has the notches *c*, into which either one of the projections *d* on each barrel lock-piece enters according to the position of the key. The barrel-locking members *e*, which carry these projections, are, by this movement of the key and through the projection and notch engagement, turned through a quarter of a circle, as is illustrated in Fig. 3.

Fig. 1

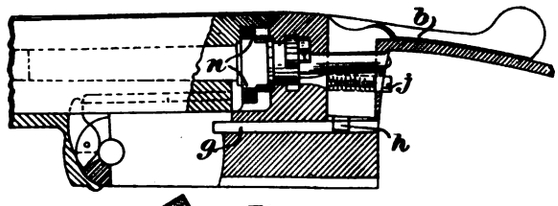


Fig. 2

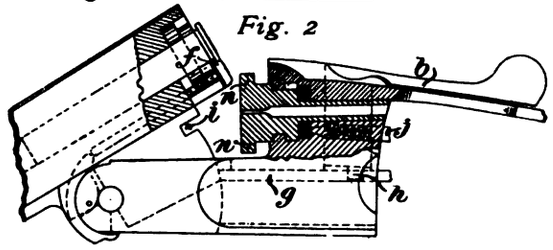
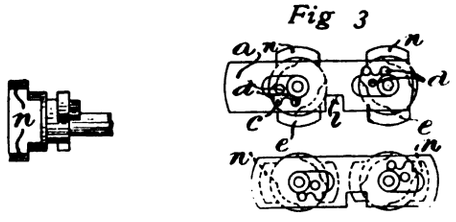


Fig 3



The unlocking movement turns the locking parts *e* into the vertical position and carries their arc-shaped ends *n* out of locking embrace with the recesses *f* provided for them in the barrel-face extensions (Figs. 1 and 2). At the same time as this series of movements is taking place, the locking-bolt *g* is drawn back in the usual way by the cam *h*, which is turned by the movement of the top lever. This disengages it from the slot *i* in the barrel lump, and it holds the locking members *e* in the inoperative position, because it is held in its backward position by the rear surface of the lump.

When the gun is closed the bolt *g* snaps into position and a spring forces the lever *b* home and so turns the barrel lockers *e* through the engagement of the pin *j* with the slot *l* in the key *a*. Accepted April 22, 1909.

INTERCEPTING SAFETY SEAR FOR GUN LOCKS.

9,644 (1908). F. Leedale, London. In order to prevent inadvertent firing of a gun with "box" or "side" lock action through jarring off or similar cause, the patentee introduces a modified form of intercepting limb which definitely locks the sear until the trigger is pulled. It consists of a bell-crank lever, one arm of which engages the sear tail and the other the trigger blade.

The device is illustrated in the drawings appended, and is shown in its application to different kinds of locks.

Fig 1

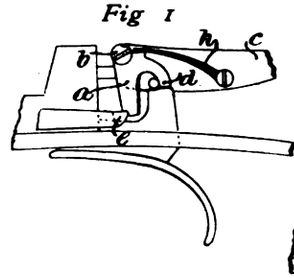


Fig. 2

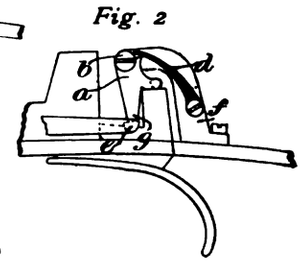
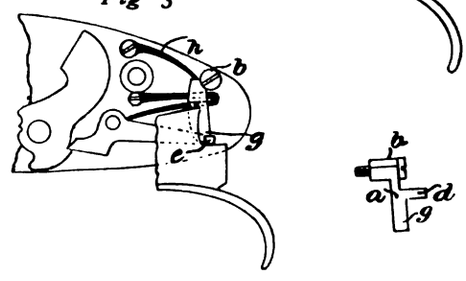


Fig 3

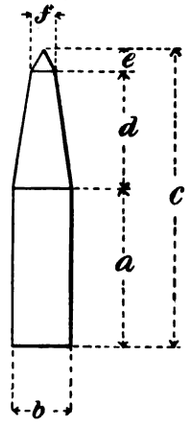


The arrangement as for a "box" or body lock gun is illustrated by Fig. 1. The lever *a* is pivoted at *b* to the end of the safety-bar *c*. One arm *d* lies in touch with the top of the trigger-blade, whilst the other *g* projects downwards into locking contact with the sear-tail *e*. In this case the interceptor does not come into operation until the ordinary "safety" is removed. It is obvious that the lever *a* must be rocked before the sear can be lifted to disengage the firing-hammer, and this can only take place when the trigger is pulled.

In Fig. 2 the lever *a* is shown as it would be attached to the fixing *f* rising from the trigger-plate, whilst in Fig. 3 the application to a side-lock is shown. In both these instances, when the gun is not cocked the lever-arm *g* lies in front of the sear tail. When the latter is cocked the sear tail drops and the spring *h* forces the arm *g* over the top of it. Accepted April 8, 1909.

RIFLE BULLETS.

13,821 (1908). G. Hookham, and Kynoch, Ld., Birmingham. The bullet described in this patent is of the kind used in high velocity small bore rifles, and it is so shaped as to receive comparatively little resistance from the air during flight. The shape has been arrived at after prolonged experiment.



The rear of the bullet may be parallel or slightly conical to suit the rifling of the weapon from which it is to be discharged whilst the forward part consists of two cones, one of which is truncated by the other, the latter being brought to a sharp point. The lengths of the rear or guiding part *a* and the conical parts have, within certain limits, a definite proportion one to another. The length *a* is from 2·1 to 4·6 times *b* and from ·29 to ·61 times *c*. The length *d* is from ·27 to ·23 times *c*, and the length *e* from ·08 to ·12 times *c*.

For the ·303 rifle the proportion preferred is: Length *a*, 2·4 times *b*. Length *d*, ·44 times *c*. Length *e*, ·09 times *c*, and length *c*, 4·8 times *b*. The diameter *f* is ·38 times *b*. The invention is not of course limited to these proportions. Different barrels and velocities naturally need variations. Accepted April 8, 1909.

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CURRENT TOPICS.

Live Pigeon Case.—The proceedings against Mr. Richmond Watson for various incidents of alleged cruelty, in connection with the shooting of live pigeons at the West London Shooting School, provide evidence that the Society for the Prevention of Cruelty to Animals continues its campaign against sport. At this stage admittedly a distinction is drawn between the entirely parallel sufferings of a domestic animal released from a trap for the purpose of shooting, and a game bird which can only be procured by the use of a gun. The principle of these institutions is undoubtedly to work towards the obvious ultimate goal by easy stages, and there can be no doubt that if pigeon shooting, coursing and sundry other sports, which depend on the release of birds or animals from traps or enclosures, were forbidden the next process would be to apply the same principle to game birds, stage by stage, beginning with the various well-known devices which are employed to circumvent the natural wildness of the quarry that is sought. There can, therefore, be only one attitude to adopt against those who wish to hamper the sports which turn around the killing of some particular creature. The reason why these sports prevail in an age where kindness to animals is carried to almost abnormal limits is that the hunting instinct is a law by itself with which other rules of life have not been allowed to interfere. Just in the same way that civilisation cannot exclude war, because force remains the backbone of argument, so sport must be allowed to endure, because it springs out of the instincts of human nature. The rules for the pursuit of game, and for the recovery of cripples, must be settled by exponents of sport, and not by theorists in humanity. It is most satisfactory to know that Mr. Watson won his case, but it is disappointing to those who have subscribed for so many years to the Field Sports Protection Association to discover that they were not on the spot to meet an organised attack with organised resistance.

The Solano Target Controversy.—It is a regrettable fact that a newspaper, so well informed generally on the subject of rifle shooting as the *Morning Post* can undoubtedly claim to be, should have committed itself editorially to a weak and ill-informed endorsement of the criticism of bulls-eye shooting as carried on at Bisley. The discussion centered around an inspection of the Solano target by a miniature rifle shooting organisation, and a report thereon to the National Rifle Association, which was accorded the status of an expert opinion. The opinion was unfavourable, and Mr. Solano took the matter up by way of correspondence, and displayed a dexterity in controversy superior, from a tactical point of view, to that displayed by Lord Cheylesmore, who expressed his views, without adequately protecting himself from smart repartee. The whole situation is extremely delicate, in that the Army Council is understood to be arguing with the N.R.A. on very much the same lines that the fox argued with the lamb concerning the clouding of the water in which both were drinking. The complaint alleged against the National Rifle Association is that bulls-eye shooting is not sufficiently practical to impart the right

kind of skill for military warfare. The N.R.A. consider that it is the best available, and they adopt a receptive attitude towards every improvement which comes their way. Now the War Office appear to think that the Solano target comes nearer the practical ideal. Models which have been exhibited have been pronounced expensive and ineffective by practically the whole of the rifle shooting world. Pitted against them in splendid isolation is the Army Council, which consists of various eminent gentlemen innocent of all knowledge of the rifle, and taking their opinions ready-made from the Hythe School of Musketry. Why Hythe opinions on rifle shooting are unsound is difficult to decide, but the fact remains that they do not know this side of their business, and that they are forcing things in a direction which will prove detrimental to the interests of the country. Against any great harm being done in the long run is the certainty that practical experience will expose the fallacies that underlie the present proposals. It is not so very long ago that all the service rifles were sent out with a considerable lateral error in the sighting. The mistake was at last brought home, someone retired, and someone else was appointed to take his place, and that was all that happened.

The Coming Bisley Meeting.—All the arrangements are now complete for holding the Jubilee Meeting of the National Rifle Association. In celebration of this auspicious event a dinner will be held at the Prince's Restaurant on the 8th inst., at which the Prince of Wales, president of the Association, will preside. With a view to the further marking of the occasion an official Jubilee Souvenir is in course of preparation. The book will contain a large number of illustrations and a variety of literary matter, all of an historical nature. The rifle meeting itself will not be marked by any features of particular interest, for the simple reason that on every occasion the top pitch of perfection is aimed at, so that the opportunities for further effort are somewhat restricted. A large sum of money devoted to special prizes might have attracted a larger and more assorted assemblage of shooters, but like all well-established concerns the National Rifle Association endeavour to make every advance of a permanent nature, so that each year may be better than the last by gradual progression. Great as one expected would be the changes in match rifle shooting the preliminary results have been most peculiar. For some unknown reason the ·280 cartridge, which undoubtedly possesses in its design claims to great excellence, has failed to come out just right. How it stands between the rifle and the cartridge has not been clearly ascertained, and it is becoming better and better known every day that theoretical properties are valueless unless everything else fits in just right, so as to give the supreme standard of accuracy required. Last year's rifles have done fairly well this year, but not so well as was expected, whilst new rifles and new cartridges, most of them representing an advance upon the old ballistics, have failed to oust the well-tried and still highly successful ·375–·303. Amongst service rifle shots great excitement prevails concerning the new aperture sights. In spite of every effort to ensure plenty of time for manufacture, shooters in hundreds are still clamouring for the factories to disgorge their output. The few that have been tried absolutely confirm the victory of the aperture near the eye over all other sighting devices. For the first time in military shooting the rifleman will be able to adjust his sights practically in odd inches on the target, and it is only regrettable that the same old cartridge prevents the full measure of the improvement from being apparent.

Pressure in Shot Guns.—Gunmakers are reported from time to time to be nervous in their corporate capacity of what they regard as the unnecessarily high pressures which the modern smokeless powder is in the habit of giving. The existence of a nitro proof provides evidence that pressures to-day are higher than they were in the days of black powder. The increase of metal around the breech also shows that the load put upon the gun is greater than it used to be. The question ceases to be so simple when an effort is made to trace the existence of the higher grades of pressure. The nitro proof originated as a consequence of the behaviour of a particular lot of cartridges not properly loaded with a condensed powder which is now not much heard of. To-day the powders are all of the bulk type, and whether they are of the 33-grain or the 42-grain class, all the makers profess to aim at a three-ton pressure, and increases in this value must be regarded as accidental. That increases do occur, and that their effect is frequently aggravated by unsuitable conditions of loading must be accepted as a fact which cannot be controverted. The gunmaker asserts that if a lower standard of pressure were adopted, the unavoidable variations would not cause excessive results. The powder maker on the other hand finds that nitro explosives cannot be regulated to give a low grade of pressure without passing the critical limit at which another kind of trouble is encountered, viz. the liability for partial combustion to occur. The many old guns in use by sportsmen constitute another difficulty, and the gunmaker, by acting as mouthpiece for complaints, himself exercises pressure on the powder maker, who, in turn, transmits that pressure to the powder. The subject is one which above all things requires properly understanding, and if gunmakers feel desirous of taking action they should commence by familiarising themselves with the facts. The powder maker would be glad to assist, especially if he could receive some kind of assurance that gunmakers would use their influence to diminish the unreasonable extremes of treatment to which powders are exposed in the loading, and nevertheless expected to perform up to a given standard.

The Gunmakers' Company.—Just at the moment of going to press a letter has been received from Mr. D. C. Lee, clerk of the Gunmakers ' Company, to the effect that at a Court meeting held on the 24th ult. Messrs. Edgar Harrison, H. Brandon White, E. J. Rigby, and F. W. Jones were elected members of the Court of Assistants, i.e., the Court. This long-delayed filling of vacancies with the very best type of candidate represents a peaceful victory for those who have urged that the executive functions of the London Proof House should receive precedence over those of a social nature.

THE LATE MR. THOMAS JOHNSTON.

On the first of last month, by the death of Mr. Thomas Johnston the explosives trade has lost one of its ablest organisers and directors. No one can allocate his exact share in all the movements and enterprises in which his name appeared. He was essentially one who was prepared at all times to sink individuality and personal fame so long as the scheme in hand could be successfully carried through. Such a nature naturally inspired confidence in others, receiving loyal support not only from his colleagues on the board, but from all the officials, great and small, of the companies in which he was interested. To attempt the biography of such a man would involve an endeavour to isolate his own personal acts and policy from the doings of

those with whom he was associated. His great popularity no doubt, arose from the full measure of praise and appreciation which he accorded to those who worked with him. Some of his greatest triumphs of organisation were achieved without his own name coming into prominence. The history of his life is thus the history of the immense organisation with which he was connected. That he must have been a man of considerable creative power is proved by the schemes which originated in his brain. He had, moreover, the practical gifts which enabled him to carry them all through. His enthusiasm was all the more convincing because caution and keen business perception allayed any misgivings which might arise. He revelled in detail, yet was capable of the broadest generalisation. Out of this finely balanced admixture of almost opposing attributes, was formed the master mind which could dream a dream, and then set to work to make it come true. Though he died at the comparatively early age of 58 his life's work had reached the stage of fruition. What more he could have accomplished no one of course can say, but that he accomplished so much in so short a time illustrates one of the marvels which the careers of great men so often present.

LECTURES TO YOUNG GUNMAKERS.

LVIII.—THE "DROP" OF RIFLE BULLETS.

An attempt will be made in the present lecture to establish a new basis for comparing small arm rifle bullets with one another. The drop of a rifle bullet is its deflection at any point from an absolutely flat trajectory. At short ranges the amount of drop is mainly dependent on velocity, whilst at longer ranges the characteristics of the bullet constitute an additional factor of considerable importance. Therefore, in order that the measured value of drop shall properly express the ranging properties of the bullet it is necessary that the measurement should be made at a distance which constitutes something approaching an extreme range from the point of view of practical rifle shooting. Such measurements can only be made by actual shooting with sights of which the true zero adjustment is known. The ascertainment of the zero sight adjustment of a rifle is a complex and not generally well-understood operation, and it is intended in the present lecture to suggest a way of minimising the difficulty of its accomplishment, and at the same time to introduce means for relating velocity and drop in a manner which may serve useful ends.

Briefly stated the idea consists in the building up of tables for translating measurements of velocity at specified distances into their exact equivalents in the form of the distance the bullet falls during its passage along the range considered. The full ventilation of the processes involved will clear up many of the difficulties which prevent the rifle shot from fully understanding the behaviour of his weapon. The amount of science involved is extremely small, and relates only to the effects of gravitational attraction. In one of the earliest lectures of this series, viz., the one appearing in December 1899, the inter-relation of gravity and foot-pounds energy was fully explained in reference to the ground work fact that a falling body is travelling at a velocity of 32·2 feet-per-second at the end of the first second, double that pace after two seconds, treble after three seconds, and so forth. There is no need now to repeat the chain of arguments by which it was made clear that the distance in feet a body has fallen equals 16·1 times the square of the time of falling in seconds. This is expressed mathematically as follows: $h = \frac{1}{2} g \times t^2$.

Where h = height, i.e., drop in feet.
g = gravity, $\frac{1}{2} g$ thus becoming 16·1, and
t = the time in seconds, or fractions of a second.

This formula makes it clear that the drop of the bullet at any range can be ascertained, provided its time of flight over that range is known. There is one particular distance over which the time of flight of every bullet is known, that is the distance over which its velocity is measured. Here then is the key which unlocks a door which has remained closed for much longer than was necessary. The standard range for the measurement of velocity of military bullets is 60 yards, otherwise 180 feet, and there is no doubt that the proper adjustment of rifle sights would be greatly facilitated if the initial shooting were conducted at the distance

over which velocity is taken. Zero elevation is then arrived at by allowing for the amount of drop corresponding with the observed velocity of the cartridge. An actual example will illustrate what is meant. A ·303 service rifle may be assumed to give an observed velocity of 2,000 f.s. over 180 feet. In travelling this distance the bullet drops 1·57in. Assuming that the foresight is exactly one inch above the axis of the bore, the sights of the rifle would have a zero adjustment when the average elevation of the shots was that of a horizontal line situated 2·57 inches below the bottom edge of the bull or other mark at which alignment was taken. Assuming that the shooter has access to the data necessary for computing the drop of the bullet at a particular distance, it is obvious that he possesses a far more exact means of arriving at zero elevation than could be achieved by testing the rifle at 10 yards, or some other very short distance, at which he assumes that the drop is so small that it may be ignored. The distance may soon be shortened to such an extent as to diminish the accuracy of the observations without, however, wholly eliminating the disturbing effect of the drop that still remains. It has long been recognised that the most accurate results are obtained by shooting a rifle at a recognised range distance like 200 yards, and treating the sight adjustment obtained as representing such and such an angle, the same being taken from whatever published figures are available. The adoption of the velocity-measuring distance is far more scientific than any kind of compromise, because the chronograph measures time by the descent of a falling weight; and the bullet, being also a falling weight, there is the most intimate connection between the two happenings.

At first sight the distance a bullet falls during a flight of 60 yards is an abstract notion seemingly of no practical importance. On the other hand drop is also the height above the object to be struck at which the barrel must be aligned to correct the curvature of the bullet's flight. A line can be marked on the target with reference to a group of shots to denote the level the bullets would have struck if gravity did not exist. In the example already considered this would be 2·57in. above the mean level of the 60 yards group wherever it might be, and no matter how it might diverge from the bull or other mark aimed at. By continuing the shooting at other distances, 100, 200 and 300 yards, other drop values could be obtained in reference to the zero line so established which would convey sufficient information to an intelligent man to enable him to fix the exact elevation of the sights to give true shooting at these distances. The conversion of target measurements into markings on the sights is a simple enough operation which is based upon the rule that heights on the target bear the same proportion to heights on the backsight that the range bears to the distance separating the two sights. The arithmetic of the subject is explained in detail in the interesting little booklet which the B.S.A. Company have recently issued The chain of arguments, which has now been completed, goes to show that when observed velocity is a known quantity, or at any rate easily ascertainable, the corresponding value of drop can be deduced therefrom, and the resulting figure can be employed in a variety of ways for interpreting practical target shooting results.

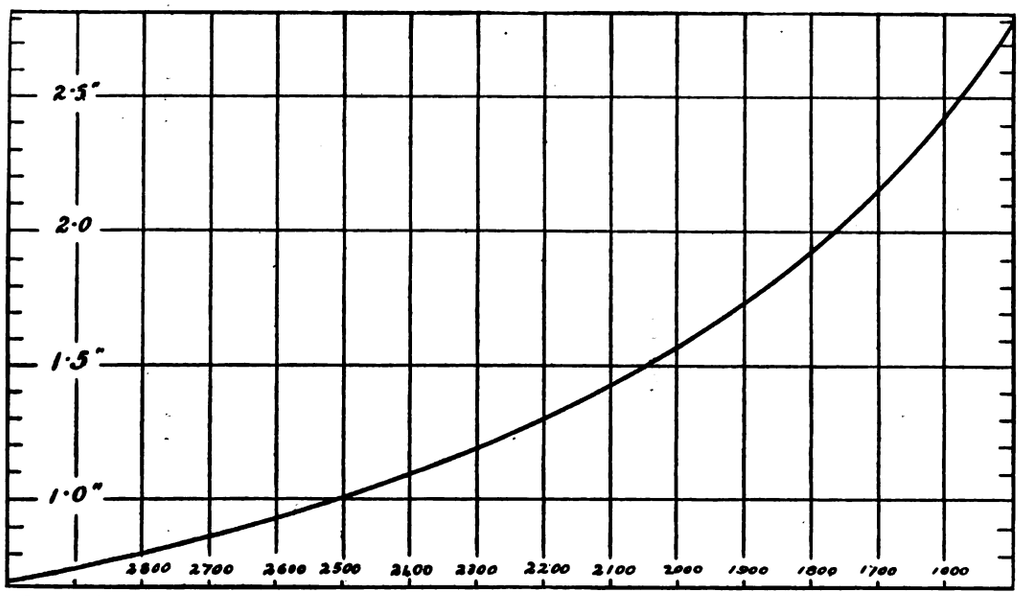
The point now to be elucidated is the readiest means for converting velocity first into time, and then into drop. Following out the school-boy method of reasoning simple proportion sums:—If a bullet travels 2,000 feet in one second it moves one foot in the two-thousandth part of a second; therefore it moves 180 feet in 180 2,000ths of a second. This gives us the rule that the time of flight over any distance is the number of feet in that distance divided by the velocity in feet per second. The drop, as explained above, is 16·1 times the square of this time. The answer comes out in feet, which can be converted into inches by simple multiplication. Since twelve time 16·1 equals 193·2, the drop in inches becomes the square of the time of flight multiplied by this figure.

A busy man dislikes few things more than to be constantly interrupted in his work to revive forgotten processes of arithmetic, in order to calculate necessary values relating to his work. Far the better plan is to do a job once and for all on co-operative principles by reducing it to a curve or table which will be at all times instantly ready for reference, and capable of giving a sufficiently accurate answer without the need for detailed calculation. Arithmetical errors are completely eliminated by the system of setting out values in the form of a curve. What is meant will at once be illustrated by tabulating a series of velocity values from 1,500 to 3,000 f.s., and converting them by three simple and visible stages into drop values. These can then be transferred to squared paper, from which can be read off a sufficiently detailed series of values to afford the practical man the whole of the information he may hereafter require. The foundation table, which is now given in a self-explanatory form, needs no further introduction:—

TABLE I.—*Process of Converting Observed Velocity over 60 yards into Bullet Drop.*

60 yard Velocity ...	f.s. 1500	f.s. 1600	f.s. 1700	f.s. 1800	f.s. 1900	f.s. 2000	f.s 2100	f.s. 2200
Time in seconds $\frac{180}{v}$	·1200	·1125	·1058	·1000	·0946	·0900	·0857	·0818
Time squared ...	·01440	·01260	·01119	·0100	·00895	·00810	·00734	·00669
Drop in inches = $time^2 \times 193{\cdot}2$	2·78	2·44	2·16	1·93	1·74	1·57	1·42	1·29
	f.s.	f.s.	f.s.	f.s.	f.s.	f.s.	f.s.	f.s.
Velocity	2300	2400	2500	2600	2700	2800	2900	3000
Time	·0783	·0750	·0720	·0692	·0666	·0643	·0621	·0600
Time squared ...	·00613	·00563	·00518	·00479	·00444	·00413	·00386	·00360
Drop	1·18	1·09	1·00	·93	·86	·79	·74	·70

It will be seen that certain values of drop have been arrived at in the manner described, and they have been plotted out in the form of a curve, from which the accompanying reproduction has been prepared. Having gone so far, it will be useful to establish finer divisions than 100 f.s. intervals provide. Accordingly a fresh table has been prepared which is wholly taken from the curve. The drop is given for graduations representing 20 f.s. intervals of velocity. It should be understood that the values are only appropriate for velocities measured over 60 yards. They would be approximate and comparative for observations



Curve showing the relation between observed velocity over 60 yards and the Drop of the Bullet.

taken at other distances, but their essential characteristic is that they are accurate and absolute for the conditions specified :—

TABLE II.—*Observed velocity over 60 yards (=180 feet) and corresponding bullet drop over that distance.*

f.s.	in.	f.s.	in.	f.s.	in.
1500	= 2·78	**2000**	= 1·57	**2500**	= 1·00
20	= 2·71	**20**	= 1·54	**20**	= 0·99
40	= 2·65	**40**	= 1·51	**40**	= 0·97
60	= 2·58	**60**	= 1·48	**60**	= 0·95
80	= 2·52	**80**	= 1·45	**80**	= 0·94
1600	= 2·45	**2100**	= 1·42	**2600**	= 0·92
20	= 2·39	**20**	= 1·40	**20**	= 0·91
40	= 2·33	**40**	= 1·37	**40**	= 0·89
60	= 2·27	**60**	= 1·35	**60**	= 0·88
80	= 2·22	**80**	= 1·32	**60**	= 0·87
1700	= 2·16	**2200**	= 1·29	**2700**	= 0·85
20	= 2·11	**20**	= 1·27	**20**	= 0·84
40	= 2·07	**40**	= 1·25	**40**	= 0·83
60	= 2·02	**60**	= 1·23	**60**	= 0·82
80	= 1·98	**80**	= 1·20	**80**	= 0·81
1800	= 1·93	**2300**	= 1·18	**2800**	= 0·79
20	= 1·89	**20**	= 1·16	**20**	= 0·78
40	= 1·85	**40**	= 1·15	**40**	= 0·77
60	= 1·81	**60**	= 1·13	**60**	= 0·76
80	= 1·77	**80**	= 1·11	**80**	= 0·75
1900	= 1·74	**2400**	= 1·09	**2900**	= 0·74
20	= 1·70	**20**	= 1·07	**20**	= 0·73
40	= 1·66	**40**	= 1·05	**40**	= 0·73
60	= 1·63	**60**	= 1·03	**60**	= 0·72
80	= 1·60	**60**	= 1·02	**60**	= 0·71
				3000	= 0·70

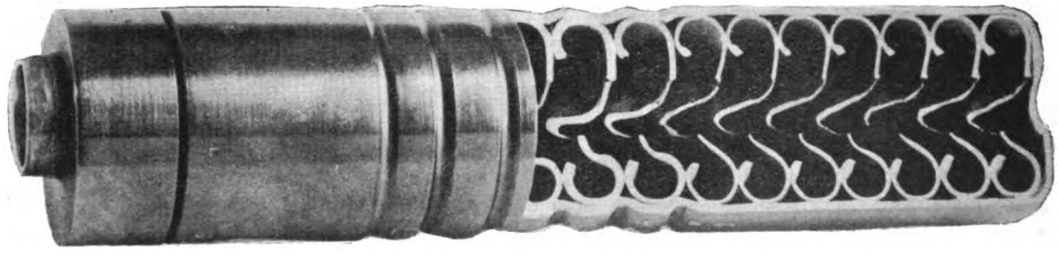
Further developments of the same idea can be carried out with reference to miniature cartridges. Low velocity bullets of this nature are generally tested over a much shorter distance than 60 yards, but from the point of view of drop a 50 yards test would give extremely useful results. The range is one which shooters well understand, and the measuring power of the Holden chronograph is capable of dealing with all bullets flying faster than the ordinary ·22 short cartridge. The derivation of 50 yards drop from velocity tests of miniature ammunition represents a subject by itself, and one which will be dealt with when the opportunity arises.

The championship meeting of the Clay Bird Shooting Association took place on the three days ending the 26th ult. on the new grounds of the Middlesex Gun Club at Hendon. The extraordinarily bad weather which marred last year's shooting for the Olympic medals at Uxendon was repeated in the form of torrential downpours on the Thursday and Friday, fortunately, however, with better conditions on the Saturday. The championship competition produced a tie between that wonderful veteran, Mr. W. Ellicott, and Mr. Mander, showing that clay bird shooting goes by form and not by luck.

From the *Journal of the United States Artillery* :—" With our present rifle we have all danger space, for infantry, up to 600 yards. The battle sight is set at 530 yards. It is set 70 yards within the limit of the extreme range giving all danger space. This is done so as to counteract in some degree the tendency of men when excited and fatigued, to shoot high. Beyond this distance it is necessary to have the proper range in order to do accurate shooting, or anything approaching it. Even with the very flat trajectory of our rifle, the bullet flies 14·5 feet above the line of sight, and gives only 39·6 yards danger space at 1,000 yards. At 2,000 yards the bullet flies 131 feet high and gives 8 yards danger space. At 2,850 yards, the extreme range for which the rifle is sighted, the bullet flies 390 feet high and gives a danger space of only 3 yards. Hence the proper range is still a very important factor in accurate shooting." The essence of the extract is that the Americans are seriously tackling the problem of relating marksmanship to battle conditions from the jumping-off point of a modern rifle and cartridge having the flattest trajectory for the moment available.

REPORT SILENCER FOR FIREARMS.

THERE can be no question that a technical achievement of the greatest possible importance is presented by Mr. Hiram Percy Maxim's device for destroying the sound produced by the discharge of firearms. Evidence has never been wanting that the sound of discharge is the result of the extremely violent outburst of gas which follows the departure of the bullet from the muzzle. Various kinds of gun have been made thicker at the muzzle as a protection against the destructive effects of gas blast, whilst those who have studied recoil have found it necessary to attribute roughly one-third of the total back kick of the gun to the violent escape of the gas, but the effect on the ear is the most eloquent testimony to the violence of the manifestation which Mr. Maxim has set himself to tame. That he has succeeded beyond all possibility of doubt in respect to rifles of various kinds has been demonstrated within the past week or two.



The accompanying illustration shows sufficiently clearly that the arrangement consists of a cylindrical chamber, attachable to the muzzle of the rifle, which is divided into a series of peculiarly formed cells capable of destroying the activity of the pent up gases and delivering them into the air at a velocity so far diminished as to render them incapable of initiating a sound wave. Though all these things were fully attested in the American accounts which reported the first tests of the invention, the idea itself was so revolutionary that cautious people on this side determined to await first-hand information. The result is at once convincing and perplexing. The noise due to the gas blast undoubtedly disappears with the use of the apparatus; and shooting is thereby robbed of what has been its most unpleasant feature since smoke and recoil were brought within reasonable bounds by the introduction of smokeless powder and light-weight projectiles. The perplexing aspect of the situation is the curious circumstance that there are various noises of a more or less intense character which remain after the gas report has been eliminated. The bullet, in cases where its velocity is greater than that of sound, makes an extremely sharp report in cutting a path through the air. The sudden impact of the sound wave is analagous to the disturbance of water which takes place when the wave of a steamer, trailing away V-shaped in the distance, strikes a small boat with precipitous violence. Not only is the sound wave to be regarded as something which is travelling ever outwards from the path of the bullet, but also as something which is reflected from every object which it meets, thereby producing varying degrees of noise, the origin of which is only apparent upon consideration. The greatest degree of silence necessarily occurs when firing is conducted vertically into the air. Then the complete absence of muzzle report is fully proved. When firing in other directions, and especially against targets or butts with large sound-reflecting surfaces, other noises are apparent. Every arch of an aqueduct sends back its own particular echo. A row of trees, in fact every obstacle that turns back the sound wave, produces its own air disturbance, and the effects vary considerably according to the nature of the country and the situation of the observer. The impact of the bullet striking a mound is far more noisy than the ordinary ear has been accustomed to realise, though this fact is, no doubt, well understood by the markers in a rifle butt, who, by their situation naturally hear only the impact, undisturbed by the sound of report.

From the point of view of shock to the ears the noises which come from the bullet occupy an entirely different footing from those which are associated with the gas blast from the muzzle. Moreover from a military and game shooting point of view, shooting loses its direction to the person or animal aimed at, the moment the sound of discharge has been muffled. Hence there are utilitarian aspects about the new arrangement which will ensure for it the most careful examination by all users of rifled arms. The vista of possibilities extends in so many directions as to make it difficult to estimate the full importance of the discovery which has been made. Qualifications and doubts may arise here and there, but these will no doubt be looked into in the near future. Meantime the general instinct of caution need not debar anyone from remarking upon the extremely promising outlook which the Maxim contrivance presents. The conditions of the shot gun are so different from those which occur with the rifle as to make it unwise to argue from one to the other, but sufficient unto the day is the knowledge that the noise incidental to the discharge of rifles is preventable by an arrangement that gives every promise of proving to be practical. Mr. Hart O. Berg is making the business arrangements connected with the invention, and the formation of a small company is understood to be well in hand. The general idea seems to be to organise as quickly as possible means for the supply of silencers to individual shooters, and to develop from small beginnings as large a trade as the merits of the invention may be capable of creating.

ROUND THE TRADE.

From Messrs. Kynoch, Ld., has been received a copy of their catalogue for the coming 1909–10 shooting season. The ·22 rifle cartridge receives exceptional notice, whilst proprietary sporting cartridges receive the usual special prominence due to coloured illustrations.

Henrite Explosives Ld. have forwarded a copy of their 1909–1910 price list of cartridges and powder. The powder as issued to gunmakers is standardised for loading into English-made cartridge cases primed with a medium cap.

The Cotton Powder Co., Ld. report a very satisfactory improvement on last year's accounts, when a small adverse balance was reported. The distribution now recommended is at the rate of ten per cent., just double that of a year ago.

An explosion occurred at the West Calder black powder factory of Messrs. Curtis's and Harvey on the 15th ult., and involved three out of the six incorporating mills, of which the works are composed. No injury was caused to any of the workers.

Mr. Axel Larsen was recently granted the appointment of explosives expert to the Geological Survey Department of the United States Government. His special duty is to assist in connection with the initiation of safety explosives into the coal mining practice of America. A man of many-sided accomplishments Mr. Larsen's latest achievement was the designing of the most striking and artistic frontispiece of the volume recording *The Rise and Progress of the British Explosives Industry*, which was noticed in last month's issue of this journal. Mr. Larsen has already left England to take up the new duties for which his knowledge and past experience specially fit him.

The report and balance sheet of Messrs. Kynoch, Ld. shows a profit on the year ended the 27th of March last of £50,072. The directors' fees absorb £5,000, debenture interest £20,000, and preference dividend at five per cent., free of income tax, makes a total distribution of £49,000. The carry forward is thereby increased from £19,679 to £20,751. Quoting from the report :—"The directors congratulate the shareholders upon the improvement in the Company's earnings for the year, and have every reason to believe that that improvement will be maintained and increased. The directors have pleasure in announcing that the first unit of the Company's new factory in South Africa was completed early this year, and regular deliveries of explosives have since been made to the mines. The orders are, however, considerably in excess of the present productive powers of the factory, and, accordingly, a second unit is now in course of construction, and this will be followed by a third unit. Certain paragraphs which have appeared in the local newspapers have apparently created an impression that it is the Company's intention to immediately embark upon other industries in South Africa. The Board, however, wish to state that such is not their intention. On the contrary, no new industries will be undertaken until the factory near Durban is equal to every demand that can be made on its resources. Thereafter, encouraged by the union of all the Colonies which may now be regarded as an accomplished fact, the Board will look forward to a similar enterprise in each of the other States, the size and nature of which, however, will be governed by the demand existing in the various States, and the advantages that may be offered to the Company for the initiation of such undertakings." In the balance sheet the only changes of any moment compared with a year ago are the increase of creditors from £205,922 to £372,670, and additions to capital, as passed by the directors, including expenditure on the new factory in South Africa, £161,380.

English arms and ammunition manufacturers are at the present moment keenly interesting themselves in Servian national questions. The re-arrangement of political forces in that part of the world has made England the probable supplier of Servia's future requirements in war munitions. Various questions are closely effected by the success or otherwise which will attend the floating of a loan.

A correspondent writes :—"The Government of Austria-Hungary has just removed the interdict dated October 21st last, which forbade, the export from, and transit through, that Country of arms and ammunition intended for Servia and Montenegro. The Ottoman Government has also in its turn signified that it will allow munitions of war to pass through Salonica on their way to Servia."

The death is announced from Gloucester of the well-known gunmaker, Mr. F. S. Fletcher, at the age of 55 years. The second initial stands for Shakespeare in commemoration of the fact that his mother, the late Mrs. Elizabeth Fletcher, was a descendant of Shakespeare's sister Joan, who married a man named Hart. This couple were the only transmitters to posterity of Shakespeare's blood and lineage. He had been in indifferent health for over a year. He was the youngest son of the late Mr. Thomas Fletcher, whose widow carried on the old-established gunmaking business until her death in 1890, when the son succeeded to full control of the business.

Monsieur G. Vander Haeghen, editor of the *Journal des Brevets*, has written a most interesting paper-cover book dealing with the various systems of automatic pistol which have been introduced from time to time. As may be anticipated the author approaches his subject mainly from the point of view of the patent description, and his illustrations clearly originate from the same source. They are thus extremely clear in their depiction of successive stages in the automatic operations which follow the discharge of one cartridge and continue until its successor is safely lodged in the chamber ready for the next discharge. The literary description aims at classifying the different systems of mechanism, and the author's deductions and comparisons are extremely useful in enabling the reader, provided of course, he is familiar with French, to appreciate the outstanding characteristics of each of the various weapons which have have now, or have in the past enjoyed, some kind of vogue.

The report and accounts of the New Explosives Co., Ld. show a profit for last year of £4,050, after payment of directors' fees, office and other charges, repairs and maintenance (£5,204), and debenture interest. It is proposed to pay a dividend of 4½ per cent., free of income tax, which will absorb £3,645. The sum carried forward thus becomes £1,215 as against £810 from last year. The report states that the expenditure upon property and plant during the year has been unusually heavy, but it has enabled the Company to extend its operations, and to deal economically with an increased output in both the cordite and guncotton departments. The sales of blasting explosives showed an improvement as compared with the previous year, but prices in some markets have been greatly reduced by competition. The sporting powder department made a satisfactory advance, and the current year shows, so far, further improvement. In addition to the Company's special brands, Neonite, Red Star and Felixite, they are supplying several sporting powders which, while still retaining a high standard of quality, can be sold at prices which meet the competition from lower priced cartridges. The directors deeply regret that, owing to continued ill-health, Major-General Sir F. Maurice has resigned his seat on the Board, which he has held for the last five years. The report announces that Mr. A. R. Berry has been appointed secretary to the Company, having previously acted as assistant to Mr. Duff Grant, who duplicated the roles of General Manager and Secretary.

The Mitchellite Explosives Co., Ld. is the name of a private company formed with a capital of £10,000 to manufacture explosives.

Notice has been received from the Japanese Explosives Co., Ld. that their offices have been moved from 41 and 42 Parliament Street to 38 and 39 in the same thoroughfare.

The Chemical Congress was brought to a successful conclusion at the beginning of last month, and everyone agreed that Mr. Macnab's honorary secretaryship of the Congress had been crowned with the success which his unstinted efforts had so fully earned. The work done by the explosives section will be recorded in due course in the form of proceedings.

Major T. H. Crozier has issued a report dealing with the explosion which occurred at the Cotton Powder Company's factory on the 1st of April last, by which a girl engaged in filling detonators lost her life. The only possible explanation is apparently the impact of one of the measuring plates on a piece of apparatus known as a jig. Having in view the fact that this operation has been carried on in the same manner for nearly 30 years, and that this is the first accident which has occurred at this factory during the filling of detonators, no blame is imputed to the Company. It has, however, been arranged that certain additional precautions shall be observed in the future.

The local proceedings, in connection with the application for a licence by Nitro-Compounds Ld. for the manufacture of explosives at Wivenhoe, near Colchester, took place at the Lexdon and Winstree sessions before a full bench of magistrates. Witnesses were examined at great length in the endeavour to ascertain who in reality was at the back of the scheme, and what financial security existed for the company carrying out its obligations and undertakings. It seems that the Company has a total capital of £100, of which £17 has been subscribed. Mr. David Paisley, who is connected with the Company, gave evidence concerning the factory which it was proposed to build. The bench decided to refuse the application on the ground that there was no evidence whatever that the Company was backed up by any men of substance or capacity. Notice was given by the applicants that an appeal would be made to the Home Office.

Copies of the fourth issue of Curtis's & Harvey's *Shooter's Year Book* have been received during the past month, and although weight has been reduced nearly ten per cent. with a corresponding improvement in handiness for waistcoat pocket use, the amount of matter and the number of pages remain unchanged. The slightly finer quality of paper used gives better printing results, and will help confirm the reputation, which this book is gradually gaining, of being the handiest pocket diary for the gunmaker and sportsman to carry. Some of the shooting statistics are of exceptional interest in that they take account of the most recent changes. Reference is particularly made to the acceptance in the pattern tables of 50 per cent. as the equivalent for improved cylinder pattern, 60 per cent. for a half choke, and 70 per cent. for full choke. These easily remembered figures, viz., the proportion of the total pellets in the charge which find their way into the 30-inch circle at 40 yards, will do much to facilitate the appreciation of pattern tests, and to destroy the absurd bogey that a gun gave one sort of pattern with one size of shot, and another sort, perhaps 15 per cent. different, with the next adjoining size. Another change is the aodption of 272 pellets per ounce for size No. 6 of shot. Reasons in favour of this change were fully explained in last month's article dealing with Eley's arrangements for shot manufacture. Other portions of the diary contain small changes of detail, all tending in the direction of further improving its reference value.

The next sale of guns and rifles will take place at Debenham's rooms on the 9th inst.

The offer of the business carried on by the late Mr. W. J. Jeffery by public auction did not produce any bid materially higher than the estimated value of the stock, viz. about £8,000. The reserve price not having been reached the business was withdrawn from sale.

Mr. Alexander Martin, of 20 Exchange Square, Glasgow, has sent a copy of his catalogue of riflemen's sundries and requirements. The list adequately reflects the remarkable changes which have taken place during recent years in the sights which are allowed to be used at Bisley.

A correspondent writes :—" The Cuban Government has authorised a firm employed in the manufacture of arms at Havana to establish a dynamite factory in Cuba. This is an entirely new departure, as up till the present, all the dynamite used in the country has had to be imported."

The ready reckoner shot table, published in last month's lectures to young gunmakers, has fully justified the anticipation that it would prove most useful in settling most of the moot questions of cartridge loading. For the convenience of firms interested, and obviously not with the idea of profit making, 100 reprints of the table are under preparation. They will be mounted on white cards measuring 10½ins. by 8ins. The price has been fixed at 6d. each, but two will be sent, post free, for this sum in respect to all applications received during the present month. They are intended for hanging up in the loading shop or for reference in the front premises of gunmakers' establishments. Facility in the use of the tables can be rapidly acquired without the need to understand the principle upon which they are based.

A correspondent writes :—" Owing to the recent Revolution in Turkey, restrictions have been placed upon the importation or possession of revolvers, and these restrictions will probably remain in force for two or three months. Revolvers of which the barrel is more than 15 centimetres (6in.) in length, must not be imported, and will be confiscated if found in the possession of private persons. Dealers are only allowed to sell such weapons to persons producing an order from the Government. There is a good opening for sporting guns in Turkey. About 90 % of all the sporting guns sold in Constantinople are of Belgian and German manufacture. The greater part of these guns are very cheap. In first-grade guns England does most of the trade. Although no duty is levied on them, there is very little business done in cartridges, as the Turkish sportsman prefers to charge these for himself."

The British Olympic Council have issued their official report of last year's Olympiad in the form of a handsome volume containing large numbers of extremely interesting illustrations of successful competitors. The shooting section contains the whole of the scores made with rifles and pistols at Bisley, and also of the clay bird shooting contests at Uxendon. The literary matter is almost entirely confined to reproductions of the observations of our contemporary *The Field*, when reporting the meetings. In some respects the tone adopted is decidedly critical, from which good may result if an effort is made to decide more precisely the lines upon which international contests should be conducted, rather than allow each nation to adopt local conditions to the confusion of the foreign competitor. Shooting contests are especially influenced by rules and regulations, and it would certainly be a good thing if some kind of international average could be struck, so as to ensure a thorough test under equal conditions for all competing nations, with the certainty beforehand that the test will be sufficiently thorough to prevent the snatching of chance victories.

CAPE COLONY EXPLOSIVES REPORT.

Mr. Jervis E. Foakes, chief inspector of explosives, in his report for last year summarises the importations during that period as follows :—

	Total Quantity.		Total Value.	
	1907.	1908.	1907.	1908.
Dynamite, Blasting Compounds and Powder	lbs. 4,053,190	lbs. 4,374,050	£ 133,801	£ 149,039
Gunpowder	51,658	41,602	4,807	4,437
Nitro-Cotton	196,146	237,449	13,689	16,620
Fuse and Detonators .	—	—	26,215	23,509

The trade is chiefly divided between the United Kingdom, Germany and Norway, our own country taking 59 per cent., Germany 34 per cent., and Norway 5·3 per cent. Belgium comes in with 1·6 per cent., and the sundry odd consignments from other countries are of no serious value. The total increase during the year is £15,075, an addition which has occurred chiefly at Port Elizabeth and Cape Town. At the former port it is due to the increased importation of blasting explosives, at the latter to nitro-cotton, wholly supplied from Germany. Blasting gelatine is the principal explosive imported ; the consumption of dynamite is decreasing very rapidly, whilst gelatine dynamite is also giving way before its more popular rival. The increase of explosives imported into the Colony from European factories will, according to Mr. Foakes. probably not be maintained. The loss will occur mainly at Port Elizabeth, the port through which Messrs. Kynoch have until recently passed all their explosives. That firm having now erected a factory at Durban, all their explosives will be manufactured in South Africa instead of being imported from England. Last year they imported upwards of 45,000 cases, so the loss to the port will be considerable. With regard to the other firms at Port Elizabeth, Messrs. Nahnsen's agents have stated that they expect a substantial increase in their detonator trade.

On the subject of railway regulations it is mentioned that the control of the Harbour Boards in Cape Colony will be taken over by the Cape Government Railways at the close of the year. It has therefore been found necessary to combine the port regulations with those of the railway. It is intended, when the opportunity presents itself, to adopt the same procedure in regard to East London and the other ports.

The output of the Cape Explosives Works at Somerset West during last year represents an increase of 18,389 cases, which shows that the previous rise of 37,000 cases has been more than maintained :—

Dynamite	64,212 cases
Blasting Gelatine	183,682 ,,
Gelignite	94,717 ,,
Gelatine Dynamite	500 ,,
Total	343,111 ,,

On the subject of the influence exercised on the heat test by local conditions Mr. Foakes mentions that some experiments have been made in this direction. He refers to the known effect of ozone acting on the paper and producing a coloured band, similar to that given by a defective explosive, in consequence of which certain precautions are necessary. Mr. Foakes reports that if a paper prepared for the heat test be placed in a pine wood discolouration will take place in less than ten minutes, while one placed in the open in the same locality will remain unaltered.

ABEL ON GUNCOTTON (1866).
PART II.

BY GEORGE W. MACDONALD, M.Sc., F.C.S.

Determination of the carbon, hydrogen, and nitrogen contained in guncotton.—The difficulties which attend the application of the ordinary analytical methods to determining the composition of so highly explosive a substance as pyroxylin, need scarcely be dwelt upon. Several special methods of proceeding have been pointed out by different experimenters ; and others have been elaborated in the course of these researches ; but even the most simple and perfect require great care and some experience in their employment, for the attainment of trustworthy results. The following is a brief account of the most successful methods tried for determining the carbon, hydrogen, and nitrogen, and of the results which each has furnished. In the majority of instances the specimens of guncotton analysed were ordinary products of manufacture. The material operated upon was always purified as far as possible by repeated digestion and washing, from matters soluble in ether and alcohol ; and, in calculating the results, allowance was made for the mineral constituents of the guncotton operated upon.

Carbon determinations. Method 1.—The guncotton yarn was cut into small pieces, dried, and the fragments introduced singly into a very long combustion-tube, each portion being separated from the next by about 5 c.m. of copper oxide. When the tube had received the entire quantity to be burned, about 15 c.m. of the anterior portion were filled with copper oxide and the remainder (about 20 c.m.) with porous fragments of reduced copper. The potash apparatus, used for absorbing carbonic acid, had a small calcium chloride tube attached to it, which was weighed together with the apparatus, before and after the combustion. Although the greatest care was taken to proceed as slowly as possible with the heating of those portions of the tube containing the guncotton, the successful completion of the operation was a matter of great uncertainty, as the explosive combustion of some small portion of the guncotton would very frequently throw the surrounding copper oxide forward, thus closing the necessary passage in the front part of the tube. This method was therefore abandoned after about two dozen experiments had been made, of which only four were brought to a satisfactory termination.

The mean result of four samples was 24·02 per cent. of carbon.

Method 2.—The weighed substance was saturated with distilled water, and the latter removed as far as possible by pressure. The moist yarn was then cut into eight or ten

pieces and introduced separately into one end of a long combustion tube open at both extremities, and divided in the centre by a plug of asbestos. The shorter portion of the tube contained only the fragments of guncotton placed at a distance of about 12 mm. from each other; the longer portion was previously filled with long layers of copper oxide, oxidised copper turnings and porous reduced copper. This part of the tube was connected with a desiccating apparatus, to which were attached the potash bulbs with the small weighed calcium chloride tube, fixed on to the outer limb. The extremity of that part of the combustion tube which contained the guncotton was connected with an arrangement for passing an easily regulated current of pure dry air through the apparatus. The two portions of the tube were separated in the furnace by a screen. When the front part of the tube had been raised to a full red heat (at which it was maintained throughout the operation), the pieces of guncotton were consecutively made to undergo slow combustion, the portion nearest the asbestos plug being first heated, and the resulting gases and aqueous vapours being carried forward by the slow current of air continuously passed through the apparatus. This passage of air served to oxidise minute portions of carbon separated from the guncotton, when the whole tube was raised to a red heat at the close of the operation. The proportion of the reduced copper employed was so regulated, that a considerable quantity remained unoxidised at the conclusion of the experiment. Great care was required in the application of heat to the parts of the tube containing the moist guncotton, there being otherwise considerable risk of its fracture by the water expelled from the heated substance. The quantities of material operated upon ranged from 0·2634 grm. to 0·4115 grm.

The mean of four determinations on different samples of guncotton manufactured in 1863 was 24·42 per cent of carbon.

Method 3.—A weighed quantity of guncotton, moistened as in the preceding experiments, was placed in a capacious strong Bohemian glass tube, sealed at one end; a small quantity of copper oxide was introduced into the tube just in front of the guncotton. The other extremity of the tube was now constricted, and was sealed when the air in the tube had been exhausted. Heat was then carefully applied to the sealed tube until the guncotton had undergone slow combustion, and the oxide of copper was afterwards shaken to that part of the tube where a minute carbonaceous deposit had been left by the guncotton. The tube was placed in a gas furnace and connected at one end with an apparatus for delivering pure air and oxygen, and at the other with a long combustion tube, in a separate furnace, containing layers of oxide of copper and porous reduced copper, to which were attached a large calcium chloride tube and the potash apparatus. The two Bohemian tubes were connected by a narrow india-rubber tube, about 12 c.m. long, fitted with a screw clamp, so that communication between the tubes could be cut off or gradually increased. The long tube having been raised to a red heat, the point of the sealed tube which was enclosed in the rubber connection was broken, and confined gases were allowed to pass gradually over the heated copper oxide and metal. When no further escape of gas from the tube took place, the other extremity, connected with the apparatus for delivering air, was broken, and the whole of the products of decomposition of the guncotton were gradually conveyed into the heated tube. Pure oxygen was finally passed through the apparatus, and the tube in which the guncotton had been burned was heated to redness. The guncotton for these experiments was taken from various products of Waltham Abbey manufacture obtained in 1863 and 1864; the quantity employed varied between 0·2257 grm. and 0·39 grm. The mean of four determinations was 24·15 per cent of carbon.

Method 4.—The guncotton was reduced, by cutting, to an extremely fine state of division, and mixed when dry as intimately as possible with a very large proportion of lead chromate in the first few experiments, and of finely divided copper oxide in the remainder. Long layers of copper oxide and porous reduced copper were employed as usual, and at the close of the combustion a current of pure oxygen, and finally pure air, was passed through the tube. With care and experience, the combustion of the substance was brought perfectly under control by this comparatively simple method of proceeding; in a few instances however, the operation was terminated prematurely by the stopping up of the tube, in consequence of the explosive combustion of a small accumulation of the finely divided guncotton. The mean of 14 determinations was 24·57 per cent of carbon.

This gives as a mean of 49 determinations 24·29 per cent of carbon. The results however, upon the accuracy of which the most perfect reliance is to be placed, are unquestionably those furnished by the fourth method, which ranged between 24·04 per cent and 24·88 per cent, the mean being 24·57 per cent.

Determination of hydrogen. The hydrogen was determined at the same time as the carbon, by the method of operating last described. The results of all the combustions (eight in number), conducted with different samples of guncotton yarn, were so remarkably uniform, that they were regarded as furnishing ample numerical data, with respect to this element. The mean of four determinations was 2·46 per cent of hydrogen.

Determination of nitrogen. The method of Dumas was employed for determining, by volume, the proportion of nitrogen contained in guncotton. A rather wide combustion tube, about 82 c.m. long, was drawn out at one end so as to admit of being connected with a carbonic acid apparatus provided with a regulating tap; and was fitted at the other end with the usual form of delivery tube. 5 c.m. of the tube were first filled with coarse porous fragments of copper oxide, a layer of 3 c.m. of fine copper oxide followed, and then the very finely cut guncotton, mixed with a large proportion of copper oxide; the mixture occupying about 25 c.m. of the tube. The next 22 c.m. were filled partly with coarse porous copper oxide, and partly with finely powdered oxide; a layer of 20 c.m. of reduced copper followed, and finally, the tube was plugged with coarse porous oxide, occupying a length of about 5 c.m. The combustion was conducted very slowly, with the usual precautions, pure

carbonic acid being passed through the apparatus for the requisite period before commencing, and at the conclusion. The gas collected was found, in one instance only, to contain traces of nitric oxide, and this determination was consequently rejected. The quantity of substance operated upon varied between 0·3006 grm. and 0·415 grm. The results of 18 analyses of various products from Waltham Abbey ranged between 13·36 per cent, and 14·60 per cent, with a mean of 13·83 per cent of nitrogen.

Deductions from the Analytical Results. The formula adopted by Hadow, as representing the most explosive product of the action of mixed nitric and sulphuric acids upon cellulose, which is the same as that first suggested for guncotton by W. Crum, afterwards adopted as probable by Gerhardt, and recently supported by Schrotter, Redtenbacher, and Schneider, demands the following formula :—

$$C_6 H_7 O_5 (NO_2)_3$$

which represents the following composition :-

C., 24·24 % ; H., 2·36 % ; N., 14·14 % ; O., 59·26 %.

The formula adopted by Pelouze and Maury as agreeing closely with the results which they obtained in their experiments was as follows :—

$$C_{24} H_{36} O_{18} (NO_2)_5$$

representing the following composition :—

C., 25·00 % ; H., 3·13 % ; N., 12·15 % ; O., 59·72 %.

The results obtained from Waltham Abbey guncotton show it to approximate quite closely to that required for the formula for trinitrocellulose.

In comparing the experimental results with the requirements of the two different formulae, it is necessary to bear in mind the following circumstances :—

(1). The guncotton examined has not been obtained from pure cellulose (for the production of which the most elaborate system of purification has been proved necessary), but has been prepared from cotton separated from foreign matters as far as it is possible by the ordinary method of purification adopted.

(2). Ample proof has been furnished, by most extensive and rigorous experiments, of the invariable existence in the purified guncotton (as produced by the most complete action of the strongest acids upon cotton-wool, purified by treatment with alkali and washing) of notable proportions of substances which owe their existence to the presence of foreign matters remaining in the cotton fibre after its ordinary purification, and also of products resulting from the less perfect action of nitric acid upon small portions of the cellulose.

(3). Although these two varieties of impurities were extracted as far as possible by repeated digestion and washing with ether and alcohol, their perfect removal from the fibre, by the application of any feasible method of purification, is extremely difficult, if not impossible.

(4). The existence of even small proportions of these impurities in a sample of pyroxylin will have the effect of raising somewhat the percentage of carbon, obtained by analysis of the substance, above that which would be furnished by the pure material, and also, consequently, of reducing to a trifling extent the proportion of nitrogen obtained, below the theoretical requirement. A proof of this is furnished by the analytical results obtained with specimens of the matter soluble in ether and alcohol, which had been extracted from Waltham Abbey guncotton.

The results were as follow :—

For the soluble portion C., 30·50 % ; H., 2·91 % ; N., 11·85 %.

For the insoluble portion in ether-alcohol.

C., 24·15 % ; H., 2·46 % ; N., 13·83 %.

It is believed that the foregoing circumstances must be admitted to account perfectly for the slight variations exhibited, among themselves, by the numerous analytical reuslts which have been quoted. The whole of the carbon percentages obtained by the most trustworthy method of analysis (Method 4) are somewhat higher, and the great majority of the results of the nitrogen determinations are a little lower than required by the formula. $C_6 H_7 O_5 (NO_2)_3$.

On the other hand, making every full allowance for errors of analysis, and assuming for an instant the possibility that the substance analysed could be an absolutely pure product, the individual as well as the mean results of the carbon, hydrogen, and nitrogen determinations, are far more closely in accordance with those theoretical requirements, than with the percentage results which should be furnished by a pure substance, having the composition more recently assigned to pyroxylin by Pelouze and Maury, viz.—

$$C_{24} H_{36} O_{18} (N_2 O_5)_5$$

The analytical results of guncotton manufactured at Waltham Abbey according to Von Lenk's directions confirm, therefore, the correctness of the conclusions that the most explosive known variety of guncotton is trinitrocellulose or trinitriccellulose ; and that cotton wool is converted into this substance by the complete action upon it, in the cold, of a mixture of one part by weight of nitric acid (1·52), and three parts of sulphuric acid (1·84). In addition to the data furnished by the analytical experiments described in the foregoing, others, bearing upon the composition of guncotton, have been furnished by different systems of experimental inquiry.

(*To be continued*).

APPLICATIONS FOR PATENTS.

MAY 17—JUNE 12, 1909.

11,617.* Percussion Fuses. Fried Krupp.
11,668.* Bursting Shrapnels. C. Puff.
11,669. Ammunition Gauging and Sorting Machine. G. F. Seaton.
11,695.* Barrel Recoil Ordnance. Fried Krupp.
11,704. Projectiles. S. O. Cowper-Coles.
11,743.* Telemeters. F. Ljunggren.
12,123.* Retarding Apparatus for Guns. K. Haussner.
12,238. Aperture Sight. J. Hillis.
12,317. Rifle Sight Bracket. J. Power.
12,419.* Small Arms. R. J. Petersen and H. & R. Whittington.
12,478. Projectiles. T. H. Klamer.
12,506. Explosives. B. E. D. Kilburn.
12,552. Explosives. H. F. Easton.
12,557. Automatic Toy Pistols. A. Pitot.
12,633. Work Feed for Ammunition Machinery. W. D. Fox.
12,651. Ordnance Recoil Gear. A. T. Dawson and G. T. Buckham.

12,672. Sights. London Small Arms Co., Ld. and F. W. Bennett.
12,681. Cartridges. R. G. Gibson.
12,960. Targets. A. M. Munby.
13,009. Ordnance Sighting Apparatus. W. Beardmore & Co., Ld., and A. Bremberg.
13,042.* Differential Recoil Guns. K. Haussner.
13,056. Ammunition. A. C. L. Guyer.
13,067. Targets. W. Winans.
13,069. Ordnance Sighting Apparatus. A. T. Dawson and G. T. Buckham.
13,096. Gun Sights. London Small Arms Co., Ld. and F. W Bennett.
13,136. Small Arms. H. White.
13,156.* Machine Gun Supports. Deutsche Waffen und Munitionsfabriken.
13,243. Ordnance Loading Gear. A. T. Dawson and G. T. Buckham.
13,311.* Firearms Safety Device. R. Frommer.
13,342. Ordnance. F. B. Yingling.
13,371. Cartridge Case Ejector. F. Baxter.
13,376. Explosives. J. R. Garroway.
13,419. Guns. E. Jones and Kynoch, Ld.
13,562.* Rifle Practice Apparatus. F. Mitchell.
13,571. Sight Testing. W. A. Burns.
13,707. Targets. D. Ralston.
13,735.* Fastening Sights on Firearms. P. Mauser.
13,742.* Cartridge Cases. K. Krnka.
13,846. Machine Guns. E. C. R. Marks.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

MAY 27—JUNE 17, 1909.

COMPILED BY HENRY TARRANT.

8,358 (1908). **Improved Gunpowder.** G. Trench, Herne Bay, and R. Lynn-Smart, London. To increase the strength of gunpowder of the ordinary type, a suitable proportion of a perchlorate such as ammonium or potassium perchlorate is incorporated with the usual ingredients. To 100 parts of gunpowder, from 5 to 20 parts of perchlorate are added in a wet state for the sake of safety. Reference is directed to patents Nos. 1,939, 1865; 1,375, 1868; 9,190, 1898, and 20,216, 1903. Accepted May 17, 1909.

9,906 (1908). **Single Observer Rangefinders.** Professors A. Barr and W. Stroud, Leeds. The object of this invention is to afford protection to the surfaces which meet to form the separating edge in single-observer range-finders. The separating device consists of three or more pieces of glass of two or more qualities as regards their refractive indices so arranged that the edge at which the separation of the partial images is effected by refraction lies in the interior of the combination. Accepted May 7, 1909.

10,111 (1908). **Ammunition Hoist for Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. Modifications and improvements are introduced into ordnance loading apparatus such as is dealt with in patent No. 28,105, 1907, in which the loading cage is provided with a flexible rammer. The cage and rammer are adapted to be operated through the proper gearing by two electric motors. Accepted May 10, 1909.

10,256 (1908). **Inserting Tubes in Ordnance.** A. Bremberg, Glasgow. (*See Selected Patents*).

10,426 (1908). **Cartridge Loading Machinery.** A. J. Boult, London (Agent for *W. I. Donaldson, U.S.A.*). A machine for loading paper shells with dynamite is described in this patent. The drum for loading the shells is pneumatically raised, lowered and intermittently turned through a part of a revolution. The dynamite trough lies above the drum. Pneumatically operated folding mechanism is adapted to fold in the ends of the cases, and automatic releasing mechanism is introduced to discharge the loaded shells from the machine. Accepted May 13, 1909.

11,326 (1908). **Automatic Rifle Mechanism.** A. Woosman, London. (Agent for *P. Kuhne, Germany*). (*See Selected Patents*).

12,732 (1908). **Discharge of Shells.** G. Banker, Birmingham. (Agent for *R. Pompili, Italy*). The patentee proposes to dispense with guns altogether. He attaches an explosive charge at the rear of the projectile which is suspended so that when the charge is exploded it is propelled in the desired direction. Accepted May 20, 1909.

13,335 (1908). **Sighting of Ordnance.** Lieut. A. T. Dawson and G. T. Buckham, London. What is called a "drunken disc" is employed in sighting apparatus in which transverse adjustment can be affected to compensate want of level of the trunnions owing to uneven ground. An arm—termed the sight carrier—is moveably mounted on the periphery of this disc whilst the sight bar is connected with the carrier. The sight carrier is permitted to rock transversely with the disc when the plane is adjusted and also to move laterally relative to the sight lever when the elevation is changed. Accepted May 29, 1909.

13,585 (1908). **Automatic Guns.** W. P. Thompson, Liverpool. (Agent for *The McClean Arms and Ordnance Co., U.S.A.*). The patentees arrange a series of ports at the end of the gas chamber so that a considerable quantity of air can be mixed with the gases of combustion which operate the breech action. The gases are thus cooled. Details of constructional improvements for facilitating assembling and dismounting the parts are also described. Accepted May 27, 1909.

15,643 (1908). **Ammunition Hoists for Ordnance.** Sir W. G. Armstrong Whitworth and Co., Ld., and C. H. Murray, Newcastle-on-Tyne. Cut off gear is introduced into ammunition hoisting apparatus (of the type which delivers to a gun no matter what its position may be) to allow the hoist to be brought quietly to rest at the top of its stroke and at ends of the varying lengths of its descending stroke. Accepted May 6, 1909.

17,453 (1908). **Armour Piercing Projectiles.** Capt. T. J. Tressider, London, J. R. Hoyle, Sheffield and H. B. Strange, Dore. The cap is so formed that the maximum amount of metal in any section normal to the major axis of the projectile lies just forward of the point of the latter, the cap being abruptly reduced immediately in front of this section so that its end is flatly conical. The angle of the apex of the cone is not less than 120°. The projectile is provided with a false nose for ballistic reasons. Accepted May 13, 1909.

18,130 (1908). **Rifle Sight Slides.** J. T. Peddie, London. In this wind gauge sight the screw on which slide is traversed is enclosed so that it cannot be fouled by the inadvertent entrance of dirt or other foreign matter. A hollow head is attached to each end of the screw. These heads work over bosses on the cross bar. The bosses are made to support the screw and it is claimed that the arrangement gets rid of the worries of back-lash and jamming. Accepted May 13, 1909.

19,417 (1908). **Air Rifle Improvements.** R. Gilbert, Birmingham. The loading plug of air rifles of the fixed barrel type (the B.S.A. for instance) is rifled. The patentee claims that by so forming a proper "lead" for the pellet greater accuracy and higher velocity are secured. Accepted May 13, 1909.

24,696 (1908). **Cooling Jacket for Q.-F. Guns.** J. Boursin, Paris. (*See Selected Patents.*)

25,393 (1908). **Sighting of Ordnance.** Fried. Krupp, A.-G., Germany. This sighting device is adapted, after adjustment to the range of the object, to give, automatically, the angle of site corresponding to the height of the object. Parts are introduced to allow the angle to be adjusted during the pointing of the sight on the object. Accepted May 27, 1909.

25,505 (1908). **Illuminating Projectile.** H. Hubbard and A. Ridley, Manchester. A projectile is designed such as will ignite when it enters the water and illuminate the object aimed at. It is made to fit any bore of gun and consists of a hollow casing with a weighted base. A tube in the interior is filled with calcium phosphide which ignites when water is added. A quick fuse carries the fire from this substance to the flare ingredients which occupy the space round the tube. This sort of illuminating projectile (which floats nose upwards) is adapted for

use in warfare or accident such as a man overboard. Accepted May 13, 1909.

27,022 (1908). **Range Finder.** Major R. E. H. Dyer, London. Range finders of the type described in patents Nos. 9,559, and 21,456 of 1908 are improved. The number of movements necessary to adjust the instrument are reduced to one; the possibility of warpage is obviated; and arrangements are made to permit of the lengthening of the sight base if necessary. Accepted May 13, 1909.

2,533 (1909). **Removing Caps from Discharged Cartridges.** J. P. Johansson, Sweden. The point of the pin used in a machine for removing caps from discharged cartridges has the point shaped off somewhat after the style of a bird's claw. The section of the point is triangular. When the machine retracts the pin the point retains its hold on the cap after is has withdrawn it from the case. Accepted May 20, 1909.

4,214 (1909). **Trigger Mechanism of Ordnance.** Fried. Krupp, A.-G., Germany. The trigger bar of this mechanism is mounted on a limb of the gun which does not take part in the elevation movement and is curved to an arc of a circle of which the trunnions form the centre. The firing handle is connected to the top of this curved bar. Accepted May 13, 1909.

5,012 (1909). **Practice Projectile.** W. I. Scasin, Russia. This projectile is specially designed for trial firing. It is formed of vegetable ivory (nuts of the stone palm) and is turned to shape on a lathe. The base is cupped for the reception of lubricant. After firing 4,000 of these shots (says the patentee) a barrel shows very little sign of wear. Accepted May 20, 1909.

6,723 (1909). **Ordnance Brakes.** Fried. Krupp, A.-G., Germany. To remove the disadvantages attendant upon the friction created between the lugs on the rotary part of the piston of a fluid pressure brake and the walls of the guide grooves, a chamber is provided between the rotary parts of the piston and its abutment for the reception of brake fluid. It communicates with that side of the brake cylinder from which brake fluid is displaced when the gun recoils. Accepted May 27, 1909.

7,131 (1909). **Gear for Differential Recoil Ordnance.** Col. H. C. L. Holden, F.R.S., and C. H. Dewett, Woolwich. On a non-recoiling part of the gun the patentees mount a pawl which is adapted to engage teeth in a rack recoiling with the gun. The pawl retains the gun in its recoiled position. When it is disengaged the gun is impelled forward by compressed air-springs or other suitable means. The pawl does not interfere with this movement. Accepted May 20, 1909.

SELECTED PATENTS.

INSERTING TUBES IN ORDNANCE.

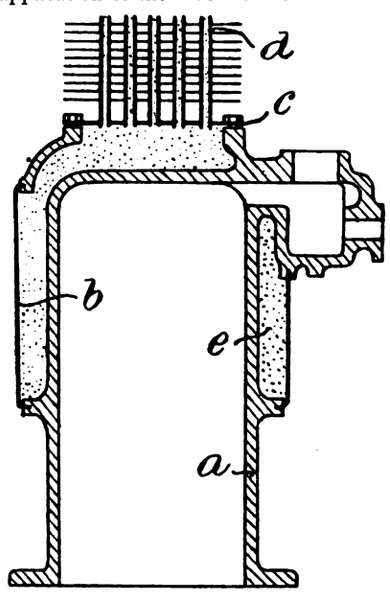
10,256 (1908). A. Bremberg, Glasgow. The method adopted by the patentee for inserting tubes (those known as "inner A tubes") in guns of the built-up kind is such, it is claimed, that on completion the inserted tube has as great a compression applied to it as the original tube had by the wiring or the shrinking-on of the outer tubes, or at any rate sufficient compression to ensure its effective life.

The inner A tube forging is turned down to external dimensions only slightly greater than the internal diameters within which it is to fit. The bore of the tube is made as small as is practicable. As in ordinary ordnance building wire is wound under tension on the tube until the whole tube is reduced in diameter. The pressure exerted by the wire is so proportioned that permanent deformation of the inner parts of the forging takes place, i.e., of the parts which will be removed to produce the final bore. The outer parts, or those which are finally left—are not deformed.

The wire is then removed and the tube after being finally turned on the outside to fit the interior of the gun is inserted in place, the deformed inner masses of the metal meantime retaining the outer metal in its compressed state. When the tube is bored out to its final diameter after insertion the outer parts are no longer held and they consequently expand against the embracing walls of the outer tube. Boring is commenced from the muzzle end because longitudinal contraction takes place with circumferential expansion. To release any dormant elasticity in the tube after boring it may be annealed in the gun. Accepted May 6, 1909.

COOLING JACKET FOR Q.-F. GUNS.

24,696 (1908). J. Boursin, Paris. The means described in this patent for maintaining a constant low pressure in explosion and high pressure engines may be applied to quick-firing guns, or to the machinery used in the manufacture of explosives. The subject matter of the specification deals particularly with the application of the invention to internal combustion motors.



The preamble of the patent is as follows:—

"This invention relates to improvements in the means for maintaining a constant and comparatively low temperature in explosion and high-pressure steam engines, quick firing arms and thermal apparatus used in manufactures, and its object is to supersede refrigeration by water-circulation in adopting a well known fusible alloy in combination with means for dissipating the heat absorbed by the alloy within its own mass and finally discharging the heat into the air without fusion taking place in the superposed portions of the alloy thereby retaining the greatest proportion of the heat generated for useful work.

To this end the engine cylinder or the like is surrounded with a shell partly cast or fitted on and partly formed of elastic and expansible metal casing such as copper, the intervening space being filled with a suitable alloy and the open end being covered with a series of radiating tubes having open outer ends.

With the ordinary water-jacket, the loss of heat is as follows: In 100 calories, generated, 15 calories are transformed into useful work, 60 calories are lost through the circulation of the water, 15 calories are lost through the exhaust, and 10 calories are lost through friction and radiation.

Thus, only a small portion of the heat is utilized while an energetic circulation of the water is necessary owing to its high specific heat coefficient. It has been found necessary to attain better results by employing a medium having a low specific heat coefficient which would keep the temperature sufficiently low so as to avoid the combustion of the lubricants as well as excessive temperatures likely to deform the cylinders or cause irregular noisy, ignition."

The illustration reproduced herewith represents a vertical section of an internal combustion motor.

The engine cylinder *a* is surrounded with a casing *b* of metal such as copper, steel, or similar material, having sufficient elasticity to allow for a reasonable amount of expansion of the inner medium. The upper portion of the casing may be cast with the cylinder as shown, or otherwise constructed and arranged to form a seat *c* for a radiator composed of a series of tubes *d* communicating with the casing *b* and open at their extremity. The casing *b* is filled with melted alloy *e* having a predetermined fusion point. The alloy is run into the casing until it completely fills the radiating tubes.

The alloy consists of tin, lead, bismuth and cadmium mixed in proportions to give the fusion point between 73 and 155 degrees most suitable for the purpose in hand. For cooling jackets of guns the proportions are not set out but for motors where a temperature of from 80 to 90 degrees centigrade in the cylinders provides proper working conditions, a mixture of three parts of tin, nine parts of lead, and eight parts of bismuth has been found satisfactory.

To quote further from the patent:—"The conducted heat produces the fusion of the alloy near the high temperature region of the cylinder and the calories then advance into the radiating

tubes while tending to extend the state of fusion throughout the alloy in the latter.

By making the tubes sufficiently long and in applying the theory of the "Fourier" experiments with various lengths of bars of different materials to ascertain the distribution of the gradually falling temperature from the point of application of heat to where the temperature becomes reduced to that of the atmosphere, it will be possible to determine the exact length of tubes required for harmlessly discharging these calories at the ends of said tubes into the ambient air. Short radiating tubes can be adopted when their surface is increased by ribs or flanges according to the usual arrangement.

In keeping a portion of the alloy in solid condition and by reason of the law of fusion it will be clearly understood that the temperature of the alloy cannot rise beyond the fusion-point originally determined by the proportions of the constituents, so that the main object of my invention is realized."

Among the seven advantages claimed for this invention five may be mentioned. Water circulation is obviated as are large radiators, tanks, pipes, etc.; the weight of the cooler is diminished; the possibility of bursts in winter is removed; the temperature is kept rigorously constant, and the burning of lubricant is avoided. Accepted May 6, 1909.

AUTOMATIC RIFLE MECHANISM.

11,326 (1908).—A. Woosman, London. (Agent for *G. Kuhne, Germany*). In the operation of the mechanism of this automatic rifle the barrel recoils a short distance and rotates at the same time, so unlocking and releasing the breech bolt and leaving it free to continue its rearward movement for the purpose of ejecting the spent cartridge and re-cocking the parts. At the limit of its backward travel the barrel is caught by a locking limb, which holds it securely until the bolt is pushed forward in the reloading movement. The patentee makes a particular point of the arrangement of the trigger and sear. He claims that it allows of a better double pull than than can usually be secured in military rifles. Pressure on the trigger must be removed before another shot can be fired.

Referring to the drawings here reproduced it will be seen that the barrel *a* is arranged to work in the sleeve *b*, and is forced forward by means of a barrel spring *c* which surrounds it and bears against an inwardly extending collar on the sleeve *b*, and against an outwardly extending collar *d* on the barrel *a*.

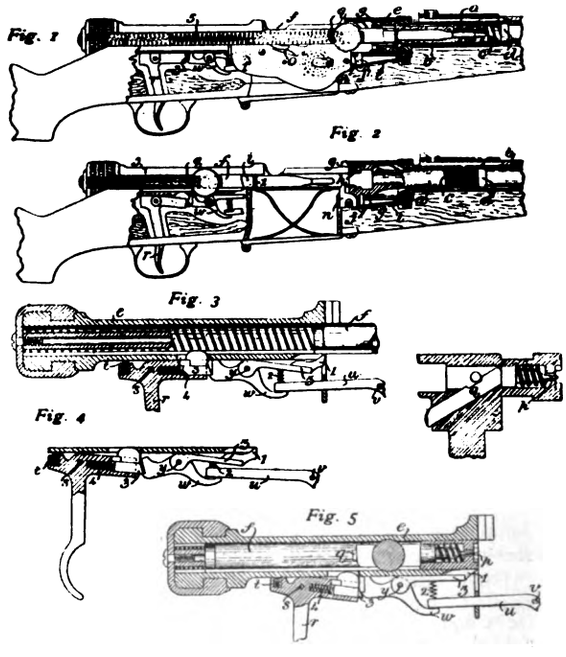
The rear end of the barrel extends beyond the cartridge chamber, and is guided in the casing *e*. This extension is adapted to receive and to be locked to the head of the breech piece *f*. For this purpose the rear end of the barrel is in the form of a cylindrical enlargement, the periphery of which is provided with helically wound ribs *g* engaging with corresponding grooves formed in the casing *e*. A chamber within the cylindrical enlargement is adapted to receive the head of the breech piece when it slides forward and while the barrel is in the loading position. The wall of the chamber is provided with interrupted transverse ribs *h* (Fig. 2) with which two laterally extending lugs *i* on the breech piece engage immediately the barrel rotates upon sliding forward.

Whilst the breech bolt is performing the cycle of operations involved in reloading and recocking, the barrel is held in its recoiled position by the locking pin *j* which is forced into a recess in the cylindrical barrel extension by the spring *l*. The bolt depresses the plate *n* when it rejoins the barrel and so disengages the pin *j* from the recess.

To secure compactness of the parts the hammer *o* is arranged at the side of the major axis of the rifle. Its blow is communicated to the striker *p* through an intermediate piece *q* which runs through the bolt handle to the striker lying in the centre of the breech bolt.

Between the trigger *r* which is pivoted on the pin *s* and is under the pressure of a trigger spring *t* and the trigger bar or sear *u* which is pivoted on a pin *v*, there is arranged a lever device consisting of the lever *w* pivoted on a pin *y* and another lever *z* also pivoted on the pin *y* and terminating in a tooth *1*. The lever *z* serves as an abutment for a spring *2*. When the breech is open, (Fig. 5) the toothed end *1* enters a slot formed in the head of the breech bolt *f*. The spent cartridge when pulled back by the extractor strikes against it and is thereby ejected. In the horizontal arm of the trigger *r* there is arranged a sliding piece *3* which is pressed outwardly by a spring *4*. When the breech bolt is in the closed position (Fig. 3) the trigger spring *t* causes the sliding piece *3* to project through a slot formed in the breech casing into the path of the breech cylinder *f*. The rear end of the latter depresses the part *1* of the lever device and by means of the spring *2* consequently depresses the bar *u* so that the rear end of the lever *w* is caused to bear against the bottom of the casing *e*. In this position a sharp-edged projection on the sliding piece *3* is in engagement with a shoulder formed on the lever *w* (Fig. 3).

If pressure is applied to the trigger *r* when the rifle is loaded, at first only the sharp trigger edge of the sliding piece *3* comes into action on the lever *w* (Fig. 4). Afterwards its front end face also acts upon the lever. The pull of the trigger is thus successively exerted on two bearing points, and it is claimed that a steady, certain, and gradual discharge is secured.



When the breech is opened the rear end of the breech cylinder *f* first pushes back the sliding piece *3* in the direction of the recoil, so compressing the spring *4*. The sliding piece is thus caused to slide on the horizontal arm of the trigger towards the trigger pivot pin *s*. Owing to this backward motion of the sliding piece *3* its sharp projecting edge is moved out of engagement with the shoulder on the lever *w*, and the latter is for the time being put out of action. In the further course of its backward movement the breech piece presses the sliding piece *3* downward, together with the trigger *r* (Fig. 5), thus causing the sharp-edged projection on the former to lie under the lever *w*. Owing to this and to the fact that the trigger *r* bears against the breech cylinder *f* through the sliding piece *3* and, through the rear end of its horizontal arm against the breech casing, it cannot possibly be actuated, so that release of the lock while the breech is open is impossible.

When the breech cylinder is moved forwards (Fig. 3) the upper part of the silding piece *3* is caused by the pressure of the spring *t* to enter the slot and its sharp-edged projection comes simultaneously into engagement with the shoulder on the lever *w*, that is, provided pressure of the finger is removed from the trigger.

The working of the rifle will, no doubt, be understood from the foregoing description of the function of each of the parts. To make it quite clear it may be said that when the trigger is pulled and the cartridge discharged, the gases of combusiton drive barrel and breech locked tog th.r a certain distance rearwards. During this movement the barrel rotates and unlocks the breech bolt, leaving the latter free to continue i's rearward movement and to extract and eject the empty case. It compresses the spring *5* and the energy so stored up is utilized to return the bolt to the barrel. A fresh cartridge is carried into the barrel, the locking pin *j* is removed from the barrel recess and under stress of spring *c* the barrel and breech continue the forward movement to the firing position. The rotation of the barrel meantime brings the lugs on the breech bolt into the locking position. Accepted May 13, 1909.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

The Shooting Season.—There have been very few instances during recent years in which the opinion was so unanimously held that the weather conditions of June were destructive of all possibility of a satisfactory shooting season. The weeks of incessant rain certainly commenced a fortnight later than the period when most of the young partridge chicks are coming off the nest. In a very short time the critical stage is safely passed, and rain in ordinary quantities ceases to have any but a good effect. There is, however, very little possibility of doubt that the excessive downpour of June though it may have failed to do its worst with the birds that had been safely hatched off before it began, has caused many deaths since. Pheasants have suffered to a reduced extent, and grouse probably not at all. Therefore the position of matters is that on many estates the very favourable conditions which existed right up to the hatching off period may result in the survival of a fair head of game, notwithstanding the very unfavourable conditions which have since prevailed.

The Bisley Meeting.—The Jubilee meeting of the National Rifle Association has come and gone with little to mark its special significance. From a shooting point of view it has been as successful as any of its predecessors. The match rifle events have caused no particular excitement, and the first prizes have been singularly evenly divided, no shooter having taken more than one. With one accord everyone seems to have returned to the well-tried ·375–·303 cartridge, after toying for a while with the ·280. Scoring has not been as high as last year, but the shade of difference is so small, to say nothing of the exceptions, that no definite conclusions can be formed. Service rifle shooting has likewise followed the old procedure, with the single exception that the aperture sight has been tried, and though admittedly open to further improvement, its success from the shooting point of view has been most marked. Its situation near the shooter's eye facilitates rapid and accurate adjustment to keep pace with changes of wind. The definition of the foresight is greatly improved, orthoptics and verniers have disappeared, and most important of all the improved conditions are relatively of much greater benefit to the tyro than the veteran. The latter had by his special skill already overcome most of the difficulties connected with shooting. Consequently he stands to derive a minimum of benefit from improved appliances. Another, and unfortunately a less satisfactory, explanation of the smallness of benefit to the best grade of shooter is the fact that the ammunition possesses so many faults due to obsoleteness of design that improved methods of aiming and adjustment are lost amidst the errors due to other causes. This, however, is a War Office question rather than one which affects the Bisley meeting as such. Nevertheless, the best shots absolutely go nap on the aperture, because it appeals to their cultivated intelligence. On the other hand the most visible improvement due to its use is mainly confined to those lesser mortals, whose connection with rifle shooting is in the elementary stages.

The Bull's-eye Controversy.—The chief topic of conversation at Bisley has naturally been the merits and demerits of bull's-eye shooting as an item of military training. Although

differences of opinion seem as acute as ever, as a matter of fact considerable advances have been made towards a better understanding of the question. The military attitude towards ordinary target shooting admits its sporting attributes, whilst denying to it the saving grace of military utility. This at once crystallises the whole argument, because if the bull's-eye shot is not a practical marksman the question that remains is who is and where does he gain his skill ? The art of shooting consists in correctly aiming with accurately adjusted sights, and pulling the trigger without materially disturbing the lie of the weapon. The successful co-working of the teachings of past experience with the nerve control which makes the lesson effective at the moment of crisis, implies the possession of qualities which can only be acquired by some form of athletic strife. The boy who after making good shooting at a bull's-eye, fails to hit a much larger object in the form of a bird, is suffering from nerves. The excitment of contest, where each shot must be delivered to the best advantage, is surely the right training to still the symptoms of "buck" fever. By reminding himself that the bird is a bull's-eye, and the weapon in his hands is a rifle and not a shot gun, the boy will gradually apply the experience gained on the range to practical problems of shooting. The difficulty of relating the two sections of shooting is not a matter of visibility or invisibility of the mark, or knowledge of its exact distance. It is the difference between theory and practice, and correct theory is always correct practice ; but they frequently appear wider apart than is actually the case. The only scientific shape for the bull's-eye is round, because aim is taken at a point, and a given divergence from a point produces a circle. Visibility again is a purely relative term. A mark of some kind must be there to shoot at, and its precise degree of sharpness simply varies the amount of difficulty experienced in aiming at it. Bull's-eye shooting thus takes its place as theory, whilst distance judging and woodcraft generally are complications incidental to its practical application. The one cannot exist without the other. Theory must undoubtedly come first, and its lessons cannot be too thoroughly instilled into the mind of the learner. It is by ventilating the foundation principles of rifle shooting that the recent discussions have caused an advance to be made.

Lieut. Dawson's Lecture.—It seldom happens that a man who combines the technical acquirements of Lieut. Dawson in combination with the commercial associations of a large concern, like the Vickers-Maxim Company, will allow himself the liberty of speaking on subjects where the least hint of future intentions would be eagerly watched for by rivals working upon similar problems. It was, therefore, in fear perhaps that the lecture would savour too much of generalities to be really interesting that members wended their way to the Junior Institution of Engineers to hear the first Gustave Canet lecture delivered by a distinguished artillerist. Lieut. Dawson was singularly successful, because, whilst confining himself to generalisations, his conceptions of the present and the future were so skilfully expressed that even the more technical members of the audience felt that he had illuminated various obscure points and had emphasised well understood facts in a manner calculated to resist retrograde tendencies. The two ordnance problems to which he devoted particular attention comprised the rival merits of the wire construction of big guns, as distinguished from the alternative process of building them up with steel hoops. His reasons for favouring the former system were expressed with due regard to the advantages of the alternative arrangement. In just the same spirit of judicial balance he summed up the pros and cons of hydraulic, as distinguished from electric operation of big guns. The former here again had the preference on the general grounds of greater convenience and reliability. The day is rapidly passing away when mechanical contrivances receive special consideration on account of their supposed more scientific nature. The tendency towards simplicity has resulted in the rejection of many ideas for automatically and electrically performing operations which are better carried out by ordinary man power. The favouring of hydraulics, as against electricity, carries out the same principle of diminishing multiplicity of gears and circuits whilst favouring the more direct arrangement, even though it may possess smaller claims in the direction of mechanical finesse.

Testimonial to Col. C. R. Crosse.—Although two of these notes have already been devoted to matters arising out of the Bisley meeting, it is impossible to resist adding a third to the number, in so far that no better use could be made of the space that remains than to endorse the high tributes which have everywhere been paid to the unexampled success of Col. Crosse's administration of the affairs of the National Rifle Association. The transference of the offices from London to Bisley Camp was the first step in the policy of highly concentrated energy which began to be associated with the new Secretary. The outstanding feature of his management is the capacity he has always shown for not allowing the exacting requirements of office work to prevent his complete accessibility at all times to those who wished to see him or business. The gun trade owe him a species of gratitude which it is hard to express in suitable terms. He has understood their difficulties, and has realised in a manner to which no previous secretary attained, the value of the gunmakers' help in forwarding the serious work of the Association. The fact that they might be traders with interested ends to promote never led him into the error of treating the trade as a necessary nuisance. The development of firearms has its legitimate place in the work of the Association, and Col. Crosse always saw that the gunmaker provided the technical knowledge necessary for the realization of improved devices and methods. Gunmakers on their side have appreciated the opportunities which have been afforded them, at all times in the most courteous fashion, for testing and otherwise demonstrating the properties of any new mechanism they wished to exhibit. The presentation which has been made provides above all things evidence of the good feeling of the members of the Association and their united wish that Col. Crosse may for many years be spared to carry on the work that evidently suits his disposition so well.

A LAY TO N.G.

A LADY OF HIGH DEGREE.

Let other bards praise what they list
I make my own selections,
My love is Nitro Glycerine,
A girl with high connections.

She's soft, and sweet, and amber hued,
She's gentle, coy, and tender,
She'll do the work of fifty men,
But pray do not offend her.

She takes offence at things so small
You have to treat her civil,
For when her monkey's up, by George!
She plays the very devil.

Her power is great, her temper's hot
She's up in half a minute,
Then off she goes and raises Cain,
And Sandow isn't in it.

Her mother's lady Glycerol,
HNO three's her daddy,
Her mother's sweetness she retains,
But has her father's paddy.

She mixes only with a few,
Some say her pride is rotten,
She's very thick with Kieselguhr,
And loves Collodion Cotton.

Her mood it changes with the year;
Is fitful as the breezes,
She's angry when she blushes red,
And awkward when she freezes.

She's fickle as the autumn wind,
Oft causing depredations,
Some think they have her tight, but find
There's after separations.

Don't press this lady over much,
She does not like a squashing,
But strange to say, her temper's best,
When she has lots of washing.

There's few can tame her spirit down,
Though every one can goad her,
The only thing to calm her nerves
Is alcohol with soda.

Folks try her humour every day,
To see if she is stable,
Though warm, she keeps her colour down,
As long as she is *able*.

Her yield of late has been improved,
Her power was lying latent,
Till elevating plans were formed,
(See Doctor Nathan's patent).

Nobel was first to bring her out
And give her introductions,
He taught her to behave herself.
And not to cut up ructions.

So pray be careful with N. G.
For quick her ire increases,
And many who disdained her *once*,
Now "*Requiescat in 'pieces.'*"

S. SODDY.

Dinamita,
Durango,
Mexico.

AN ANCIENT GUNMAKER'S BILL.

We are indebted to the firm of Cogswell and Harrison, Ld. for the loan of a most interesting document in the form of a gunmaker's account for work done upon a gun in the year 1773. The document consists of a plain sheet of notepaper some 6¼ins. wide by 8in. high. The penmanship, as will be seen from the accompanying reproduction, whilst crude,

can at the same time claim to be considered the medium of a distinctly artistic conception. The general effect produced is that of an engrossed deed. The following is an xact transcript of the original text :—

"5 *October* 1773
Works Don for FRANCIS WALKER Esqr.
By ordors of JOBE WALKER BAUGH Esqr.

	£	s.	d.
For new Stocking a Best Steel mounted flying Gun	0	15	0
and making a new small Brichpin and mending the Bentes of the Seare and tumbler and making the mainspring Ly Clos to the Plate ..	0	1	0
and a new Gunkace for it	0	1	0
Do 23 For Reparing a Best Short flying Gun Grafting a Pece of Wood to the But of the Stock to make it lounger and Grafting a Pece of Wood on the top of the But of the Stock for the top parte of the Healeplate to Ly in and fixing the Healeplate on a new and new Smouthting and Polishing the Healeplate and Gluing and Pining and Lining a Spel as Was in the Stock Before the Sidepece and Clening the Lock and furnetur By the Same ordors ..	0	4	0
2 July 1774 then Received the total ..	1	1	0

Contentes of this Bill in full of all
Demandes By me WM. HARDING."

It is possible that some of the oldest established firms in the trade could produce similarly ancient evidence of a long standing family connection with the art of gunmaking. William Harding certainly did an astonishing amount of work for what to-day seems a very modest scale of reward. The document further provides evidence that gunmakers had already begun to give long credit.

TESTING STATIONS ABROAD.

AT th Seventh International Congress of Applied Chemistry, Drs. Mente and Will communicated a paper on the above subject. All large coal-getting countries employ testing stations of some kind, in order to safeguard, to the highest possible extent, the lives of the men employed in this industry. Most countries employ galleries of considerable diameter, and fairly short length; but within recent times, long galleries, with drives and other accessories approaching as closely as possible the actual conditions of mining have been installed. The following are the details of the testing stations employed in the countries mentioned.

United States. A circular iron gallery 1·9m. in diameter, and 30·5m. in length is used. The shot is fired either into a mixtur of pit gas and air, or into coal dust and air.

France. In this country, particularly, the authorities consider that tests for safety explosive should be based upon considerations of the theoretical temperatures of explosion. The gallery at Lievin has a length of 65m., but it can be extended to 500m.; and is furnished with drives and other accessories.

Belgium. The Belgian authoriti s commenced experiments in 1889, and partly adopted the French system of explosion temperatures. At the official testing station at the Frameries, experiments are carried out in an explosive mixture consisting of 8 per cent. of pit gas and 92 per cent. of air, or in coal dust and air in a gallery 2 sq. m. in area and 30 m. long. Shots are fired without stemming, and the maximum weight of charge, which, under these conditions, will not ignite the explosive mixture, is known as the *charge limite*, or limiting charge, for that particular explosive in practice.

England. The official gallery at Woolwich is of circular section 0·7m. in diameter and 9m. in length. The shots are fired into a very sensitive mixture of 15 per cent. coal gas and 85 per cent. of air. Firing into coal dust is not officially adopted. The weight of explosive to be used in the test is determined, as that which will give, with the ballistic pendulum, results corresponding to 56grms. of No. 1 Dynamite, (75 per cent. of nitroglycerine). Ten shots are fired with 30 c.m. stemming, and another 10 with only 23 c.m. stemming, consisting of specially prepared clay. No shot should ignite the mixture or leave any appreciable amount of unconsumed explosive. The gallery at Althofts is 2·3 m. in diameter and 213·5 m. long. Experiments are to be carried out as to the effect of coal dust in initiating and spreading explosions.

Austria-Hungary. In 1886 galleries were erected at Mahrisch-Ostrau and Segen Gottes. In this case the shot is fired into pit gas and air, or coal dust and air, not from a bore in a gun or mortar, but from a cartridge lying freely in the gallery on top of a lead cylinder, the compression of which gives some idea of the strength of the explosive. At Rossitz a gallery 300 m. long is used.

Germany. There are five official galleries in Germany, of which the best known is that at Gelsenkirchen. It is elliptical in section, 2 sq. m. in area, and 35 m. in length. Pit gas and coal dust are employed. The limit charge is determined in the same way as at the Frameries testing station in Belgium. Germany has recently had under consideration the erection of a gallery which would approximate closely to the actual conditions of mining.

A number of problems remain to be solved in testing safety explosives. The relationship between tests carried out with natural gas, and those carried out with artificial mixtures such as coal gas is still undecided. The relationship of diameter of the cartridge and that of the bore; the length of the bore and the distance of the cartridge from the muzzle; the temperature and humidity of the air and explosive mixture in the gallery, and many other factors require investigation.

In view of the great importance of this subject, the authors consider that it should be viewed from an international standpoint, and that all those who are interested in the question of safety explosives should carry out, between now and the next meeting of the International Congress in three year's time, experiments which would tend to elucidate many of the problems with which this subject is beset. At the 8th International Congress a commission could be appointed to consider the results obtained by investigators in different countries, report on the whole subject, and place the question on an international basis.

G. W. McD.

WESTERN AUSTRALIA EXPLOSIVES REPORT.

Mr. E. A. Mann has presented his report on the work carried out by his department during last year. Pressure of routine duties has prevented the initiation of researches upon the various interesting problems which present themselves from time to time. The value of the importations of explosives during the year shows an increase of £35,000, which indicates that in spite of the alleged depression in the mining industry there is an increasing demand for explosive agents on the goldfields. The following comparative values shows how the quantities have been progressing.

Kinds and Quantities of Principal Industrial Explosives imported during the past three years.

	1906	1907	1908
Gelignite ..	2,554,565	2,469,780	3,261,928
Blasting Gelatine	445,650	552,600	438,500
Gelatine Dynamite.. ..	244,250	297,500	339,852
Dynamite ..	7,000	..	12,000
Blasting Powder	112,544	282,750	116,500
Sporting Powder	4,500	3,057	1,150
Total ..	3,548,509lbs	3,605,687lbs	4,169,930lbs

The number of tests carried out in the course of the year is 2,812 which represents an increase of 280 on the previous total. The rise is mostly due to the increased number of fuse tests which have been made in continuation of the special precautions which are being taken to bring about a greater uniformity and regularity in the safety fuse used in blasting, and which received special mention in last year's report (*vide A. & E., August*, 1908). It is very satisfactory to find that the burning speed limit, which was imposed by regulation under the Mines Regulation Act at Mr. Mann's suggestion, is having a very beneficial effect. The regular testing of fuse on the mines is now becoming an established practice, and everything points to greater regularity being now achieved in the fuse supplied to the mines than has ever hitherto been the case.

It is of interest to note one development in the use of explosives which has taken place, namely in connection with agriculture, in the application of nitroglycerine explosives to the clearing of land. The blowing up of large trees by means of small charges of explosives is becoming a very common practice, as it is found it is not only expeditious but cheap, and every month this practice is growing to an extraordinary extent, so that in some districts it has led to the consumption of quite considerable quantities of explosives.

For reasons of continued ill-health Mr. A. J. Guest has resigned his position, and Mr. T. N. Kirton has now been appointed assistant inspector of explosives.

LECTURE TO YOUNG GUNMAKERS.

LIX.—THE 50 YARDS DROP OF RIFLE BULLETS.

LAST month's lecture explained the process of translating observed velocity over a given distance into the amount of the bullet's drop during its passage along the range. During recent years various details of trajectory have become much better understood amongst gunmakers and shooters than was formerly the case, and it is likely that this species of knowledge will show still further development now that improvements in the sighting of rifles make the angle for any given range something much more real than ever it was before. It was fully explained last month that it is only at zero range that a bullet can be said to have zero drop. Therefore any attempt to define the zero of a rifle's shooting is at the best only approximate, unless a definite allowance is made for the action of gravity during the period the bullet is traversing the short distance under consideration. Practically speaking the true angle for a given range cannot be ascertained with regard to a particular rifle until the zero has been defined. True zero adjustment cannot be determined from the location of the axis of the barrel, because the rifle may jump considerably between the aligning of the sights on the object and the departure of the bullet from the muzzle. In many instances the jump is a truly parallel motion, but in others the front and back ends of the barrel move unequally. Especially is this so with regard to variations from the ordinary bullet weight. Therefore it may be said that the zero of every rifle is an unknown quantity until it has been definitely located by the user.

At the rifle factories great pains are taken to get things just right. But the firing tests are necessarily effected by means of more or less mechanical methods, differing in various ways from those which the shooter himself adopts in practical use. Rifles are in any event highly sensitive to the method of holding, and they are especially prone to give altered results when some form of rest is used to ensure steadiness. The National Rifle Association have recognised the importance of a preliminary short-range test of a rifle to the extent that they have provided a special 50 yards range at which a rifle's zero may be tested under conditions giving the shooter power to examine the actual target, and measure the deflection, vertical and horizontal, from the point aimed at. The service rifleman wants only the wind zero, whilst the match rifleman needs both wind and elevation. The former gets his elevation at 200 yards and works therefrom by the well-known rises. The distance 50 yards is likely for many reasons to be selected for preliminary short range experiments of the kind under consideration. First and foremost it is a regular shooting distance for miniature rifles and revolvers. Hence there are properly arranged firing points, and a supply of targets with suitable size bulls for 50 yds. tests wherever shooting is carried on. Therefore whatever may be the theoretical justification for zeroing military and other rifles at 60 yards, there will be a great many who perforce adopt the shorter and more generally recognised distance of 50 yards. The tables published last month have accordingly been re-worked for this distance, but they have been made to cover a very much wider choice of velocity, so as in fact to include all the miniature cartridges, and even air-gun bullets and stone throwing. It might be objected that since nobody troubles to measure the velocity of miniature ammunition over a greater distance than 20 yards, the necessary velocity results would not be available to supply the necessary foundation for arriving at the drop. In answer to such an objection it may be stated that one result can be converted into the other with the greatest ease by anyone conversant with the use of ballistic tables; furthermore, that the difference in drop caused by taking the velocity over 20yards as being the same as that over 50 yards is so small that it might almost be ignored. With the ·22 cartridge the difference, i.e., the loss of velocity between 10 and 25 yards, would be something in the region of 20 f.s. Bearing in mind that a velocity test is at best only the average of a series of shots, showing considerable divergence from round to round, it is obvious that the 20 f.s. difference is theoretical to the extent that the practical result may be the other way round. If each bullet were tested at each point of the range, consistent results would be obtained, but the average of one series compared with the average of another is liable to turn out as follows :—

20 yards velocity.	*50 yards velocity.*
1047 f.s.	1039 f.s.
1015 ,,	1064 ,,
1021 ,,	
1040 ,,	Av. 1052 ,,
1032	
Av. 1031 ,,	

It will be seen from the above results that quite as many rounds need to be fired at 50 yards as at 20 yards to show a true relation, and the simplest means in practice of arriving at the required value would be to work by tables from the ordinary result over 20 yards, and take from the 50 yards velocity so deduced, the required drop. Knowing, by whatever means are adopted, the 50 yards mean velocity of a particular bullet the translation of this value, first into time of flight, and then into drop, can be carried out by the means described in last month's issue. Briefly stated, these consist in dividing the velocity into the distance (in feet) which gives time, then squaring the time, and dividing by half gravity, which gives drop in feet, finally multiply by twelve to convert feet into inches. The results at each stage of the calculation have been tabulated as shown overleaf. Such a table is extremely interesting for many purposes outside the mere calculation of drop. The time of flight of a bullet over 50 yards for such a considerable series of velocity values provides interesting reference material. From the point of view of drop it is desirable to expand the values so as to show finer divisions than 100 f.s. graduations provide. This has been carried out by drawing the figures shown in the first table on squared paper, and reading off as many intermediate values as were thought to be useful.

The complete results are presented in the two following tables :—

TABLE I.—*Mean Velocity over* 50 *yards with corresponding time of flight and drop of bullet.*

Velocity ..	100	200	300	400	500	600	700	800	900	1000
Time ...	1·50	·750	·500	·375	·300	·250	·214	·187	·167	·150
Time² ...	2·25	·562	·250	·141	·0900	·0625	·0459	·0352	·0278	·0225
Drop" ...	435	109	48·3	27·2	17·4	12·1	8·87	6·80	5·37	4·35

Velocity ..	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
Time ...	·136	·125	·115	·107	·100	·0937	·0882	·0834	·0790	·0750
Time² ...	·0186	·0156	·0133	·0115	·0100	·00878	·00778	·00696	·00624	·00563
Drop" ...	3·69	3·01	2·57	2·22	1·93	1·70	1·50	1·34	1·20	1·09

Velocity ...	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
Time ..	·0714	·0682	·0652	·0625	·0602	·0577	·0556	·0536	·0517	·0500
Time² ...	·00510	·00465	·00425	·00391	·00370	·00333	·00318	·00287	·00267	·00250
Drop" ...	·984	·897	·820	·754	·696	·644	·607	·554	·517	·483

TABLE II.—*Mean velocity over* 50 *yards and corresponding bullet drop over that distance.*

f.s.	in.	f.s.	in.	f.s.	in.
100	=435·0	**1020**	= 4·18	**1720**	= 1·47
200	=109·0	**40**	= 4·02	**40**	= 1·44
300	= 48·0	**60**	= 3·87	**60**	= 1·41
400	= 27·2	**80**	= 3·73	**80**	= 1·38
20	= 24·7	**1100**	= 3·59	**1800**	= 1·34
40	= 22·6	**20**	= 3·47	**20**	= 1·31
60	= 20·6	**40**	= 3·35	**40**	= 1·28
80	= 18·9	**60**	= 3·23	**60**	= 1·26
500	= 17·4	**80**	= 3·12	**80**	= 1·23
20	= 16·1	**1200**	= 3·01	**1900**	= 1·20
40	= 14·9	**20**	= 2·91	**20**	= 1·18
60	= 13·9	**40**	= 2·82	**40**	= 1·16
80	= 13·0	**60**	= 2·73	**60**	= 1·13
600	= 12·1	**80**	= 2·65	**80**	= 1·11
20	= 11·4	**1300**	= 2·57	**2000**	= 1·09
40	= 10·7	**20**	= 2·49	**20**	= 1·06
60	= 10·0	**40**	= 2·41	**40**	= 1·04
80	= 9·4	**60**	= 2·34	**60**	= 1·02
700	= 8·9	**80**	= 2·28	**80**	= 1·00
20	= 8·4	**1400**	= 2·22	**2100**	= ·98
40	= 7·9	**20**	= 2·15	**20**	= ·96
60	= 7·5	**40**	= 2·09	**40**	= ·94
80	= 7·1	**60**	= 2·03	**60**	= ·93
800	= 6·8	**80**	= 1·98	**80**	= ·91
20	= 6·5	**1500**	= 1·93	**2200**	= ·90
40	= 6·2	**20**	= 1·87	**50**	= ·87
60	= 5·9	**40**	= 1·82	**2300**	= ·82
80	= 5·6	**60**	= 1·78	**50**	= ·80
900	= 5·4	**80**	= 1·74	**2400**	= ·75
20	= 5·1	**1600**	= 1·70	**2500**	= ·70
40	= 4·9	**20**	= 1·66	**2600**	= ·64
60	= 4·7	**40**	= 1·61	**2700**	= ·61
80	= 4·5	**60**	= 1·57	**2800**	= ·55
1000	= 4·4	**80**	= 1·54	**2900**	= ·51
		1700	= 1·50	**3000**	= ·48

A certain amount of discrimination has been exercised with the idea of giving a maximum of information in the space available. The condensation of values at the high velocities in the table is justified by the extremely small drop difference which 100 f.s. alterations of velocity produce. At ordinary military velocities each 100 f.s. makes approximately the tenth of an inch difference in the 50 yards drop, which is a very interesting general rule to commit to memory. In the region of shot gun velocity the effect of 100 f.s. more or less velocity is nearer an inch, whilst at air-gun velocity the effects are so varied that no general rule can be given. For instance, eighteen inches has been fixed by practical experiments as the 50 yards drop of a first-class rifled air-gun with a propelling spring of full power. According to the table this corresponds with a mean velocity over 50 yards of about 500 f.s., a result which fits in very closely with published velocity records. Other air guns with not quite so much power give from 24 to 30 inches of drop, and it will be seen from the table that this approach towards the limit of absolute inefficiency is accounted for by a fall of velocity to 400 f.s. or under.

Another portion of the table is equally interesting from the point of view of ·22 rifle cartridges. Low power ammunnition, with a velocity in the region of 800 f.s. has a 50 yards drop in the neighbourhood of six inches, which is reduceable to four inches, or even 3½, when velocity is in the region of 1,100 f.s. Taking 1050 f.s. as the average velocity over 20 yards, and assuming from the table that four inches is the corresponding 50 yards drop, it will be seen that a difference of elevation at 50 yards of two inches exists as between high power and low power cartridges of the same nominal type. This again is a result where practical experiments correspond with tabulated results.

In zeroing military and target rifles, generally speaking of the military type, it is interesting to notice that the table values arrange themselves around the inch value in the most convenient possible fashion. The inch drop, which is equivalent to two minutes of angle, is true for most bullets in the region of 2000 f.s. velocity. For more exact work, such for instance as the location of a rifle's zero with a view to locating the elevation mark for some untried distance, say 500 yards, the table values should be used. Assuming that the bottom of the bull is the point aimed at, if there were no drop the bullets would strike the height of the foresight, measuring from the axis of the barrel, below the bottom edge of the bull. The table value of the drop is then added, and the rifle has true zero elevation when the bullets arrange themselves around a horizontal line drawn the drop plus foresight distance below the bull. Assuming the rifle to have the same general characteristics of trajectory as the ·303, the 100, 200 and 300 yards sight adjustments could be obtained by 50 yards shooting as follows. :—

Range in yards.	Angle in inches per 100 yards.	Corresponding position at 50 yards.
100	4·5	2·25
200	9·3	4·65
300	15·0	7·5

The first column gives the range in yards, the second consists of well-known figures relating to the ·303 rifle, which are true for all the high power express rifles with about the same length of bullet, and the third column is the second lot of values divided by two. By drawing a series of horizontal lines above the zero line on the target, and adjusting elevation so that the bullets strike each in turn, a rifle can be correctly sighted at 50 yards to any distance for which the angle of elevation is known.

ROUND THE TRADE.

The Electric Ordnance Co., Ld. has been registered with a capital of £10,000, and the first directors are Messrs. H. F. Spencer, A Blackman, and Dr. Voltereck.

Major F. T. Fisher, R.A., *p.a.c.*, superintendent of experiments at Shoeburyness, is reported to be the chosen successor of Lieut.-Col. Sir F. L. Nathan, as superintendent of the Royal Gunpowder and Small Arms factories at Waltham Abbey and Enfield Lock respectively.

Messrs. Joseph Lang & Sons Ld. have issued a new edition of their pamphlet and catalogue dealing with the work carried on at their shooting school at Neasdon. Some of the photographs are especially fine, particularly the one showing the ride where the idea of shooting woodcock amongst trees is carried out.

The explosives department of the Home Office has issued an order under Section 6 of the Coal Mines Regulation Act, 1896, entitled "The Explosives in Coal Mines Order of the 3rd July, 1909," the effect of which is to add "Nobel Ammonia Powder," "Samsonite," and "Titanite No. 1" to the list of permitted explosives.

Messrs. Thomas Bland & Sons' premises in King William Street, Strand, were entered by burglars, who removed a certain amount of stock consisting of various of the more portable forms of firearm Their booty was thus confined to various double-barrel pistols, revolvers and automatic pocket pistols, all of which bore registered numbers which will facilitate their identification should they in due course be offered for sale.

From Messrs. Eley Bros. there has arrived a seasonable reminder that the time for shooting has once more come round, in the form of a countryman of typical bucolic aspect heavily laden with pheasants, partridges, rabbits, a duck, and a hare, the moral of the story being the deadly nature of Eley cartridges for all species of game. The original picture is undoubtedly the work of a clever artist, and the colour reproduction successfully transmits his ideas without anywhere marring the carefully balanced proportion which characterises the picture as a whole.

A correspondent writes:—"The import of arms and cartridges to Abyssinia amounted to 49 tons in 1908, against 100 tons in 1907, and 85 tons in 1906. Their import is not allowed except under a special permit from the Emperor. The Ottoman Government has decided to sell a large number of bronze cannons, which have to-day, merely a historical interest. Invitations have been extended to various well-known European foundries to send their representatives to Turkey to inspect these out-of-date weapons with a view of tendering for them. They include a large number of cannon captured from the enemy in various engagements. The Turkish Grand Master of Artillery has been authorised to appoint a Commission to consider the tenders of interested firms."

The Souvenir which has been issued in celebration of the jubilee of the National Rifle Association is well worth the shilling which has been charged for it. It contains reproductions of various interesting scenes associated with the early days of the Wimbledon rifle meetings. In the old days the caracaturist and the serious artist were not in rivalry with modern photography. Consequently the jubilee souvenir contains several interesting contrasts between the humourous illustrations of the past, and the faithful but unexciting photography of the present. The letterpress has been extremely well compiled, with the result that many historical incidents, known only to the few, are here brought into prominence in a popular form. Messrs. Gale and Polden are the publishers.

Messrs. Debenham, Storr & Sons will hold their next sale of guns and rifles on the 13th inst.

The firm of Charles Lancaster & Co., Ld. have forwarded a copy of their most recent catalogue, which is characterised throughout by the excellent arrangement of a quantity of extremely interesting technical matter relating to the manufactures of the firm, and the various goods in which they deal.

The Council of the Royal Society of Arts have honoured Sir Andrew Noble by the presentation to him of the Albert medal in recognition of his long continued and valuable researches into the nature and action of explosives, which have resulted in the great development and improvement of modern ordnance. The Prince of Wales, as president of the society, made the presentation, being supported by a large gathering of distinguished members of the Council.

It is reported from Australia that the contract for building a factory at Lithgow for the manufacture of Government service rifles has been awarded to the Pratt and Whitney company in the United States. The price mentioned is £68,000, and the intended output is placed at 15,000 rifles per annum. In justification of the contract having been placed with an American firm, it is mentioned that to place the contract in England would have entailed a considerable extra cost, and a material extension of the time between giving the order and the commencement of manufacture.

Gunmakers who have argued that the Pistols Act Clauses have no deterent action in the case of persons of criminal intent, but mainly incommode legitimate users of these weapons, will find in the report of the proceedings against the murderer of Sir W. Curzon Wyllie the most emphatic testimony in confirmation of their case. The prisoner purchased in his own name a gun licence at the Hatton Garden post office, be it understood at a time of year when the ordinary game shooter's licence is about to expire. On the following day he proceeded to Messrs. Gamage's premises and purchased an automatic pistol with all due formality. Having possessed himself of a weapon of destruction he regularly frequented a shooting gallery in Tottenham Court Road, where he engaged in serious practice, daily firing a dozen or so rounds for the purpose of perfecting his acquaintance with the mechanism of the weapon. His progress was rapid, but subsequent events proved, when he endeavoured to compass his own destruction, that he had not fully mastered the necessity to keep the safety catch under compression whilst pulling the trigger.

A correspondent writes:—"From a recently-published Austro-Hungarian Consular Report it appears that the import of arms and guns to Australia during 1907 was valued at £80,000. The principal articles imported were sporting guns, these making up £64,300 of the total import value. United States manufacturers secured £33,000 worth of this business, Great Britain did £20,300, Belgium £6,660 and Germany £4,200. The guns coming from the United States were mostly of cheap and medium qualities, Great Britain doing nearly all the better class trade and a fair amount of the middle-class business as well. Belgium and Germany provided only the cheapest qualities, and it is interesting to note that the latter country has lost considerable ground of late years. In the inferior qualities the greatest demand is for guns of from £1 to £2 10s. in value; guns priced from £2 10s. to £4 are not so much asked for, and the sale of really high-class guns is very limited. The import of military guns reached a value of £3,500, and they came entirely from England. The value of imported revolvers and pistols was £6,800 of which £3,600 worth were supplied by the United States, £2,000 from Great Britain; one or two other countries sharing the balance between them. Other arms were imported to the value of £5,800."

ABEL ON GUNCOTTON (1866).
PART II.

BY GEORGE W. MACDONALD, M.Sc., F.C.S.

(*continued*).

The relation between the nitrogen and carbonic acid obtained by oxidation of guncotton has been determined. For this purpose, Liebig's method of operating was adopted in the first instance; the guncotton being prepared and arranged for combustion as in the case of the nitrogen determinations, and the mixed gases collected in successive proportions and examined. A few experiments rendered it evident, however, that this method, when applied to the examination of guncotton, did not furnish trustworthy results. In the decomposition of this substance, when distributed through a very large proportion of copper oxide; the oxidation of the carbon does not proceed uniformly; small portions of that element evidently escape oxidation in the first instance, and are only subsequently burned when the nitrogen has already been in great proportion liberated. The proportion which the carbonic acid bears to the nitrogen in the gases successively collected varies therefore, frequently, as the combustion proceeds; and it would consequently be necessary to collect the entire quantity of gases furnished by the guncotton operated upon, in order to arrive at a correct result. The following statement of the relative proportions by volume of the gases collected successively in two operations of this kind, will serve to illustrate the variable composition of the gas collected at successive stages of one and the same operation. In both experiments the gas had been allowed to escape for some time, before the first collection, for expulsion of the air in the combustion tube. The results varied from 77·45 per cent. of carbonic acid and 22·55 per cent. of nitrogen, to 80 per cent. of carbonic acid, and 20 per cent. of nitrogen. The majority of results obtained in each of the above experiments are concordant among themselves, and agree closely with the percentage proportions (by volume) of carbonic acid and nitrogen which should be furnished by trinitro-cellulose (namely 80 of carbonic acid to 20 of nitrogen). But in each experiment somewhat discordant results were obtained, and therefore this method of determining the relation between the carbon and nitrogen in guncotton was abandoned as not sufficiently trustworthy. It should be observed, however, that even the mean of the several results obtained in each experiment corresponds much more closely with the volume-proportion which should be furnished by trinitro-cellulose, than with that demanded by the formula which Pelouze and Maury adopted.

Several determinations of the relative proportions of carbonic acid and nitrogen have been made by Bunsen's method. The mode of operating was as follows. Into a very stout wide Bohemian glass tube, about 22 m. long and sealed at one end, were introduced, first some reduced copper, then about 0·1 to 0·15 grm. of the dry guncotton, and afterwards sufficient oxide to fill about 4cm. of the tube. The open extremity of the latter was constricted, and sealed when air had been exhausted. The guncotton was then decomposed by applying the flame of a lamp for a short time to the tube. After the oxide of copper had been distributed over the surface of the tube (to the interior of which it adhered, in consequence of the deposition of water from the exploded guncotton upon the glass), the latter was introduced into a vessel of wrought iron, within which it was compactly surrounded on all sides by very fine sand. The vessel consisted simply of a piece of gas-pipe about 25 cm. long and of 3 cm. internal diameter, closed at one end by means of a plug welded into it, and provided at the other extremity with a screwcap. A few small perforations were drilled into the sides of the pipe. The glass tube was exposed in this envelope to a red heat for about an hour; when cold, it was opened under mercury, and the gas transferred and examined in the usual manner. The results thus arrived at, which will be quoted presently, were very concordant, and stood in close relation to the results obtained by the separate determinations of carbon and nitrogen in guncotton.

The reproduction of cotton from pyroxylin by Hadow's method has been made the subject of many experiments, with the view of controlling by its means the analytical and synthetical results obtained. It was found that by submitting purified insoluble guncotton to the action of an alcoholic solution of potassium hydrogen sulphide, as directed by Hadow, the amount of cotton obtained corresponded closely to the theoretical proportion to be furnished by trinitro-cellulose. The following results may be quoted as examples. They were obtained with guncotton which contained only small proportions of matter soluble in ether and alcohol. From 4·064 to 4·898 grms. of substance were employed. The theoretical percentage of cotton produced from trinitro-cellulose was 54·54 per cent. From 9 different samples of guncotton the results varied from 53·64 per cent. to 55·38 per cent. In conducting experiments on this method of examination, a liability to mechanical loss was observed when a very strong solution of the potassium hydrogen suphide was employed, in consequence of the fibre becoming to a considerable extent disentegrated during the digestion; but this can be easily avoided by employing the reagent in a more dilute form. The solution best adapted for effecting the complete reduction of guncotton by digestion in the cold without breaking up the fibre, was obtained by preparing a saturated solution of potassium hydrate, completely saturating this with hydrogen sulphide, and diluting the liquid thus obtained with half its volume of alcohol. A small loss of product occurs generally, even when the sulphide solution is not stronger than just described, in consequence of a feeble solvent action exerted by the liquid upon the reduced cotton. In one experiment a sample of cotton obtained from guncotton sustained a loss of 0·6 per cent. by digestion in the cold for forty eight hours with the K.H.S. A slight excess (about 0·5 per cent.), is sometimes exhibited by the weight of the reduced cotton over the amount which should be furnished, theoretically, by pure trinitro-cellulose. In order to ascertain how far this might be ascribed to the retention of sulphur by the cotton under treatment, a very careful examination of several specimens was instituted. A faint

odour of sulphurous acid was sometimes observed when the reduced cotton was burned, and in two or three instances the cotton sustained a slight loss (from 0·1 to 0·3 per cent.) upon being digested and washed with carbon disulphide; but in other instances the proportion present was only very minute, and the cotton was generally found to be quite free from sulphur. A comparison between the ash existing in the guncotton, showed that no proportion of an excessive result can be ascribed to an accumulation of that constituent. Although the amount of guncotton operated upon is about double that of the cotton recovered, the latter was found to contain the smallest proportion of ash. It is evident that the mineral impurities which, during the washing operations, have attached themselves to the guncotton fibre, become partially detached during the digestion in KHS, and the subsequent washing. Some combustions made of the reduced cotton furnished proportions of carbon and hydrogen which, though according fairly with the requirements of pure cellulose (allowance being made for the ash in the specimens analysed), were somewhat below the theoretical numbers. The theoretical percentage of carbon in cellulose was 44·44 per cent. The amount found was 43·98 per cent. The specimens analysed were carefully examined for nitrogen, and very small quantities were detected. The deficiencies of the carbon obtained from them may, therefore, be to a slight extent ascribable to minute portions of the nitro-product having escaped reduction. A still greater influence upon the results must, however, be exerted by the invariable existence of small quantities of foreign organic substances in the samples operated upon. The slight excess obtained, in many instances, above the theoretical amount of cotton may, it appears, be occasionally due to some extent to accidental causes, but it is mainly to be ascribed to the presence in the specimen examined of a proportion of material resulting from the less perfect action of nitric acid upon some portions of the cotton fibre. Unfortunately, however, the fluctuations in the results which may be furnished by different examinations of the same specimen of guncotton by this method, though they might be regarded as not very important in an ordinary analytical process, may be equivalent to differences which would be caused by very considerable variation in the amount of soluble guncotton present in the substance. Supposing that the matter soluble in ether and alcohol in a specimen of guncotton amounted to 2 per cent. and consisted of the compound $C_{18}H_{23}O_{15}(NO_2)_7$, the result of the analysis should be affected by that impurity to the extent of about 0·1 per cent. An excess of 0·5 per cent. obtained in the examination of a sample should therefore indicate the existence of 10 per cent. of the above compound (readily soluble guncotton) in the sample; or if the specimen contained that percentage of a compound $C_{18}H_{22}O_{15}(NO_2)_8$, this would only affect the result by 0·3 per cent. It cannot be confidently asserted that the errors of the method itself are ever less than from 0·3 per cent. to 0·5 per cent. It is evident, therefore, that this method of examining guncotton, though useful as a mode of controlling the results obtained by determining the increase of weight which cotton sustains by treatment with nitric acid, under varied circumstances, is not susceptible of affording sufficiently definite and trustworthy results to render it applicable as a method of ascertaining the degree of freedom from soluble guncotton, of products of manufacture.

(Photo by the Dover Street Studios.)

The Explosives Section of the Recent Chemical Congress.

Experiments on the increase sustained by cotton in its conversion into guncotton. Hadow found that cotton-wool, by treatment with the strongest mixture of nitric and sul-

phuric acids, sustained an increase of 81·34 per cent., that the guncotton produced was quite insoluble in mixtures of ether and alcohol, and that the increase of weight which cellulose should sustain by conversion into the trinitro-cellulose agreed very nearly with the results of his experiment. Pelouze's earlier experiments fixed the maximum increase in weight sustained by cotton upon conversion into guncotton at 76 per cent. But in the recent report of Pelouze and Maury it is stated that, in a number of laboratory experiments in which the composition of the acid-mixture, the proportions borne by the acid used to the cotton treated, and the duration of the treatment, were variously modified, the increase in the weight of the cotton fluctuated within narrow limits, and did not exceed 78 per cent. The authors are led, mainly by these results, to adopt the formula :

$$C_{24}H_{36}O_{18}(N_2O_5)_5$$

because cellulose, by conversion into a substance having the percentage-composition which that formula demands, should sustain an increase of weight of 77·78 ; a number which is very slightly *below* the maximum results obtained in their experiments. It should be stated that they describe the acids employed by them in all their experiments as follows : the sulphuric acid had a density of 66° Baume (which corresponds to a sp. gr. of 1·767), and the nitric acid had a specific gravity of 1·50 at 9°C. It will be observed that these acids, but more especially the sulphuric acid, are very notably inferior in strength to those prescribed by Von Lenk, which have been used in all the experiments now described, and are always employed in the manufacture of guncotton at Waltham Abbey ; namely, sulphuric acid of sp. gr. 1·833 to 1·84 (somewhat above 69° Baume), and nitric acid of sp. gr. 1·52 at 15° C. It appears most probable from many of the experimental observations included in these researches, that such discrepancies as exist between the results arrived at by Pelouze and Maury, and by Hadow, the German chemists and myself, are to be mainly ascribed to the differences in the strength of the acids employed. The subjoined results of very numerous experiments will, I believe, be admitted not only to establish satisfactorily the correctness of Hadow's statement, that cotton-wool may be made to sustain an increase in weight above 81 per cent. but also to show that the results of other experimenters who have found the increase sustained by cotton not to exceed 78 per cent. are in perfect harmony with the conclusion that the product of the complete action, upon cotton-wool, of certain mixtures of the strongest nitric and sulphuric acids, is the substance

$$C_6H_7O_5(NO_2)_3$$

in a nearly pure condition. Experiments where guncotton was subjected to repeated immersion in fresh mixture of acids, where the proportion of acid to cotton was about 60 to 1 showed that 100 parts of cotton increased in weight to 182·13, a number somewhat higher than that obtained by Hadow. By protracting the treatment beyond the point when the product ceased to increase in weight, a slight but continuous loss was sustained, which, there appears no doubt, from the results of confirmatory experiments, is to be ascribed to the solution of small quantities of guncotton in the strong acids with which it was left in prolonged contact. Repeated immersion of cotton in an acid-mixture of somewhat less strength, does not effect, nearly as rapidly or as completely, its conversion into insoluble guncotton, as does a single treatment with the acid-mixture prescribed by Von Lenk. Experiments in which the proportion of acid to cotton was 50 to 1 showed that by a single treatment of cotton with a considerable proportion of the strongest acid-mixture, results may be obtained closely in accordance with the number given by Hadow, and with the theoretical requirement of trinitrocellulose. The mean of these experiments fixes the maximum increase in weight which cotton is capable of attaining by this treatment at 82·16 per cent. ; the theoretical number is 83·3 per cent. Where the proportion of acid to cotton was 10 to 1 and the time of contact 12 to 48 hours the conversion into trinitro-cellulose cannot be completely accomplished. In these instances, the increase of weight sustained by the cotton is between 78 and 80 per cent. As might have been anticipated, the products contained notable proportions of matter soluble in ether and alcohol, while those obtained in the experiments with a larger proportion of acids yielded only a minute trace to the solvent.

(*To be continued*).

THE EXPLOSIVES REPORT.

IN consequence of the death of Capt. Thomson, also the retirement of Capt. Lloyd to join the board of Messrs. Curtis's & Harvey and finally the absence of Capt. Desborough during his trip to America in connection with the enquiry concerning coal mining dangers in that country, the usual programme of H. M. Inspectors of explosives was somewhat disorganised during the period covered by the twenty-third annual report, which has just been published. The number of visits of inspection has been considerably curtailed, but such time as was available has been employed where supervision is most needed. The number of deaths from accidents by fire or explosion in the manufacture of explosives during last year was three only, which is considerably below the average, seven, for the past decade.

HEAT TEST COMMITTEE.

The following reference deals with this subject :—" For some years before his death the late Dr. Dupré had been engaged with the assistance of his sons, in experimental research, with the object of finding an efficient check test for the Abel heat test, and, with a view, if possible, to complete this work, a conference, attended by the chief representatives of the trade and at which Sir Frederick Nathan very kindly agreed to be present in an unofficial capacity as a manufacturer, was held at the Home Office on December 15th. The general feeling of the meeting seemed to be (1) That, although the heat test was second to none as regards reliability, and as a test of purity in manufacture was, by reason of its convenience and adaptability to all natures of nitro-compounds, practicably indispensable, it was undoubtedly highly desirable that where important interests are involved a verdict of rejection should not depend on a single test. (2) That if substantial financial assistance were to be forthcoming from the trade, it was of the utmost consequence that any check test or tests should be formulated under the *ægis* of a body of experts of unquestioned authority, such as a joint committee represent-

ing the Home Office, War Office, Admiralty, and, lastly, the trade itself. As the above accorded with our own views, we undertook to advise that the War Office and Admiralty should be approached in the matter."

REPORT OF CHEMICAL ADVISERS.

Messrs. F. H. and P. V. Dupré, after detailing the routine tests of their department, mention, under the head of research, that the fund provided by the treasury for some years past for an investigation into the heat test and other stability tests came to an end this year. It seems that a large amount of work has been done which has been extremely useful to them already, and they hope to have an opportunity of publishing all the results at some future time. Before this can be usefully accomplished they have to carry out a number of further tests, which they will do at the earliest opportunity, but as they have, unfortunately, very little time or facilities for special work at present they are quite unable to give any date for such publication. If it may be permitted to criticise so obvious a confession of nerveless endeavour, it may be stated that research work, especially if conducted at public expense for public good, gains order and definition of purpose by occasional organisation in the form of interim reports. Human affairs are best conducted on the principle of instalments, and certainly half the information of a scientific enquiry is for ever lost if publication is delayed till the mental grasp of the subject has lost its freshness. The Society of Chemical industry would no doubt be delighted to include in their journal the "extremely useful" results which the brothers Dupré describe themselves as having already obtained. The logical arrangement of ideas, which is one of the essential preliminaries to publication, provide an all-important basis upon which to commence the next stage of the work. Interim publications have also the advantage of dividing the programme of research into manageable and self-contained units. Furthermore, the cultivation of literary ability is not the smallest of the duties which students of science owe to their public.

Mercury in Explosives.—The following is a verbatim reproduction of the remarks which appear under this heading :

We think it desirable to add a few remarks on mercury in explosives to those made in our last report, and hope that it will not be necessary for us to refer to this subject again. There seems to have been a feeling in some quarters that our rejection of some explosives for containing mercury was unjustifiable on account of the minuteness of the quantity present, and at the same time it has been alleged that our Spectroscopic Test for mercury in explosives is far too delicate for a test that, after all, is to control the Heat Test.

As stated in our annual report for 1907, we found that 1/1000th milligram of mercury, under favourable conditions, has a marked influence on the Heat Test. We have also found that, with the conditions under which we work in the Spectroscopic Test, we do not detect with certainty much less than 1/100th milligram of mercury. Now take for consideration the explosive for which the smallest quantity is taken for the Heat Test, and the largest for the Spectroscopic Test, viz., cordite. One thousandth of a milligram of mercury, or a quantity sufficient to affect the Heat Test, on the 25 grains taken for this test, is, very approximately, 1 part in 2,000,000, while 1 part in 2,000,000 on the 15 grams employed for the Spectroscopic Test is very nearly 1/100th milligram, or the smallest quantity we detect ; the two tests are therefore, in this case, strictly comparable, while in the case of all other explosives, under the tests at present prescribed, the Heat Test is the more sensitive. It is obvious that, when considering the amounts of materials that might influence the Heat Test, their action under the most favourable conditions must be considered, such, *e.g.*, as would obtain if bi-chloride of mercury in solution, were painted on the outside of the explosive.

Incidentally the Heat Test has been called a very rough test, a very refreshing change from the charge that has been levelled against it for so many years, viz., that it was far too sensitive. Notwithstanding the above we maintain that the presence, in however minute a proportion, of an unnecessary ingredient, which may be objectionable, justifies the rejection of the material containing it, regardless of the quantity required to do actual harm. If it can be proved that the precautions necessary to avoid the presence of such minute traces would seriously hamper the trade as a whole, a compromise might become necessary. We must here state emphatically, however, that the results of a very large number of tests, made on many samples to which we had no reason to suspect a deliberate addition of mercury, have convinced us that it is, to say the least, highly improbable that the test, as carried out by us, will detect such mercury as may find its way into the explosive in the ordinary process of manufacture.

Special Work.—"During the course of the year we have done a very large amount of work on the stability and purification of guncotton. We have got a large number of very interesting and suggestive results, but so far are not in a position to make any definite statement about them. We much hope, however, to be able to do this at some future time."

PERMITTED EXPLOSIVES.

No experimental work has been carried out at the testing station during the year under review. Various explosives have, however, been submitted to the official test. Capt. Desborough calls attention to a case of ignition which occurred with Carbonite. He says :—

This explosive, when tested by the unstemmed shot system gives the result that a charge of 1,000 grammes fails to ignite the most sensitive gas mixture. In the particular case, at the Whitwood Colliery, a charge of under 350 grammes ignited fire-damp ; no coal dust was involved. I do not mean to imply that this proves that the Continental system of testing is wrong, but it demonstrates that the advocates of that system of testing explosives are not warranted in making the statement that it is always safe to use charges not exceeding the *charge limite*. This is the first recorded instance in this country of an ignition of fire-damp by Carbonite. It may be of interest to note that an ignition occurred at the Glencoe Colliery in Natal on the 13th February this year. According to the report of the Commission appointed to enquire into the accident, the ignition was occasioned by the firing of a charge of 6 ozs. (about 170 grammes) of Carbonite in a shot hole 2 feet 9 inches in depth, stemmed to the mouth with damp sandy loam. A shot had been fired the previous day, but had only "chambered" the coal, leaving the face and stemming intact. The shot which caused the ignition was planted 15 inches from the former shot hole. There was evidence to show that the coal which it was intended to bring down had apparently not been loosened or shaken by the shot fired on the previous day. On firing the shot eight persons were injured by the resulting ignition ; three of them subsequently succumbed to their injuries. The coal was also found to be on fire. Subsequent explosions occurred which caused great loss of life. (12 Europeans and 74 natives were killed).

The 1907 table of relative consumption of permitted explosives has been reprinted in this year's report to notify a clerical error by which ammonal was wrongly put second on the list due to accidental multiplication of the total by ten. The various explosives hold, with few exceptions, the same relative positions in the table for 1908 as compared with the previous year. The total consumption dealt with is 8,297,738lbs. as against 7,764,122lbs. in 1907. Permitted explosives represent 26·9 per cent of the total consumption under the Coal Mines Regulation Act, gunpowder 60·9 per cent., gelignite 8·9 per cent., other nitroglycerine explosives 2·2 per cent, whilst the figure for Cheddite is 0·8 and various 0·3.

APPLICATIONS FOR PATENTS.

JUNE 14—JULY 17, 1909.

13,921.* Small Arms. J. Tambour.
13,946.* Automatic Firearms. K. Krnka.
14,006.* Barrel Recoil Guns. Fried. Krupp.
14,032.* Gun Mounts and Shields. P. M. Justice.

14,079. Sighting Rifles. P. Wilkie.
14,138.* Breech Loading Machines. E. C. R. Marks.
14,223.* Recoil Loading Guns. Aktiebolaget Svenska Vapenoch Amunitions-fabriken.
14,250. Ordnance Sight Testing. A. T. Dawson and J. Horne.
14,284. Projectiles. S. D. Cushing.
14,305.* Small Arms. P. Mauser.
14,330. Operating Gun Mechanism. H. C. Leake.
14,490.* Adapting Small Arms for Miniature Ammunition. R. E. Reardon.
14,503. Targets. W. Winans.
14,522. Ordnance Shells. E. Wall and G. C. A. Kohler.
14,534.* Artillery Projectiles. C. W. Gebauer.
14,563. Rifle Barrel Cleaning Implement. A. W. Foster.
14,590. Sighting Device. A. Shaak.
14,726.* Differential Recoil Guns. K. Haussner.
14,804.* Differential Recoil Guns. K. Haussner.
14,851. Shooting Gallery Target. H. James.
14,926.* Bayonet Attachment. C. A. T. Sjögren.
14,939. Reducing Sound of Discharge. T. R. R. Ashton.
14,996.* Automatic Pistols. C. P. Clement.
15,064. Repeating Firearms. R. E. Jeffrey.
15,296. Checking Recoil in Gun Mountings. J. Carey and J. Lecoche.
15,307.* Gun Mountings. M. Amico and L. Lavagna.
15,309. Aiming and Firing Rest. J. C. Morris.
15,339. Moving Targets. D. H. Marrable.
15,487. Indicating Gun Positions. Evershed and Vignoles Ld., and W. D. Kilroy.
15,503. Target Practice Apparatus. F. Mitchell.
15,606. Projectiles. L. Tabulo.
15,734. Carbide of Calcium Cartridges. A. Barnett.
15,753.* Firearms. M. C. Lisle and H. M. Kipp.
16,128. Small Arms. R. J. Petersen.
16,159.* Percussion Fuses. E. Schneider.
16,202. Ordnance Control. L. J. Graham and H. R. Latham.
16,223. Small Arms. H. White.
16,439.* Attaching Slings to Rifles. C. E. Schaar and B. Hauschild.
16,444.* Gun Carriage Attachment. F. Marchionni.
16,474. Ordnance Recoil Apparatus. H. A. Bethell.
16,486. Blasting Cartridge. J. Turns.
16,505. Small Arm Sights. A. L. Tisdall and W. J. Robinson.
16,506. Small Arm Sights. A. L. Tisdall and W. J. Robinson.
16,525. Rifle Breech Mechanism. T. R. R. Ashton.
16,617.* Ammunition for Guns on Airships. Fried. Krupp.
16,709. Electric Igniting Apparatus. Nobel's Explosives Co., Ld., and W. T. Evans.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

JUNE 24—JULY 22, 1909.

COMPILED BY HENRY TARRANT.

13,332 (1908). **A Portable Cartridge Holder.** Capt. J. H. D. Savile, London. (*See Selected Patents*).

13,742 (1908). **Single Trigger Mechanism.** O. H. Peak, U.S.A. In this mechanism, through which two barrels may be discharged by means of a single-trigger, what is called a ponderable member is suspended from a support beneath the tang of the action. This member is operated by the recoil and regulates the conveyance of movement of the trigger to either of the sears. Accepted June 29, 1909.

13,813 (1908). **Single Observer Range-finder.** Prof. A. Barr, Glasgow, and Prof. W. Stroud, Leeds. Single observer telemeters of the type described in patent No. 1,462, 1903 are fitted with handles or supports projecting downwards. Working heads are located adjacent to the handles. The instrument is in this way better adapted for field work. Accepted June 24, 1909.

13,880 (1908). **Automatic Pistol.** A. Tomischka, Vienna. This automatic pistol has an exposed hammer. The magazine is situated between the hammer and the trigger mechanism. A cocking bar runs between the trigger and hammer. The whole of the parts are arranged so as to allow of easy dismounting. Accepted June 10, 1909.

15,916 (1908). **A Perchlorate of Ammonia Explosive.** E. H. D. Kilburn, London. (Agent for *C. Pieper, Germany*).

15,928 (1908). **Automatic Rifle Mechanism.** J. Eastwick, London. The mechanism of this rifle is operated automatically by the recoil and by hydraulic pressure. The hydraulic apparatus lies below the bolt. The barrel of the arm does not recoil. Accepted June 24, 1909.

16,343 (1908). **Automatic Firearms.** A. G. Bloxam, London (Agent for *Oesterreichische Waffenfabriks Gesellschaft, Austria*). Special means are introduced for turning the cover on the breech casing of automatic bolt action rifles. An inclined plane on a ledge lying below the cover operates a part through which the cover is turned in opening and closing. Accepted June 24, 1909.

16,503 (1908). **Ordnance Firing Mechanism.** Lieut. A. T. Dawson, and G. T. Buckham, London. The box slide carrying the moveable firing lock is dealt with in this patent. It is held in place by means of interrupted fillets engaging fillets on the axial vent. The patentees introduce means for preventing the entire disconnection of the box slide from the vent. Accepted June 3, 1909.

17,980 (1908). **Small-arm Bullets.** L. B. Taylor, Birmingham. The bullet described in patent No. 3,897, 1901, is improved. For ballistic reasons a long hollow conical point is attached to front of the body of the bullet. Accepted June 10, 1909.

19,327 (1908). **Shot Cartridges.** J. Page Wood, Bristol. To reduce friction between the barrel and the overshot wad the end of the loaded cartridge is compressed so that the wad is made dome shaped. To ensure complete combustion of the powder charge the cartridge is crimped about its middle. Accepted July 1, 1909.

19,404 (1908). **Automatic Pistol.** Col. O. H. J. Krag, Norway. An automatic pistol containing novel features is dealt with in this patent. It may be operated entirely by one hand. In front of the ordinary trigger is another trigger which when pulled rearwards opens the bolt for loading the first cartridge. Accepted June 10, 1909.

20,042 (1908). **Cartridge Clips.** M. G. Farquhar, London. This clip is designed with the object of holding the cartridges securely. A little stud is pivoted at the end of the clip so that it may be turned over the base of the end cartridge when it is desired to hold the clip load properly and may be removed when the cartridges are to be loaded into the magazine. Accepted July 1, 1909.

21,472 (1908). **Ordnance Sights.** La Société Schneider et Cie, France. Ordnance sights of a certain type are made of smaller dimensions, it is claimed, without interfering with precision. The modifications necessary to bring about this result are fully described and illustrated in the specification. Accepted June 10, 1909.

22,555 (1908). **"Hydrox." An Explosive Compound.** G. Lezinsky, U.S.A. (*See Selected Patents*).

27,672 (1908). **Sights of Turret Ordnance.** E. Schneider, France. This invention has application to the sleeve or tube which has an eye piece and an objective at the lower and upper extremities and consists of a protector for the objective which projects beyond the turret roof during firing. The protector folds down when the sighting tube is lowered. Accepted June 10, 1909.

187 (1909). **Night Sights.** F. H. Harrison, J. W. B. Ross and H. Bebbington, Calcutta. A portable acetylene lamp is attached to the top of the barrel just behind the backsight. The generator is carried in the pocket. The light from the lamp illuminates both sights and the object. Accepted June 3, 1909.

2,278 (1909). **Magazine for Automatic Pistols.** P. Mauser, Germany. (*See Selected Patents*).

2,462 (1909). **Revolver Butt.** Count Bela Kreith, Hungary. The stock for a revolver is shaped so that the fingers may enter separate rings in the underside. This arrangement renders it useful as a "knuckleduster" supposing the user desires to strike instead of shoot. Accepted July 1, 1909.

2,576 (1909). **Cocking Mechanism for Breakdown Smallarms.** Chas. Osborne and Co., Ld. and C. Ryland, Birmingham. (*This patent will be fully described in our next issue*).

7,785 (1909). **Range Finder Frames.** Prof. A. Barr, Glasgow, and Prof. W. Stroud, Leeds. The inner frames of range finders are improved. These frames, which carry the objectives, eyepieces, prisms, etc., and the adjusting parts for the end prisms, are made longitudinal in section with strengthening pieces. Accepted June 24, 1909.

7,786 (1909). **Range Finder Scales.** Prof. A. Barr, Glasgow, and Prof. W. Stroud, Leeds. A horizontal scale graduated on both sides is provided. It is observed through eyepieces on both sides of the instrument and is made to appear vertical by prisms or mirrors. The scale is shown as for a single observer telemeter. Accepted June 16, 1909.

SELECTED PATENTS.

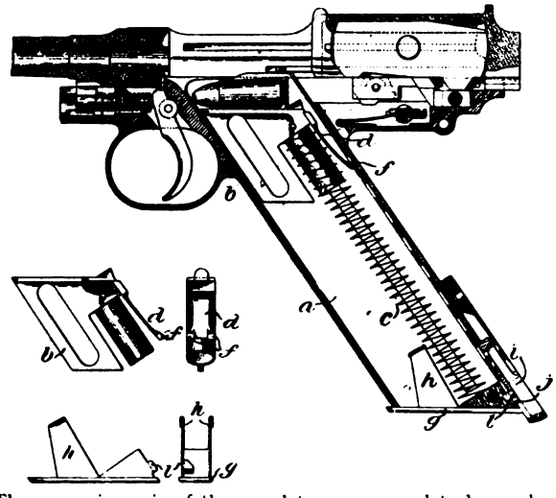
A PERCHLORATE OF AMMONIA EXPLOSIVE.

15,916 (1908). B. E. D. Kilburn, London. (Agent for *C. Pieper, Germany*). The explosive described in this patent is of the type in which perchlorate of ammonia is used in combination with an alkali nitrate and one or more hydrocarbons. The compound consists of perchlorate of ammonia, a nitrate of alkali metal either nitrate of soda or nitrate of potassium, and two hydrocarbons—one a solid or liquid product of natural petroleum, substantially non-volatile at ordinary temperature, and the other a nitrated coal tar product. The ammonia perchlorate and the nitrates are proportioned in the usual manner. The relative carbon and oxygen contents are arranged so that complete combustion is assured.

An example of the explosive is as follows :—Paraffin wax 13% ; Trinitrotoluol 14% ; perchlorate of ammonia 42% ; sodium nitrate 31%. Other hydrocarbons of a similar nature to those mentioned may be employed, the proportions then being varied as is found necessary. The constituents when amalgamated are treated with a binding medium to render the explosive convenient for handling. Accepted June 17, 1909.

MAGAZINE FOR AUTOMATIC PISTOLS.

2,278 (1909). Paul Mauser, Germany. What is called an arresting mechanism is introduced into magazines of automatic pistols, the object being to ensure the guidance of each cartridge to the correct position for loading. Means for allowing rapid insertion and detachment of the magazine are also provided.



The magazine *a* is of the usual type arranged to be pushed in and pulled out of the cavity in the stock provided for it. It consists of sheet metal and contains the platform *b* and spring *c*. The cartridge arrester consists of the pawl *d* the lower end of which is adapted to engage with slots *e* cut in the back of the sheet metal casing of the magazine. These slots are cut at intervals corresponding with the width of a cartridge, the projections *f* engaging step by step with the corresponding slots as the cartridges are removed from the magazine. The object of this arrester is to prevent recoil tipping the cartridges rearwards. The *two* projections are arranged on the arrester in order to allow of the retention of as much metal as possible in the back wall of the magazine.

The bottom of the magazine is closed by the plate *g*. This is held in position by the lateral spring arms *h*. The plate carries a slanting block which forms a base at right angles to the direction of thrust of the spring *c*.

When it is desired to load the magazine a supplementary plate or tool is used. It is inserted in the slots at the back of the magazine so that the projections on the arrester *d* in its progress to the bottom of the magazine shall be unobstructed.

The magazine is held in the butt by the locking lever *i*. The projection *j* on the back of this engages beneath the projection *l* on the slanting part in the bottom of the magazine. The lever may quickly be swung from one side to another to allow the magazine to be withdrawn. Accepted June 3, 1909.

"HYDROX"—AN EXPLOSIVE COMPOUND.

22,555 (1908). G. Lezinsky, U.S.A. The patentee is aware that explosive compounds have been proposed in which chlorate of potash, resin, and a cereal meal are treated with nitric acid. In the new compound the same ingredients are used but the process of production differs and the final product is claimed to be chemically and physically different to any other. The only point that is common to all explosives of this nature including the new invention is that chlorate of potash is used as the oxydising agent.

The new explosive is called " Hydrox " by its introducer who claims that unlike the makers of other of these mixtures he obtains an intimate uniform combination of the organic matter and of the chlorate of potash. A homogeneous solidified mass is formed of a hygroscopic nitrated product. Combined with the chlorate of potash and water a plastic compound is formed. When dried this becomes very hard. Intimate combination in this manner of the hygroscopic portion of the nitrated product with the chlorate of potash gives it is said a new character to the latter, removing its sensibility to friction and rendering it stable.

In the preparation of the explosive ordinary commercial resin and a vegetable substance, such as grain or cereal of the general character of ordinary wheat are pulverized, and a mixture of these materials is made of various proportions from about two parts in weight of the resin to from one to three parts in weight of the cereal or grain. Into this mixture is poured and mixed just a sufficient quantity of ordinary commercial nitric acid (being from 36° Baume to 42° Baume) to bring the whole mixture into a homogeneous mass consisting of a porous cake. A specific illustration of the proportions of resin, cereal and acid which may be used in producing the nitrated product is as follows :—53 *per cent.* by weight of resin, 27 *per cent* by weight of ordinary wheat, and 20 *per cent.* by weight of nitric acid of 38° Baume. If the materials are cold, they should be heated until the action commences. For lack of a better name the product is referred to as a " nitrated " product, but there is, strictly speaking, not a complete nitration. It has been found upon analysis that the nitrated product contains approximately from 20 to 50 *per cent.* of hygroscopic matter according to the proportion of ingredients used in making it. The mass or porous cake is dried and pulverised.

The nitrated product is in itself non-explosive, and in order to produce the explosive compound, this pulverized nitrated product is mixed with chlorate of potash (or other oxygen yielding substance, such as permanganate of potash). When using chlorate of potash as the oxidizing agent, one part in weight of the nitrated product to three parts in weight of the chlorate of potash are employed. To the mixture is added a sufficient quantity of water (for instance, about 25 *per cent* of water) to render the whole a homogeneous mass wherein the intimate combination of every part of the mass is complete. This mass is then moulded or formed into sticks, cakes, lumps, or grains as desired and is then dried and is ready for use. The inventor states that he believes he is the first to make an explosive which is a combinatoin of chlorate of potash with a non-explosive material in a solidified form as distinguished from a granular form.

As this explosive, as described, is water absorbent or hygroscopic, and when wet its explosive qualities are partly or wholly impaired, it is made adaptable for use in water or in wet places by dipping the dried sticks, cakes, lumps or grains, into which it has been moulded or formed into melted paraffin or similar substance, forming a waterproof coating over the entire surface of each form, or by enclosing them in a water-proof covering.

This coating does not interfere with the efficiency of the explosive compound. The coating of the dried stick of explosive in this manner, also adds to its stability, safety and keeping qualities. It prevents action of the air or atmosphere on the explosive which might bring about decomposition.

The object of varying the proportions of the quantity of resin and the quantity of grain or cereal used in the production of the nitrated product and in varying the proportions of the quantity of the nitrated product and the quantity of chlorate of potash used in the production of the explosive, is to procure explosives of varying degrees of force and rapidity of explosive action, and adapted for various uses and purposes. The explosive of greatest force and most rapid in explosive action is produced by using the smallest proportionate quantity of the grain or cereal to resin in producing the nitrated product and by using the greatest proportionate quantity of the chlorate of potash to the nitrated product in producing the explosive. The explosive of least force and least rapidity of explosive action is produced by using the greatest proportionate quantity of the grain or cereal to resin in producing the nitrated product and by using the least proportionate quantity of chlorate of potash to the nitrated compound in producing the explosive.

When unconfined and brought in contact with conditions of very high temperature, the explosive will burn, not explode. For instance, a stick of it could be thrown into the furnace of an ordinary steam plant, with a temperature of over 1,000°, and it would merely burn.

The base itself is non-explosive and the powders manufactured therewith may be employed it is claimed with more safety than the ordinary nitro-glycerine powders now in use or any powder having similar explosive force. It will not explode by ordinary concussion but requires the initial explosion of a detonating cap to render it active. This feature is of importance in that it obviates the possibility of accidents so commonly occurring by the explosion in mines by striking the nitro-glycerine powders remaining in missed holes. It is stated to be not susceptible to climatic conditions, and will consequently not freeze or melt. Accepted June 10, 1909.

A PORTABLE CARTRIDGE HOLDER.

13,332 (1908). Captain J. H. D. Savile, London. The holder described in this patent is of the type in which a number of cartridges (generally of the sporting gun pattern) are arranged horizontally so that they may conveniently and quickly be withdrawn for loading into the gun. The cartridges fall through the case as those at the bottom are withdrawn fresh ones being dropped into the case from the top. The device possesses merits it is claimed that are non-existent in others intended for a similar purpose.

The holder consists of a vertical case *a* of such a horizontal section that it will accommodate a number of cartridges resting upon each other in a horizontal position. They fall under the influence of gravity. The case *a* has an opening *b* at the top through which the cartridges are inserted, and it has a bottom *c* partly extending across the case upon which the lowest cartridge rests. The lower part *d* of the case *a* projects forwards away from the body so that the cartridges may be more readily grasped and withdrawn without catching against the buttons of the wearer's clothing. The patentee says that in other cartridge holders the case has projected forward to cause the cartridges to slide into a rotating part driven by clockwork.

The lower part of the front, back, side and bottom of the case *a* are cut away on one side at *e*, and the flanged ends of the two lowest cartridges project from the case at this part so that they may be grasped by the fingers in the correct position for loading and be readily withdrawn, either singly or two at a time. As soon as one or two cartridges is or are withdrawn, the others fall in the case, so presenting two others ready to be withdrawn.

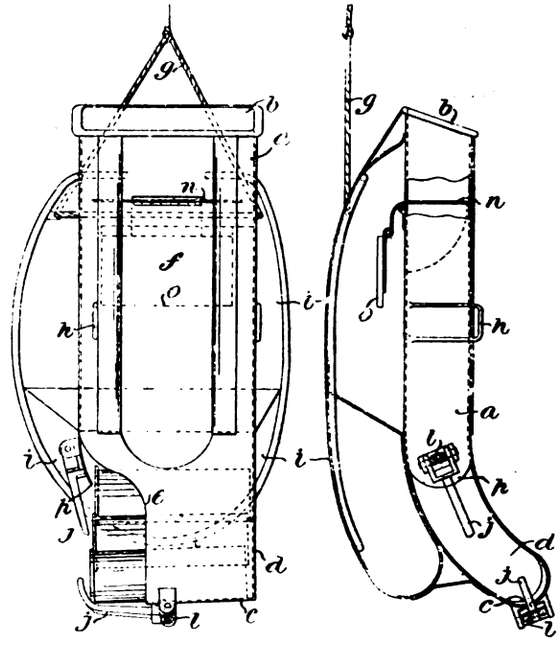
In order to ensure that the rim of the lowest cartridge shall not catch the rim of the next highest cartridge and withdraw it when it is only desired to withdraw one cartridge, the bottom *c* of the case *a* slopes slightly towards the cutaway part *e* of the case, thus enabling the rim end of the lowest cartridge to drop so that it cannot catch the rim of the adjacent cartridge. This sloping bottom *c* also allows sufficient play to enable two cartridges to be withdrawn together without the rim of the second catching behind the rim of the third cartridge. The latter cannot be withdrawn as the cut away portion *e* is only large enough to allow two cartridges to be withdrawn together.

In case the cartridges should not have fallen horizontally into the case *a*, the latter is provided with the usual opening *f* down the front, through which the cartridges may be moved into their correct horizontal position.

The case *a* is provided with a cord *g* as shown, or with a strap or strip of metal having an eye by which it is supported on a button on the waistcoat or coat. The case *a* is also preferably provided with dees or loops *h* through which a strap is passed and is fastened around the body so that the case does not move sideways when cartridges are withdrawn. The strap also holds the case snugly against the body and prevents it swinging about. An extra strap may also be attached to that side of the case opposite to the cutaway part *e* and may be attached, by means of an eye, to a trouser or other button for the purpose also of preventing the case moving sideways as a cartridge is withdrawn.

To render the case more handy in use, it is mounted upon plate *i* located at a short distance behind the said case, so that there is less chance of the fingers catching against the clothing when the cartridges are being withdrawn, and so that the cartridges may be nearer to the gun to enable them to be more rapidly inserted in the barrels.

The case *a* may be attached to the body in an inclined position to prevent the two lowest cartridges accidentally sliding out of the case. The case is preferably provided with two suitably arranged hinged arms *j* located in the paths of the two lowest cartridges, which arms *j* are retained in the positions shown by two light springs *l* and prevent the cartridges entirely sliding out of the case endways unless they are actually withdrawn by hand.



To facilitate the insertion of the cartridges and to ensure them falling horizontally, a hinged flap *n* is provided towards the upper part of the case *a*. This flap *n* may be provided with a counterbalance weight *o* located between the case *a* and the plate *i*, or it may be provided with a light spring to return it to the horizontal position as soon as the cartridges will allow it to assume that position. The flap *n* will support two cartridges but gives way when a third is placed in the case. It causes the first and second cartridges paced thereon to assume a horizontal position and, when the third cartridge is placed on the other two, it causes all three to descend horizontally together.

A portion *p* of the case *a* is preferably slightly bent inwards to retain the third cartridge from the bottom away from the open part of the case. When this third cartridge falls and becomes the second cartridge from the bottom, owing to the sloping bottom *c*, it falls slightly forward and its rim is then outside the rim of the third cartridge from the bottom. When the second cartridge from the bottom falls on to the sloping bottom *c*, it also slides slightly forward. The arms *j* as above explained, prevent the two lowest cartridges falling right out of the case *a*. Accepted June 23, 1909.

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CONTENTS.

CURRENT TOPICS.

Second-Hand versus New Guns.—The monthly sales at Debenham's auction rooms provide an interesting illustration of the argument that even a genuine second-hand gun is but a poor substitute for a new one of equal price. Although the modern hammerless ejector has been a more or less fixed type for ten or more years, the number of guns of first-class make coming on to the market as genuine second-hand goods is surprisingly limited. Fine examples of Purdey, Grant and other hammer guns are certainly put into every sale, but the condition of their barrels and the general obsoleteness of design make them more interesting as curios than suitable for practical use. Commoner guns of similar date, of course, represent a still less desirable purchase. In fact the only weapons really worth the buyer's attention are those which are sold off by the trade as surplus stock, under precautions calculated to prevent them going at an unremunerative price. On the other hand, the general procession through the sale room of guns of a past generation recalls the accounts of old horses on their way to the Continent to start a new career in an edible form. What becomes of all the old guns which still appear to have a market value is not apparent on the face of things. Many of them go abroad, and especially to the colonies, where they are rejuvenated when they come into contact with the still older models which are regularly used in distant places. The most marvellous circumstance surrounding the life history of a gun seems to be that it never wears out, hence modern productions are unable to oust the older types. If only collectors of curios could see merit in amassing specimens of old guns the more out-of-date examples might eventually be withdrawn from circulation. But guns are cumbersome things to store, and though their decorative value is considerable, by the accumulation of rust they become a nuisance the moment they are taken out of their cases to be used for the adornment of halls and passages.

Design and Price.—Though the hammerless system was introduced many years ago, and ejectors have long lost their novelty, a steady process of simplifying design and generally decreasing liability to mishap has since been proceeding. A gun made during the past five years is a better weapon than another of earlier date; but work as they will to increase the motive for new purchases, gunmakers encounter a persistent adhesion to the old weapons that still faithfully perform their allotted service. It is useless in such circumstances to point out that up-to-date guns of medium quality contain minor defects which a better method of manufacture would eliminate. The long life of a gun proves that it already has the quality of outlasting a reasonable span of existence, and although a fifty-shilling air-rifle may be held together by a better set of screws than a twenty-guinea gun, such differences are explained by the entirely diverse methods of manufacture which the two undergo. Arguments of this character do not, however, satisfactorily dispose of the circumstance that double-barrel guns are in very few respects made on cheaper lines than those in use twenty years ago. Skilled labour, working on piece rates in a more or less disorganised fashion, soon reaches the limit beyond which further improvement of quality or reduction of price is possible. The Americans, by approaching the problem in a different

manner, have discovered markets for cheap machine-produced types of weapon which apparently command a sale in quantities capable of justifying the initial expense of laying down special plant. The growing consumption of cartridges proves that shooting still retains its popularity, but though the game area in this country may be diminishing, improved means of communication increase the opportunity for shooting in out-of-the-way places. The immense movement of population into the colonies has also opened up new areas of sport, and if all these markets are unable to absorb the precise kind of gun which Birmingham has been in the habit of supplying, it would be much better to develop a new type than see the trade pass into other hands. Hitherto the old methods have held full sway. For some unaccountable reason the efforts which have been made to import the latest processes of machine manufacture into gun construction have not produced any marked changes. Except for the very cheapest goods, the market is limited, and over-production supervenes as soon as the demand fails to absorb any increased output that may be organised.

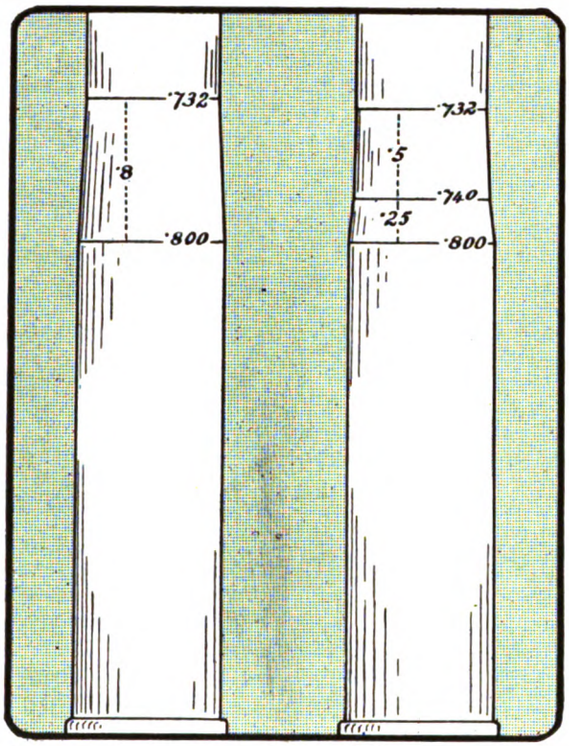
Explosives amongst Coal.—The Englishman, with sufficient dignity to resent the constant efforts which are being made by newspapers in search of sensation to make his country look foolish, will regret the absurd scare which has been created by the reported finding of packets of explosives amongst coal supplied to the navy. On the subject of explosives generally so much ignorance prevails that a single dynamite cartridge is credited with possibilities of destruction which a whole magazine of powder would fail to accomplish. No complaints can be made against those who honestly believe that the wreckage of a man-of-war would follow from shovelling a packet of safety explosive into the boiler furnace. Even if the explosive were present in sufficient quantities to cause some slight accident, less serious of course than the premature ignition of a gun charge, the risk would certainly rank very small in proportion to the other untoward incidents of naval life. The risk from explosives amongst coal must be very slight indeed, otherwise it would by now have taken a place amongst the causes of the roll of casualties which are constantly occurring. In order, however, to prevent a sane and just view of the situation from being formed, it has been hinted that the explosive was mixed with the coal at the instance of some unfriendly power. The whole circumstance boils down to the very simple explanation that explosives are used for getting coal, and that nothing more than carelessness is necessary for some of the packets of unused material to get amongst the gotten mineral on its way to the pit mouth.

The Lecture on Cartridge Loading. This month's lecture to young gunmakers may possibly exercise an important influence on the future of cartridge loading by reason of the proof it affords that all the well-known charges follow a simple law which is applicable to all ordinary conditions. The finding of special loads and charges has always been a tedious operation, and finality is seldom achieved at the first attempt. If enough work is done, and the experiments are sufficiently frequently repeated, something very near the underlying law, which has now been discovered, eventually comes to the front. Briefly stated the idea consists in utilising the tabulated details of a sporting cartridge which have lately been compiled for the purpose of ascertaining the exact length of tube which is available for powder and shot. It was at once apparent that these two divide the available space in a highly regular manner, so that for any given cartridge of which the usual details are known, the precise powder and shot charge can be specifically stated. A grain adjustment up or down is no doubt permissible to avoid disturbing well known combinations, but where the exact charges are not generally agreed upon the calculated values have much to recommend them. There is no benefit, but only a large amount of inconvenience, in the existence of disagreement between the various authorities in the trade concerning the charges most suitable for the different sizes of sporting cartridge. Powder makers cannot gain a better reputation for their product by adopting peculiar combinations of load for the least used cartridge sizes. They are bound to accept a standard load for the 12-bore as a basis for the usual proof tests, and logic suggests that the same system of equal treatment should be adopted wherever possible. Experimental work shall be greatly facilitated by reducing the whole system of powders to a common basis of treatment in the loading; and in the long run a considerable saving of time should ensue.

The Official Bisley Scores. The preliminary issue of the official scores made at the recent Bisley rifle meeting again provides evidence of the extremely effective organisation of the N.R.A. staff. In place of waiting for the annual report, the scores which occupy the bulk of that volume are now available a few weeks after the firing of the last shot. The preliminary circulation of the prize lists provides an opportunity for the pointing out of any errors that may occur in the text, with a view to their amendment in the final edition. Just at the present moment no great battles of marksmanship are being fought out between rival weapons, but the contest is as keen as ever for premier honours by the different brands of match rifle ammunition. The large bulk of the laurels have been earned by the King's Norton Company, which is a just reward for the painstaking care of their expert, Mr. H. Melville Smith. Miniature rifles are not now brought into very keen competition with one another. The problems of manufacture have been solved, and the contest lies between individuals. Keener interest might be aroused if the conditions of the various contests could be brought into closer touch with the problems of the moment. This, however, is a question which must be settled by the representatives of miniature rifle clubs who are now in close touch with the Council of the National Rifle Association. Whether they will elect to stereotype the shooting by continuing the present restrictions as to type of arm allowed is a matter of considerable interest to the trade. The unrestricted development of the ·22 rifle with special reference to club conditions should no longer be retarded now that the Astor trustees have lost their power with the exhaustion of the fund.

CONES FOR GUN CHAMBERS.

WITH the very excellent object of diminishing the tendency to balling of shot, the shortest possible cone has been recommended in these columns for all gun chambers. The cone is the taper which reduces the external diameter of the cartridge tube to the internal. The lead is a second taper which aims at smoothing the entry of the charge into the barrel. To ensure gastightness it has been suggested that the cone should be kept inside the quarter of an inch long, and that the lead should taper from ·740 down to the barrel diameter, whatever it may be. These figures refer only to 12-bores, but proportionate treatment can be readily applied to the other sizes. It has happened, not once but many times, that guns bored with one long taper from chamber to barrel give the most excellent results. The excellence is not confined to to any one maker's productions, but to guns coming from many factories. On the other hand, a considerable amount of trouble has been found with guns having the orthodox short cone, no matter how delicately the sharp edge may be smoothed down in the form of a lead. Balling is not a common fault with long coned guns, perhaps it occurs a little more frequently when the cone is over-long than when it is short, but experience with many makes of gun suggests that if there is a connection it is very remote. Balling of pellets can generally be traced with certainty to the existence of excessive chamber pressure, but that its occurrence is assisted or retarded by certain forms of joining the chamber to the bore is little more than guess work. It may, therefore, be that the ideal of a short cone is based upon fallacious reasoning. At any rate practical experience is so often contrary that it becomes necessary to withdraw the strong support that has hitherto been accorded to the short cone plus a lead based upon wad diameter.



The accompanying illustrations show the two forms of cone under discussion. That on the left has been carefully taken from a sulphur cast of a very common gun, which, when tested for pattern, gave most exemplary behaviour. There was no sign of balling, and the patterns obtained showed a degree of uniformity between round and round and evenness of distribution which made the characteristics of the gun's boring of more than passing interest. This is how the two barrels measured with the Allport gauge :—

	At 6in.	12in.	18in.	24in.	30in.
Right Barrel ..	·725	·724	·723	·720	·696
Left Barrel ..	·736	·732	·732	·730	·694

The right barrel patterns were a little less than full choke, which can be accounted for by the fact that, though the muzzle diameter is right the general gauge is ten points on the tight side, so diminishing the contrast. The left barrel is the correct size for a 12-bore and gave true full choke results. The gentle taper from breech to muzzle was no doubt accidental and due to careless manufacture, but it is a feature which many excellent shooting guns possess. Possibly by progressively pinching the shot in its passage down the barrel, the pellets are prevented from adhering together. The taper becomes very pronounced for the last few inches behind the choke. These things suggest that possibly there is no merit in a parallel bore. Certainly the thickening of metal near the choke will assist in strengthening the walls of the barrel at a point where ring bulges are apt to occur. Quality of pattern seems unaffected by diameter of bore. One of the finest shooting pigeon guns which has recently been tried has a diameter over rather than under ·740 inch, and the calibre tightened in both barrels the same ·001 per six inches of length. Another gun giving excellent results gauged ·738 in., and the bore did not begin to taper towards the choke till a point 24 inches from the breech. The barrel was only 28 inches long, so that this gun would be regarded as having a parallel bore. The short cone has been tried in many directions, but has certainly not shown itself a noticeable means of improving results. Possibly the long cone in combination with a slightly taper bore introduces a more favourable state of affairs. Looking at the drawing, quite as sound arguments could be advanced in favour of the long cone as the alternative double taper arrangement. It is more than probable that the charge of shot by pressing against the fully expanded cartridge tube has a diameter materially in excess of the ·740 of the card wadding. If so the junction of the two cones presents an obstruction to the passage of the charge which does not exist in the alternative arrangement. If present ideas are in the nature rather of theories than demonstrated certainties, they must be abandoned when sufficient proof is accumulated against them.

GERMAN EXPLOSIVE FACTORIES IN 1908.

The *Zeit. für das gesamte Schiess und Sprengstoffwesen* contains certain particulars concerning the chief explosives works in Germany. A correspondent has suggested that the details might be of interest to readers of this journal. The material in question is as follows :—

Sprengstofffabriken Hoppecke A.-G.

The capital of this company has lately been increased from £90,000 to £150,000. During 1908 the company had a share capital of £90,000 and £56,250 in debentures. The manufacturing concessions were valued at £6,000 ; land at £8,500 ; plant and buildings at £112,650 ; stocks, etc. at £3,250. There were no profits during the year and the special reserve funds had to be drawn on to the extent of £10,000.

Sprengstoffwerke Glückauf A.-G. (Hamburg).

Share capital £30,000 ; land, plant, buildings, machinery, etc. are valued at £11,200. Patents stand at £4,835. The loss on the year's working was £9,400.

Oberschlesische A.-G. fur Fabrikation von Lignose, Schiesswollfabrik fur Armee und Marine (Kruppamühle).

Share capital £32,500 ; Reserve funds £31,000 ; Land, buildings, machinery are valued at £59,470 of which £11,000 is represented by new plant. Profits £31,000. Dividend 12½ per cent.

Dynamit A.-G. vorm. Alfred Nobel & Co. (Hamburg).

Share capital £600,000. Reserve funds £100,000. Land, buildings, machinery, etc. are valued at £175,000. After deducting £31,000 for the sinking fund a net profit of £106,871 was declared and a dividend of 16½%.

Westfalisch-Anhaltische Sprengstoff A.-G.

Share capital £150,000. Debentures £36,000. Reserve funds £30,000. Buildings, plant, etc. are valued at £66,250. Dividend 15 per cent.

Rheinisch-Westfalische Sprengstoff A.-G. (Cologne).

Share capital £250,000. Reserve funds £60,000. Land is valued at £26,600. Plant, etc. at £160,000. After placing £16,150 to the sinking fund a profit of £30,700 was declared, and a dividend of 11 per cent.

This company owns at Triosdorf a guncotton factory, a smokeless powder factory, a detonator factory, a celluloid factory and a metal rolling and stamping works. There is also, in addition a dynamite factory at Fõrde and an ammunition factory at Nürnberg.

Erzgebirgische Dynamitfabrik A.-G. (Geyer *i.* S.)

Declared a net profit of £5,300 and a dividend of 7½ %.

Vereinigten Köln-Rottweiler Pulverfabriken.

Share capital £825,000. Reserve funds £450,000. Plant, buildings, etc. are valued at £325,000. After placing £29,250 to the sinking fund a dividend of 12 per cent. was declared.

Dresdner Dynamitfabrik.

Share capital £36,250. Reserve funds £12,500. Plant and buildings are valued at £5,000. The net profit amounted to £6,914.

Sprengstoffgesellschaft Kosmos (Hamburg).

Capital £60,000. Reserves £12,500. Profit £4,675. Dividend 7½ %.

Nordeutsche Zundschnur-Industrie A.-G. (Wennigsen am Deister).

Capital £7,500. Loss during the year £1,000.

Zundhutchen und Patronenfabrik vorm. Sellier und Bellot.

Dividend 12 %.

Sprengstoffwerke Dr. R. Nahnsen & Co., A.-G. (Domitz Hamburg).

In consequence of the serious explosion at this factory, and other circumstances, the share capital has been reduced from £175,000 to £116,666. £58,400 has been recently issued in preference shares, and there are £50,000 in debentures. During 1908 a small profit was made. After placing £9.350 to the sinking fund a dividend of 6 % was paid on the preference shares (£4,000). No dividend was paid on the ordinary shares. The Domitz factory is valued at £120,000. The Anzhausen factory at £32,500. The glycerin factory at Neuwied at £12,000. The magazines abroad at £7,500. There are no reserves.

Sprengstoff, A.-G. Carbonit.

After placing £6,500 to the sinking fund there was a net profit of £6,500 and a dividend of 7½ per cent. was paid. Share capital £80,000. Reserve funds £6,250. The land, plant, buildings, etc. are valued at £116,666. The company has £137,500 on mortgage in other factories.

Rheinische Dynamitfabrik (Cologne).

Capital £60,000. Reserves £24,000. Land, plant and machinery are valued at £15,000. The profits amounted to £10,800 and a dividend of 16½ % was declared.

Castroper Sicherheits-sprengstoff, A.-G.

Capital £65,000, consisting of £30,500 in founder's shares and £34,500 preference shares. The Castrop factory stands in the books at £137,500 and the Rummerohl factory at £63,200. The profit from both factories amounted to £4,430. (The loss during 1907 was £1,200). After payment to the sinking fund, etc. a loss of £2,080 was carried forward to 1909.

G. W. McD.

A LAY TO N.G.

SIR,—I have just read the funny piece of poetry you have published in No. 203, August 2, 1909, of *Arms and Explosives* under the title "A Lay to N.G.—A lady of high degree."

The author of the lay states that :

"Nobel was first to bring her out"

but, really, he who "was first to bring her out" is, as you are certainly very aware of, an Italian, Doctor Ascanio Soprere, who invented the N.G. in 1847.

Nobel is the great inventor of dynamite, and his invention gave origin to the following French song :

"On en parle fort, pour l'instant,
Londres reconnaît son mérite,
Et son succès est éclatant,
On l'appelle : Lady Namite.

Elle fait un bruit effrayant,
On prétend que sa voix imite
Le son d'un canon très bruyant,
On l'appelle : Lady Namite.

Il ne faudrait pas s'aviser
De lui fixer une limite,
Elle aimerait mieux tout briser,
On l'appelle : Lady Namite.

Si quelqu'un vient à la heurter
Elle se scandalise vite
Et sé dépêche d'éclater ;
On l'appelle : Lady Namite.

Sans savoir si ça nous plaira
Gentiment elle nous invite
A des bals où *l'on sautera* ;
On l'appelle : Lady Namite."

E. BRAVETTA.

La Spezia. Aug. 7, 1909. (*Captain Italian R.N.*).

["Bring her out" may have been intended in the sense of a debutante being introduced to society. ED.]

LECTURES TO YOUNG GUNMAKERS.

LX.—FIXING CHARGES WITH THE READY RECKONER CARD.

A couple of months' practical experience of the ready reckoner system of examining loads for sporting cartridges shows it to possess all the good qualities that have been claimed on its behalf. Just at this season of the year powder makers have been required to revise the loading instructions issued for use by cartridge fillers, and the card has been instrumental in calling attention to anomalies, being afterwards used for correcting them. To all sections of the trade the process of attaining finality in cartridge loads is of the utmost importance. Presumably there is a best load for every cartridge, and once that load has been found the makers of the gun, the powder and the cartridge share the credit due to a successful accomplishment. Cartridge filling attains a higher development when the goal to strive for is well defined, and the ready-reckoner card serves the office of handmaiden in pointing the way. Its intended function having been fulfilled in due course it will gracefully retire, the copies that have been issued being relegated to a back position, since they will no longer be required.

A new application of the values in the card, of greater practical importance than any previously discovered, has been brought into being during the past few weeks. The original intention of the card was to enable the quantity of powder, shot and wads to be adjusted so as to make a properly filled case, that is avoiding the extremes of looseness on the one hand, and over-compression on the other. In an approximate way it was also possible to fix the amount of powder and shot in one cartridge by referring to the loads known to be right for some other bore of cartridge of the same length. This principle has now been extended, so as to give absolute loads for all bores of cartridge, on the principle that the best known standard loads govern those which occur with less frequency. The key load is of course the standard three drams charge in a 12-bore with 1⅛ oz. of shot, the same being assumed to include the usual cards and a ⅜ inch felt. Another load which receives the sanction of long-continued use is 47 grains of Schultze and 1¼oz. in a 2¾ inch pigeon 12-bore cartridge. Then again, the large amount of experimentation recently carried out with 16-bores has absolutely fixed the powder charge at 28 grs. or 36 grains, according to the class of powder used, and 15–16 oz. of shot. The latter is by custom reducible to ⅞ oz. for 33-grain powders, the space difference being compensated by using a $\frac{7}{16}$ inch felt in place of the ⅜ inch thickness for the full load. It is difficult to name any other loads which are so well known and generally accepted as the three above named. The tendency to overload 20-bores still endures, and suffices to throw a doubt on the correct load. The 10-bore cartridge is not well understood in this country, as is shown by the discrepancies which characterise the recommended loads. Smaller bores such as the 28 are over much neglected, consequently there are no figures that readily occur to the mind. In favour of at once reducing all loads to a system of proportional treatment is the fact that the complications due to the existence of two classes of powder are now increased by the recent development of a third. The rival claims of 42 grain and 33 grain powders are well understood, but 30 grain powders have also their own special points not as yet fully defined.

Briefly stated, the new system of fixing charges consists in finding the net length of each cartridge which is available for powder and shot, and deciding from selected standards the share of space that each occupies. The total length of every cartridge is divided up in the following manner :— (1) head, (2) powder, (3) card wad, (4) felt, (5) card wad, (6) shot, (7) card wad, (8) turnover. By eliminating all items but those numbered 2 and 6, the net effective capacity of the cartridge is fixed. It then becomes necessary to ascertain whether a settled proportion exists between powder and shot, irrespective of calibre and length of case. The nominal 2½ inch 12-bore cartridge has an actual length of $2\frac{9}{16}$ inch, which is expressed in decimals as 2·56. For manufacturing reasons this is made a maximum dimension, and actual cartridges are cut somewhat shorter. All present requirements are served by taking the decimal lengths as absolute. The deductions to arrive at net effective capacity are as follows :—

Thickness of Cartridge Head	·30	inch.
Two cards on either side of felt ..	·17	,,
Top wad	·06	,,
Turnover	·30	,,
⅜ felt	·37	,,
Total ..	1·20	,,

Deducting this 1·2 inch from the total length of case gives the net effective capacity, which, with the ordinary 12-bore, becomes 2·56 — 1·20 = 1·36 in. The standard three drams of powder occupies a little under half this space, and the 1⅛ oz. of shot what remains. The exact percentage is 47·8, this being the magic value that settles all powder and shot charges. The above 1·36 inch of net effective cartridge capacity is divided up so that ·65 inch is powder, compressed as in a loaded cartridge, the remaining ·71 inch being the space available for shot.

For the purposes of this lecture, and to avoid recrossing old ground, the conversion of lengths into charges will be carried out by means of the original charts or curves from which the values in the ready reckoner card were obtained. The additions for cartridge head, card wads, turnover, etc., were added afterwards. These charts show that in a 12-bore ·65 length of powder equals 33 grains, and ·71 of shot equals 1⅛ oz—and similarly in all the other instances where lengths require to be converted into the corresponding values of charge.

As a start it will be useful to assume a series of 12-bore cartridges in all lengths from 2½ to 3 inches. This will cover the American practice, seen in 10 bores, of cartridges $2\frac{5}{8}$, and $2\frac{7}{8}$ inches long. The various stages for calculating appropriate charges, based on the 47·8 per cent. law are as follows :—

Series of Charges for all possible lengths of 12 *bore.*

Length of Cartridge.	Space for Pdr. & Shot. Case length − 1·20	Space for Powder 47·8 %	33 gr. pdr.	42 gr. pdr.	Shot.
in. in.	in.	in.	grs.	grs.	in. oz.
$2\frac{1}{2}$ = 2·50	1·30	·62	**31·7**	**40·4**	·68 = $1\frac{1}{16}$
$2\frac{9}{16}$ = 2·56	1·36	·65	**33·0**	**42·0**	·71 = $1\frac{1}{8}$
$2\frac{5}{8}$ = 2·62	1·42	·68	**34·3**	**43·6**	·74 = $1\frac{3}{16}$ bare
$2\frac{3}{4}$ = 2·75	1·55	·74	**37·0**	**47·1**	·82 = $1\frac{1}{4}$ full
$2\frac{7}{8}$ = 2·87	1·67	·80	**39·4**	**50·2**	·87 = $1\frac{3}{8}$
3in. = 3·00	1·80	·86	**41·9**	**53·3**	·94 = $1\frac{1}{2}$ bare

What is remarkable is not that the standard 12-bore charge works out at 33 or 42 grs. and $1\frac{1}{8}$ oz., because that is the underlying assumption of the whole table, but that the standard $2\frac{3}{4}$ pigeon cartridge charge works out at 37·0 and 47·1 grs. respectively, when 37 and 47 grains are the recognised loads sanctioned by long standing use and practice. For 3-inch cartridges the shot works out at $1\frac{1}{2}$ oz., the charge every one uses, and the powder at practically 42 grs. and 53 grs. respectively, when the recommended charges lie from 40 to 44 grs. for one style of powder and at 52 grs. for the other. The above table does not take into account the practice of reducing the shot charge a sixteenth ounce when 33-grain powders are used. This adjustment may be effected after the maximum loads have been defined.

The above table provides sufficient evidence to justify applying the 47·8 per cent. rule to the loading of all bores of cartridge falling within the limits of length considered. The only variation of treatment involved is that the deduction for turnover must be varied to suit the size of each bore of cartridge. Thus, for the 12-bore ·30 inch at the mouth of the case is left for turnover, whereas with 28-bores the corresponding allowance is ·20 inch. The various stages of calculation are shown in the accompanying table, with the exception, already noted, of the conversion of powder and shot lengths into the corresponding charges. It should be understood in regard to shot that the loads are given to the nearest sixteenth of an ounce, the words " bare " or " full " being used to indicate a divergence one way or the other of the 32nd part of an ounce. Differences below a 64th are ignored.

Series of calculated Charges for all calibres, not including 12 *bore.*

Cartridge.	Net effective length.	Pdr. only. 47·8 %	33 gr. Pdr.	42 gr. Pdr.	Shot.
in.	in.	in.			in. oz.
10 bore $2\frac{7}{8}$	2·87 − 1·22 = **1·65**	·79	**43·4**	**55·2**	·86 = $1\frac{1}{2}$
,, ,, $2\frac{5}{8}$	2·62 − 1·22 = **1·40**	·67	**38·3**	**48·7**	·73 = $1\frac{5}{16}$ bare
14 ,, $2\frac{1}{2}$ *nom.*	2·56 − 1·19 = **1·37**	·66	**30·2**	**38·4**	·71 = 1
16 ,, $2\frac{3}{4}$	2·75 − 1·18 = **1·57**	·75	**30·9**	**39·3**	·82 = $1\frac{1}{16}$
,, ,, $2\frac{1}{2}$ *nom.*	2·56 − 1·18 = **1·38**	·66	**27·7**	**35·2**	·72 = $\frac{15}{16}$
20 ,, $2\frac{3}{4}$	2·75 − 1·15 = **1·60**	·76	**27·0**	**34·3**	·84 = $\frac{15}{16}$
,, ,, $2\frac{1}{2}$ *nom.*	2·56 − 1·15 = **1·41**	·67	**24·3**	**30·9**	·74 = $\frac{13}{16}$
24 ,, $2\frac{1}{2}$	2·50 − 1·13 = **1·37**	·66	**21·5**	**27·4**	·71 = $\frac{11}{16}$
28 ,, $2\frac{1}{2}$	2·50 − 1·10 = **1·40**	·67	**19·4**	**24·7**	·73 = $\frac{3}{4}$ full
32 ,, $2\frac{1}{2}$	2·50 − 1·07 = **1·43**	·68	**16·4**	**20·9**	·75 = $\frac{9}{16}$

It is indeed curious that we should have been all these years blindly groping to find the best charges, being constantly misled by experimental errors and differences, when the best of all values were lying hidden beneath a very thin covering needing for its removal nothing but simple arithmetic. The time may not have been ripe for such a development till now, but it cannot be denied that a set of calculated charges which reproduce practice with such extraordinary consistency must for the future exercise an important controlling influence when powder makers are asked to specify recommended charges.

The ultimate goal in cartridge loads is undoubtedly uniformity of treatment. Progress will not be retarded but rather assisted by the removal of hitherto unsuspected but nevertheless unjustifiable variations from the standard treatment laid down with reference to the 12-bore. The cartridge loader will always need to have his wits about him to turn out good work. His difficulties will certainly be lessened by the removal of anomalies in respect to recommended loads. The temptation to depart from the instructions given to him will be removed with every increase in the proportion of charges which are exactly correct. Powder makers will similarly gain by better knowing the conditions under which their products will be used. Closer standardization of density will in due course eliminate the need for at times using a surplus thickness of felt or card to correct an over-dense or unduly compressible powder. Gas pressures will attain greater regularity by the diminished temptation to overload, or what is nearly as serious, the curtailment of the allotted combustion chamber for the powder.

The material of this lecture may now be completed by giving the following summary of cartridge loads as arrived at by the arithmetical and other processes which have been demonstrated.

Table of Loads based on the 47·8 % *rule.*

Cartridge.	33 grain Powders.	42 grain Powders.	30 grain equivalents.
10 bore $2\frac{7}{8}$ in.	43 − $1\frac{7}{16}$ − $\frac{7}{16}$	55 − $1\frac{1}{2}$ − $\frac{3}{8}$	39·1
,, ,, $2\frac{5}{8}$,,	38 − $1\frac{1}{4}$ − $\frac{7}{16}$	49 − $1\frac{5}{16}$ − $\frac{3}{8}$	34·6
12 ,, 3 ,,	42 − $1\frac{7}{16}$ − $\frac{7}{16}$	53 − $1\frac{1}{2}$ − $\frac{3}{8}$	38·2
,, ,, $2\frac{3}{4}$,,	37 − $1\frac{1}{4}$ − $\frac{3}{8}$	47 − $1\frac{1}{4}$ − $\frac{3}{8}$	33·6
,, ,, $2\frac{1}{2}$,,	33 − $1\frac{1}{16}$ − $\frac{7}{16}$	42 − $1\frac{1}{8}$ − $\frac{3}{8}$	30·0
14 ,, $2\frac{1}{2}$,,	30 − $\frac{15}{16}$ − $\frac{7}{16}$	38 − 1 − $\frac{3}{8}$	27·3
16 ,, $2\frac{3}{4}$,,	31 − 1 − $\frac{7}{16}$	39 − $1\frac{1}{16}$ − $\frac{3}{8}$	28·2
,, ,, $2\frac{1}{2}$,,	28 − $\frac{7}{8}$ − $\frac{7}{16}$	35 − $\frac{15}{16}$ − $\frac{3}{8}$	25·5
20 ,, $2\frac{3}{4}$,,	27 − $\frac{7}{8}$ − $\frac{7}{16}$	34 − $\frac{15}{16}$ − $\frac{3}{8}$	24·6
,, ,, $2\frac{1}{2}$,,	24 − $\frac{3}{4}$ − $\frac{7}{16}$	31 − $\frac{13}{16}$ − $\frac{3}{8}$	21·8
24 ,, $2\frac{1}{2}$,,	22 − $\frac{5}{8}$ − $\frac{7}{16}$	27 − $\frac{11}{16}$ − $\frac{3}{8}$	20·0
28 ,, $2\frac{1}{2}$,,	19 − $\frac{9}{16}$ − $\frac{7}{16}$	25 − $\frac{5}{8}$ − $\frac{3}{8}$	17·3
32 ,, $2\frac{1}{2}$,,	16 − $\frac{1}{2}$ − $\frac{7}{16}$	21 − $\frac{9}{16}$ − $\frac{3}{8}$	14·5

It should be understood that the rule for 33-grain powders of deducting $\frac{1}{16}$ oz. of shot and adding $\frac{1}{16}$ inch to the thickness of felt has been followed. The column of 30-grain charges gives the nearest equivalent to a tenth of a grain for the values in the other powders. In several instances the equivalent charges 33 and 42-grain types of powder are not in mathematical proportion. This is because the grain charges are based on the decimal values of the previous table.

ROUND THE TRADE.

The firm of A. J. Spalding and Brothers are advertising in *The Field* a revolution in the price of guns. They offer retail at the price of four, five and six guineas respectively three models of Stevens double-barrel guns. This is in connection with the announcement that they have become selling agents for the Stevens Arms Co., U.S.A.

The New Explosives Co., Ld. have issued a circular to the effect that the vacancy caused by Mr. McLoughlin's death has been filled by the appointment of Mr. W. B. Hamilton as their travelling representative for England and Wales in connection with sporting powder and cartridges. Mr. Hamilton has been connected with the gun and ammunition trades for the last eighteen years.

It has been decided, in the absence of a suitable offer for the business of the late Mr. W. J. Jeffery, to form a private limited liability company for carrying on the same. Registration has accordingly been effected with a capital of £15,000, with Mr. J. Parnell as permanent chairman, with a special qualification of 3,000 shares, the other directors being Messrs. C. Jeffery, W. Palmer, J. J. and H. B. J. Johns.

The bad luck of Nobel's Explosives Co. Ld., in having Saxonite lose its position on the list of explosives permitted for use in fiery coal mines, was followed by the instalment of Samsonite on July 3rd last as its successor. The new explosive is reported to have already made considerable headway, having been adopted in many important collieries for stone work. It is said to be noticeable free from obnoxious fumes.

A new edition of the immense catalogue of the Manufacture Francaise d'Armes et Cycles of Saint Etienne has just been issued. Besides dealing exhaustively with all forms of firearms it contains an immense list of requisites for other sports. The total number of illustrations is stated to be 20,000, and such a list, dealing, as it does, with many purely Continental models, has a considerable reference value. The firm offer to send copies post free on receipt of three pence, presumably in English stamps.

THE latest Winchester catalogue No. 75 has just been received in this country. It is dated last March, and although it is difficult to pick out what is new amidst the large mass of statistics, there is a satisfaction about an up-to-date edition which should result in many copies being enquired for. The Winchester Arms Company, as manufacturers of rifles and shot guns, and in an even larger way of cartridges, both metallic and sporting, must rank as the largest firearms concern in the world. Their encyclopædic catalogue accordingly ranks as a scientific treatise the high character of which is maintained by a quantity of carefully compiled technical statistics. The United Kingdom agents are the London Armoury Co., Ld. of Bury St., St. James'.

From Sir F. L. Nathan a notice has been received stating that from the 9th of last month his permanent address would be Ardeer, Stevenston, Ayrshire, N.B. The issues of *Nature* for July 29 and Aug. 5 last, contained a reproduction of Sir Frederick's lecture before the Royal Institution on Jan. 29th, on the subject of improvements in production and application of guncotton and nitroglycerin. An interesting proof that the administrative capacity, which has been so marked a feature of the career of the late superintendent at Waltham Abbey, is shared by other members of his family is provided by the announcement that his brother, Sir Matthew Nathan, has been appointed secretary to the Post Office, having previously occupied several important colonial posts, the latest having been the governorship of Natal. Another brother was knighted for distinguished public services in the legal branch of colonial administration.

The next sale of guns at Debenham's rooms will take place on the 3rd inst.

An explosion attended with fatal results occurred at the black powder mills of the Chilworth Gunpowder Company, at Fernilee in Derbyshire, near the Chester border, on the 12th ult.

A company has been registered under the title Carlite Syn. Ld. for the purpose of dealing with explosives in various ways. Another company with the title Anglo-French F. & S. (1909) Ld. has been registered with similar objects in view. The capital of the first is £500 and the second £36,000.

In view of the large proportion of total orders for best guns which the gun trade now receives from the Continent it is interesting to note that it is intended to hold an International Hunting Exhibition in Vienna during the course of next year. The exhibition will, it is understood, be on a large scale. The exhibits will cover sporting guns and rifles and everything else which is likely to be of use in connection with both small and big game shooting.

A correspondent writes :—"Owing to the large number of cases in which Italian workmen resort to the use of the knife, or of firearms, to settle their quarrels, the Government of the country has just amended the existing law relative to the public safety. The amendment, which came into force on the 3rd July allows arms of all sorts to be kept in the house but absolutely prohibits the carrying of knives and stilettos in the street. Revolvers, guns, and pistols may be carried only in those cases, where a licence has been secured. As was to be expected the amendment has called forth numerous complaints from those persons who are interested in the manufacture or sale of knives in Italy."

The transference of the sporting gun department of Messrs. Webley & Scott, Ld. to the old Scott factory, Premier Gun Works, Lancaster Street, Birmingham, is now approaching completion. Section by section has been removed from the old quarters to the new with a minimum of disturbance. There can be little doubt that the change will greatly facilitate the supervision of work. The main warehouse and gun finishing department occupies a central position on the first floor with excellent top light. Symetrically arranged on each side are wings containing several floors, each devoted to a special department. With windows on both sides the lighting is of the best. The conditions for the workmen are greatly improved. The main factory in Weaman Street has correspondingly benefited from the provision of extra space to accommodate the large output of automatic pistols, of which an important new model is in course of preparation.

The Field of the 7th ult. contained the following letter from the Colonial Office notifying the prohibition of military calibres, in respect to Uganda.

"I am directed by the Earl of Crewe to transmit to you the accompanying copy of a proclamation issued by the Acting Governor of the Uganda Protectorate prohibiting the importation into the protectorate of rifles of ·303 and ·450 Martini Henry calibres and ammunition suitable for the same. Lord Crewe would be obliged if suitable publicity could be given to this prohibition in order to avoid disappointment and inconvenience to sportsmen and travellers intending to proceed to the protectorate. (*Signed*) H. W. JUST. Downing Street, July 30."

"UNDER THE UGANDA CUSTOMS CONSOLIDATION, ORDINANCE, 1904. I hereby prohibit the importation into the protectorate of rifles of the following calibres and of ammunition suitable for use therein, unless the consent in writing of the Governor shall have previously been obtained: Rifles of the calibre ·303; rifles of the calibre ·450 M.H. (*Signed*) STANLEY C. TOMKINS, Acting Governor. Entebbe, May 22."

The draft regulations for the organisation and working of cadet corps in connection with the territorial organisation have recently been issued. Apart from a small money grant, each corp will receive five ·22 or other rifles for every 100 enrolled, in addition to rifles for drilling purposes, etc. The free ammunition allowance is 30 rounds each member.

The National Rifle Association has given its decision in good time to the effect that the barrels of match rifles must not exceed 3¼lbs. weight at next year's meeting. This reversion to the old value is understood to be in consequence of the discovery that the 3½lbs. weight, which was allowed as the result of last year's trouble, is not as a matter of fact the weight of the barrel of the ordinary Canadian service pattern of the Ross rifle. It is also interesting to note that officially certified specimens of any service rifles which are intended to be used as such at the Bisley Meeting shall be deposited beforehand.

A special sitting of the Stowmarket Justices was held on the 21st ult., Mr. F. H. Pretyman presiding, to hear an application on the part of the New Explosives Company for a licence for the construction of eight additional magazines on their premises. Mr. Walter Stewart (instructed by Mr. F. C. Peecock), who appeared in support of the application explained that the Company were large employers of labour in the district, employing over 300 hands, and paying during the last year no less than £17,250 in wages, and the assent of the local authority was asked for the construction of eight additional magazines for storage purposes on the premises which they occupied in the parishes of Stowmarket and Stowupland. The present magazine capacity, roughly speaking, was 42 tons, and the eight additinal magazines asked for would have a capacity for ten tons each. Mr. L. G. Duff Grant, general manager of the Company, explained that cordite now required a longer drying process. With their present plant it was necessary to stop one-ninth of a week, and it was desirable that the plant should be kept continually running. Further evidence having been given by Mr. J. C. Ody, works manager, and Mr. Oscar Guttmann, the bench granted the application

The following seems to have been inspired by a recent application before a local authority :—

1.—Now in these days it came to pass that David went up before the judges and rulers of Hes-hex and said unto them, Grant me, I pray you a licence for the manufacture of explosives, so that there may be work in the land ; for the people are sore distressed and in great need.

2.—For behold in the land of the north is a great giant, who hath a mighty army, and they eat up all the corn and consume all the substance, and no man dare even glean thereof.

3. But I, even David have an army of five score warriors, seventeen of whom are valiant men, ready for war.

4. Now when the giant shall hear of this he will tremble and be sore afraid, for he knoweth my might of old.

5. Then peradventure he will offer us peace offerings and meat offerings that we do him no hurt, and we shall wax fat and there will be plenty in the land of Hes-sex.

6. When the judges and rulers heard this they marvelled thereat and took council together, and after a while they came back saying, The giant of whom thou speakest hath twice ten thousand, thousand warriors, and how can seventeen do battle against so many. Surely if we grant this prayer it may bring evil on the land, and thy warriors will be slain and all that thou hast will be lost.

7. Go thou then away in peace, for that which thou asketh we can not do.

8. Then David and his brethren murmured together saying, Surely the hearts of the judges are hardened against us, for they hearken not unto our supplications, nor give heed unto our requests. And they went away sorrowful.

MEXICO. July 1909. S.S.

The Austrian small arms factory have forwarded for inspection and report an extremely neat looking model of automatic pistol of the waistcoat pocket order. It has been made under Nicolas Pieper's patent, and, therefore, comprises the valuable feature of a breakdown barrel. An additional improvement in the form of a spring results in the barrel flying open the moment a thumb catch on the left side of the action is depressed. If a cartridge happens to be in the chamber it is thrown into the air clear of the pistol. The calibre is the usual 6·35 m.m., viz., ·250 bore, and there is also a larger size viz., 7·65 m.m. which corresponds with ·301in. The advantages claimed for the tip-open barrel are, primarily, facility for use as a single shot weapon, secondly, that it provides an easy system of unloading the weapon, and thirdly, that the barrel is at all times readily accessible for cleaning. The sample model pistol which has been received weighs, with the magazine empty, a trifle under 12oz. It is highly finished, and the general appearance is distinctly pleasing.

From the New Explosives Co., Ld. a little pamphlet has been received which ranks differently from an ordinary trade advertisement in the fact that it contains a statement of that Company's policy with regard to the general question of smokeless powder manufacture. The line taken is sufficiently expressed by the following paragraph which we venture to quote in full :—" Sporting powders no longer hold their position by virtue of a special composition, but rather on account of the skill exercised in their manufacture. The ingredients of nitro explosives are well known, and for a considerable number of years the methods of manufacture have shown little or no change. Between powders of different make there are undoubtedly differences of quality and behaviour, but quality is not achieved by exclusive processes protected by patents or carried out under the seal of secrecy. In the making of smokeless powders there is thus a fair field and no favour. The obstacles are in full view, and success is only to be achieved by an intelligent application of the laws of standardisation. In other words the making of a first-class smokeless powder consists in successfully maintaining a midway course between the various extremes of behaviour to which modern nitro powders are especially prone. The good smokeless powder is thus not merely the powder which is good to-day, to-morrow and the next day, but the one which, wherever encountered, and under whatever conditions it may be used, maintains the nearest approach to average behaviour." The pamphlet then proceeds to develop the same idea in detail with respect to pressure, velocity, recoil, density and damp resisting properties. They give to pattern its own proper place in respect to the other properties of a cartridge. Quoting the actual words used " Pattern is the manifestation, not of one property in a powder or cartridge, but of all the properties rolled up and added together so as to form a single outstanding characteristic. It attains its highest expression when the three main factors, pressure, velocity and recoil, are correctly co-ordinated with one another. Whether the patterns from a gun are wide or close is of relatively small account, so long as they are regular from round to round. This gives a shooter the opportunity to time his shots so as to catch his bird when the pattern is nicely opened out, but is still free of empty spaces." The letterpress concludes with a table of comparative loads for Felixite, Red Star and Neonite powders these being in the proportion of 42, 33 and 30 the respective number of grains in the three-dram charge. The charges dealt with run from 11 to 44 grains of a 33-grain powder, advancing a grain at a time. The equivalent charges in Felixite and Neonite are given to the nearest tenth of a grain. The pamphlet is well printed, being decorated with three rather striking coloured representations of the Company's three powders.

ABEL ON GUNCOTTON (1866).
PART III.

BY GEORGE W. MACDONALD, M.Sc., F.C.S.
(*concluded*).

Where the proportion of acid to cotton was 50 to 1, and the time of immersion only 10 minutes, the importance of continuing the digestion with acids longer than is merely necessary for the production of an explosive material, was clearly shown. By immersion for ten minutes only, the cotton increased in weight 62·43 per cent., and the product was to a considerable extent soluble in ether and alcohol. In another experiment a still more soluble product was obtained by immersion for only three minutes. Where the quantity of acid is limited, digestion for 12 hours is scarcely sufficient to ensure the maximum attainable increase of weight; under equal conditions the results obtained by immersion for 24 hours were quite equal to those furnished by more protracted digestion. This observation was fully borne out by the results of manufacturing operations. There was no doubt that an actual loss of product, though only slight, was sustained by prolonging the contact of the acids with the guncotton much beyond the period necessary for its perfect production. It was shown that a very brief treatment of cotton with a warm acid-mixture effects its conversion into soluble guncotton as completely as a long-continued treatment with cold acids (the proportion of the latter being limited). This experiment was made for the purpose of ascertaining whether, with the employment of the strongest acids, heat exerted a similar influence upon the character of the product to what it does when weaker acid-mixtures, or mixtures of saltpetre and sulphuric acid are employed. This is evidently not the case, for the product obtained was as slightly soluble as the general products of manufacture at Waltham Abbey. It was also found that a few minutes immersion in a warm acid mixture converted an imperfect product, obtained with a few minutes treatment with *cold* acids and containing much soluble matter into a guncotton of the ordinary kind. The results furnished, under most favourable circumstances, by cotton of an ordinary commercial quality varied between 78 and 81 per cent., never quite reaching the latter number. The results also point, as did some of those obtained with the purer cotton, to a tendency of the guncotton to dissolve in the acid-mixture when the immersion is continued for a very long period. Results obtained by treatment of the cotton for 24 hours were notably higher than those furnished by the 48 hours treatment. The loss of product ascribable to this cause was doubtless somewhat greater in these experiments than in manufacturing operations, when the proportion of acid to the cotton is considerably lower. A comparison of the weight of cotton, obtained from samples of guncotton, with the original weight of cotton employed in their production, affords data which are strongly in support of the conclusion that the differences between the increase in weight which cotton should sustain by conversion into trinitro-cellulose $C_6H_7O_5(NO_2)_3$ and the results furnished by as perfect a treatment of different specimens of cotton as is practicable, are to be ascribed, not merely to the presence, in the products, of small quantities of imperfectly converted soluble guncotton, but also to the existence in them of substances which are foreign to the cotton, and which are only partially removeable by simple washing with water. Using Hadow's method for the regeneration of cotton from nitrocellulose, it was shown that cotton which was recovered from the laboratory products, furnished by comparatively very pure cotton which had sustained an increase of weight of 82 and 82·6 per cent. (the theoretical increase being 83·3 per cent.) amounted to only about 1 per cent. less than the cotton originally taken; and that when the employment of a limited quantity of acid yielded a product the weight of which represented about 2 per cent. less increase than these, the cotton recovered was in this instance only about 1 per cent. below the quantity employed, the difference in the weight of the nitro-product having been due only to the formation of a somewhat larger proportion of soluble guncotton. It appears from these results, and estimating the proportion of loss which the processes of conversion and reduction may involve at about 0·5 per cent. that the particular cotton-wool operated upon contained about 0·5 per cent. of matter foreign to cellulose, which was eliminated in the course of the transformation and reproduction of the latter. But, when less pure samples of cotton were converted as completely as practicable into insoluble guncotton, and furnished results from 1·74 to 4 per cent. lower than those obtained by a similar treatment of the pure material, the weight of the recovered cotton indicated a loss upon the original substance employed of from 4·4 to 6·3 per cent. an increased loss which must be due to the larger proportion of foreign matters existing in the cotton operated upon. These facts surely afford strong support to the conclusion that the deficiency in weight exhibited by the products obtained from ordinary cotton wool, even after its purification with alkali, as compared with those furnished under the same circumstances by purer cotton wool, is due to the presence of foreign matters in the cotton, which though partially retained by the guncotton, exist there in the form of products whose formation does not add, in so high a proportion, to the original weight of the cotton as does the production of trinitro-cellulose.

Two quantitative operations were conducted in the ordinary course of manufacture at Waltham Abbey, with the view of ascertaining the actual quantity of guncotton furnished by 100 parts of cotton in the ordinary course of operating with considerable quantities of material. In one experiment the cotton employed, which contained about the average quantity of seed, and had as usual the peculiar colour of unbleached fibre, was submitted to the ordinary purification in the bath of potassium carbonate, and was dried as usual for twenty-four hours at 50°C before immersion in acids. Its weight, when dry, was 31lbs. 6ozs. It was afterwards treated in all respects like an ordinary product of manufacture. The weight of the air-dry guncotton showed an increase upon the original dry cotton of 74·3 upon 100 parts. The weight of the thoroughly dry product corresponded to an increase of 71 upon 100. In another experiment, made with a somewhat higher quality

of cotton, an increase of 76 per cent. was obtained. The products of these operations were quite similar in character to those usually obtained, and to the results furnished by the laboratory experiments previously described, which were conducted with samples of the same description of cotton. A difference of about 9 per cent. between the latter results and the lowest number furnished by the quantitative manufacturing experiments had therefore to be accounted for. The following statements show that this deficiency was not greater than would be anticipated. In the cotton operated upon, besides the resinous and other impurities which are partly removed by solution in the acid and by subsequent extraction in the purifying processes, and which also occasion a notable loss in the laboratory experiments with this kind of cotton, as already pointed out, there exists a more or less considerable proportion of seed, of which only minute particles are here and there observed in the finished guncotton. To this source of loss upon the weight of the cotton employed, has to be added the mechanical loss of product unavoidably attending the repeated submission of the guncotton to the expressing and long continued washing processes. But the principal loss of product, and one which alone suffices to account for the difference observed between the results of the laboratory experiments and those of ordinary manufacturing operations, occurs in boiling the guncotton in the alkaline bath. The brief digestion of the material in the weak solution of potassium carbonate not only abstracts a considerable proportion of the products foreign to guncotton, resulting from the action of the acids upon the impurities which the cotton fibre obstinately retains, but also causes a very notable proportion of the guncotton itself to pass into solution. A quantity of Waltham Abbey guncotton which had, in the ordinary course, already been submitted to the treatment with alkali, was boiled for ten minutes in a solution of potassium carbonate precisely similar to that usually employed (sp. gr. 1·02). The liquid became of an amber colour, and the guncoton, when dried, was found to have sustained a loss of 3·7 per cent. The same guncotton was again boiled for twenty minutes in the same alkaline bath, which deepened in colour considerably during this second employment. The total loss sustained by the material, after this second treatment, amounted to 12·09 per cent. 9·22 grms. of cotton yarn, previously purified by treatment with alkali and carefully freed from seed, were converted into guncotton in the ordinary manner, excepting that about three times the ordinary proportion of acid was used, whereby the solution of foreign matters in the acid was promoted. The product, after long continued washing in distilled water, was dried and weighed. The increase sustained by the cotton amounted to 78·14 per cent. (a number closely corresponding to the laboratory results previously described). The guncotton was then boiled for eleven minutes in a solution of potassium carbonate of the usual strength. When washed and again dried, it was found to have lost considerably in weight, and the finished product showed an increase of weight upon the original cotton equivalent to 69·8 upon 100, which was therefore 1·2 per cent. less than the lowest result obtained in the manufacturing operations. It is easily conceivable that, in the smaller operations, the guncotton, though submitted for only exactly the usual period to treatment with an alkaline bath of the ordinary strength, should sustain a somewhat greater loss than a large compact mass of the material, such as is always operated upon. But the results of these experiments establish a source of loss in the usual process of manufacture, which fully accounts for the discrepancies exhibited between the yields of usual manufacturing operations and of laboratory operations conducted with the same description of cotton, in which the treatment with boiling alkaline water has been omitted.

Comparison between analytical and synthetical results. The relative proportions of carbonic acid and nitrogen furnished by the complete oxidation of guncotton, afford the means of instituting a comparison between the analytical and synthetical results, of which the details have been given, and, it is believed, of demonstrating beyond dispute the correctness of the conclusion, that the product of the complete action upon cotton wool of the mixture of strongest acids prescribed by Von Lenk is most correctly represented by the formula $C_6H_7N_3O_{11}$, of which the expression $C_6H_7O_5(NO_2)_3$ appears to be the most rational interpretation.

From the relative volumes of carbonic acid and nitrogen furnished from the guncotton, it appeared that the nitrogen, though somewhat low, is nearer to the requirements of the trinitro-cellulose formula than to those of the formula adopted by Pelouze and Maury; the proportions of the gases observed in three experiments, which happened to be identical in their results, corresponded with the requirements of $C_6H_7N_3O_{11}$, as closely as could possibly be expected when operating upon a substance of approximate purity only. Upon calculating the proportion which the nitrogen found (13·32 and 13·59 per cent.) in these experiments bears to the mean percentage of carbon (24·6) obtained by the most trustworthy method employed for the determination of that element, it was evident that these percentage proportions of nitrogen were not only in perfect accordance with a considerable number of results obtained by direct determination of the volume of nitrogen furnished by samples of Waltham Abbey guncotton; but they were also as close approximations to the theoretical percentage of nitrogen in trinitro-cellulose as the analysis of products containing small proportions of lower nitro-compounds could be expected to furnish; and lastly, the increase in weight which cotton of average purity should sustain by conversion into nitro-cellulose products which furnish these proportions of nitrogen, corresponded closely to the average results obtained by operating upon moderately pure cotton with the mixed acids of *prescribed strength* and in the proportion (about 10 parts to 1 of cotton) indicated by Von Lenk.

Abel's general conclusions were as follows:—

1. The products obtained by submitting cotton wool to treatment with the prescribed mixture of nitric and sulphuric acids, and to purification as directed by Von Lenk, are very uniform in character; they consist almost entirely of the most explosive known variety of guncotton or pyro-

xylin, which is insoluble in mixtures of ether and alcohol. This substance, when produced upon a manufacturing scale, contains from 1 to 2 per cent. of mineral substances, and a small proportion, varying with the quality of the cotton, of matters soluble in alcohol, partaking of acid properties, and consisting chiefly, if not entirely, of products of the action of nitric acid upon resinous or other bodies enclosed in the cotton fibre. There is also always present in the guncotton a small quantity (from 1 to 3 per cent.) of cellulose-products of a less explosive character, soluble in mixtures of ether and alcohol, which result from the incomplete action of nitric acid upon small portions of the cotton operated upon.

2. The guncotton, when purified as far as it is possible from foreign substances, soluble in alcohol and in ether and alcohol, furnishes analytical results which agree much more closely with those demanded by the formula

$$C_6H_7N_3O_{11}, \text{ or } C_6H_7O_5(NO_2)_3$$

than with the requirements of the formula

$$C_{24}H_{36}O_{18}(N_2O_5)_5$$

recently adopted for guncotton by Pelouze and Maury.

3. If cotton wool of great purity is digested for a period of about twenty-four hours with a considerable proportion of the prescribed acid mixture (about 50 parts to 1 of cotton) it sustains an increase of weight ranging between 81·8 and 82·6 upon 100 of cotton. Lower results (between 78 and 80 per cent. increase) are obtained by digesting the cotton for a short period only, or for very considerable periods, by using a limited proportion of the acid (from 10 to 14 parts to 1 of cotton) by employment of acids of slightly lower specific gravities than those specified and by operating upon cotton of somewhat lower quality. The digestion, for a second or third time, of products which have exhibited a comparatively low increase of weight, in an acid-mixture of the kind first used, or of greater strength, has the effect of raising the weight of the product to within the higher limits above named. The increase in weight which 100 parts of pure cellulose should sustain, theoretically, by complete conversion into a substance of the composition $C_6H_7O_5(NO_2)_3$, is 83·3, while, if converted into a substance of the formula

$$C_{24}H_{36}O_{18}(N_2O_5)_5$$

the increase sustained by it only amounts to 77·8 upon 100 parts.

4. Cotton wool always contains, even after careful purification, small proportions of foreign organic substances, the presence of which, in the material submitted to treatment with the acids, must affect to some extent the quantity of the product obtained.

5. It is extremely difficult, indeed apparently impossible, even in operating under most favourable conditions upon small quantities of cotton wool, to convert this substance *completely* into the highest nitric product—the perfectly insoluble guncotton. Small quantities of guncotton soluble in ether and alcohol can always be extracted from the products; the quantities are only minute in the highest laboratory products, but they are always very appreciable in the most perfect manufacturing products. Their invariable formation must unquestionably cause the increase of weight sustained by cotton to be somewhat less than that which theory would demand.

6. The long-continued digestion of the guncotton in the acid-mixture, the several mechanical operations to which it is submitted in the course of its purification, and above all, the solvent action exerted not only upon certain by-products, but also upon the guncotton itself by the alkaline liquid, in which it is boiled for a short time, are all sources of loss which, in examining into the results of a system of manufacture, must not be disregarded, and the existence of which explains satisfactorily the difference observed between the weights of the laboratory products and those of manufacturing operations.

7. In accepting the formula proposed by Pelouze and Maury for guncotton, it would be necessary to assume that the cotton wool operated upon was pure cellulose; that the operation of conversion was an absolutely perfect chemical process; that there were no possible sources of loss in the production of the material; and that in all laboratory operations which had furnished an increase of weight above the theoretical demand (77·8 per cent.), some substance, differing in composition from the ordinary products of manufacture, must have been obtained.

8. The identity in their characters, and close resemblance in composition, of the most perfect products of laboratory operations and of the *purified* products of manufacture, the very close approximation in the weight of the former to the theoretical demands of the formula

$$C_6H_7O_5(NO_2)_3, \text{ or } C_{12}H_{14}O_7(N_2O_5)_3$$

and the satisfactory manner in which the unavoidable production of somewhat lower results in the manufacturing operations admits of practical demonstration, appear to afford conclusive evidence of the correctness of either of those formulae as representing the composition of the most explosive guncotton, and to demonstrate satisfactorily that the material, prepared strictly according to the directions perfected by Von Lenk, consists uniformly of that substance (now generally known as *trinitro-cellulose*) in a nearly pure condition.

THE *Illustrated Official Journal* of the 25th ult. contains the report of an interesting case which was heard in the Court of Sessions in Scotland, and related to an alleged infringement of patent on the part of Nobel's Explosives Co., Ld. The pursuers, that is the plaintiffs, were the Badische Anilin und Soda Fabrik, and they alleged against Nobel's the infringement of five patents relating to the manufacture of anhydride and other compounds, and for damages. The case, as reported was for an order for inspecting the processes to see whether in reality they were carried out as stated under another patented system, viz., the Verein Chemischer Fabriken patents. The defenders also impugned the validity of the pursuer's patents.

In support of the claim for inspection the pursuers pointed out that the only possible objection that could be lodged was that the processes were of a secret nature, an argument which could not hold where the processes claimed to be in use were protected by patent. The other side urged that inspection should not be permitted until a

prima facie case had been put forward by affidavit to show necessity for an inspection. The case was heard on the 7th of June last, and Lord Salvesen in giving judgment said :—"I think I ought to grant a warrant to inspect in this case. I have come to that conclusion because I do not see in what other way the Pursuers can obtain proof of the facts which they aver. If the whole evidence of what is done in the Defenders' works were to come from the Defenders' witnesses it would be impossible for the Pursuers, who have no access to these works, to check its accuracy. I must assume that the Pursuers are acting on some information which they consider to justify the definite statements they have made of infringement of their Patents. I cannot suppose that they are attacking the Defenders on suspicion only, that is without any knowledge other than that the latter are manufacturing sulphuric anhydride. I am the more disposed to take this course because the Defenders maintain that they are making sulphuric anhydride under a patented process. No harm to them can possibly be done by inspection by experts, who will be careful not to interfere in any way with their process or business or to act otherwise than as skilled observers. It may turn out as the result of the inspection that the Pursuers will be satisfied that there is no infringement ; and there will then be an end of the action. If the contrary appears, then the action of the Pursuers will so far be justified, and only the question of the validity of their Patents will remain."

It was thereupon decided that two distinguished scientists should make the needful inspection, and that in order that their attention should be directed upon the proper points they should be accompanied by an expert member of the staff of the pursuers, since it was only possible for persons familiar with the patented processes to indicate where infringement might occur. The pursuers explained how they could have been willing to suggest outside practical men if they could find them, but they knew of none.

APPLICATIONS FOR PATENTS.

JULY 19—AUGUST 21, 1909.

16,754. Holder and Protector for Rifle Muzzles. W. Brown.
16,776. Rifle Sights. F. Greener.
16,788. Guns. R. J. W. Brown.
16,826.* Sight for Firearms. E. O. Deere and T. O. Jäderborg.
16,847.* Telemeters. R. Haddan.
16,898. Small Arm Sights. H. E. S. Holt.
17,008. Field Gun Sighting Apparatus. Vickers, Maxim, Ld. and G. Buckham.
17,029. Self Levelling Guns. Princess Anne of Lowenstein Wertheim.
17,211. Automatic Firearms. M. G. Farquhar and A. H. Hill.
17,372. Calcium Carbide Cartridges. A. Barnett.
17,482. Rifle Sights. W. J. Clifford.
17,523.* Target Practice Attachment. E. C. R. Marks.
17,566. Lessening Sound of Discharge. T. R. R. Ashton.
17,625.* Explosives Buildings. O. Guttmann.
17,699.* Ammunition. H. Dörn.
17,861. Gun Sights. C. Crompton and Crompton & Co.
17,996.* Recoil Guns. K. Haussner.
18,080. Projectiles. M. R. Heide.
18,160.* Ammunition Hoists. Fried Krupp.
18,191. Projectiles. A. T. Dawson and G. T. Buckham.
18,202. Silencers for Rifles. C. E. Challis.
18,279.* Smokeless Powder. V. Vender.
18,383.* Ordnance. E. J. Blood.
18,410.* Apparatus for Arresting Bullets. H. P. Maxim.
18,425.* Small Arm Grenades. W. Berger.
18,495.* Automatic Revolver. G. Van der Haeghen.
18,551. Explosives. H. F. Easton.
18,554. Foresight. F. Harvey.
18,571. Silencer for Guns. C. E. Challis.
18,589.* Projectile. C. Banka.
18,611.* Range Finders. C. P. Goerz, Akt. Ges.
18,622.* Explosives. C. Wesler.
18,626.* Gas Operated Repeating Gun. H. Böhm.
18,669. Gun Mountings. Armstrong Whitworth & Co., Ld.. R. Matthews and C. Wale.
18,848.* Firearms. W. E. Lake.
18,915. Shrapnels. G. Wedde.
19,051. Targets. F. G. Skerritt.
19,251.* Target Device. T. H. Bree.
19,279.* Projectiles. H. Brust.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

JULY 29, AUGUST 19, 1909.

COMPILED BY HENRY TARRANT.

10,418 (1908). **Machine Gun Improvements.** G. C. Dymond, London (Agent for *the McClean Arms and Ordnance Co., U.S.A.*). Machine Gun mechanism of the type described in Patent No. 10,021, 1908, is improved. The parts are arranged so that they may easily be dismounted without tools and the cartridge feed mechanism is altered. Accepted July 13, 1909.

11,057 (1908). **Ordnance Mounting for Meters.** W. P. Thompson, London. (Agent for *The McClean Arms and Ordnance Co., U.S.A.*) A portable mount for machine guns adapted to be carried on an automobile is described in this specification. The propelling mechanism is mounted through the chassis much in the usual way on resilient springs, but the gun is connected directly with the axles. Means for controlling the recoil by the action of the gases of combustion are described. Accepted July 21, 1909.

14,159 (1908). **The "Leonard" Single Trigger Mechanism.** S. A. Leonard Cheltenham. (*See Selected Patents*).

14,966 (1908). **Tripod Mountings for Ordnance.** Lieut. A. T. Dawson, and C. A. Larssen, London. In tripod mountings of the type dealt with in patent No. 29,793, 1906, the axle of the wheels is connected with the mounting in such a way that they can be set into different positions with respect to the distance of the axle from the axis of the gun. The gun may thus be adapted for crawling, travelling and other positions. Other improvements are dealt with in the patent. Accepted July 8, 1909.

16,205 (1908). **Auxiliary Sights for Ordnance.** Rheinische Metallwaaren und Mf., Germany. An aiming circle or panorama telescope is combined with a travelling arc upon which it is made to travel. This combination is detachably secured to the rear of the gun and is adapted for use in case of damage happening to the ordinary sights. Accepted July 15, 1909.

19,177 (1908). **Automatic Pistol Mechanism.** W. J. Whiting, Birmingham. A modified way of holding the breech slide open after the last cartridge from the magazine has been fired is introduced into this pistol mechanism. The top cartridge in the magazine after each shot engages with one end of a lever, the other end of which is consequently depressed below the path of the breech bolt. When there are no more cartridges the back end of the lever is forced up by a spring so that it catches the bolt when the recoil spring attempts to drive it forward to the closed position after the firing of the last shot from the magazine. Accepted July 29, 1909.

20,855 (1908). **Eye Protector for Rifle Sights.** C. R. C. Hart, London. An indiarubber or "Dermatine" eye protector for use with telescopic sights is first formed of one piece of material—barrel-shaped. This is doubled over so that the two extremities may be joined. An air space lies between the folds. Accepted July 22, 1909.

21,516 (1908). **Aperture Sight Construction and Manufacture.** H. Greener, Birmingham. (*See Selected Patents*).

22,283 (1908). **Metal Cartridge Case Manufacture.** W. D. Fox, Leeds. (*See Selected Patents*).

23,640 (1908). **Automatic Air Rifle Target.** L. Jeffries, Birmingham. The usual form of target used in air rifle shooting has a bell just behind the hole which forms the bullseye. This bell is struck by the pellet. The patentee eliminates possibility of bell breakage by arranging a

spring plunger behind the " bull " hole which when struck releases a lever. The latter records the fact that a bulls-eye has been scored by dropping and ringing the bell. Accepted July 22, 1909.

23,833 (1908). **Automatic Pistol Mechanism.** A. D. Chronis, Germany. The pistol described in this patent has a barrel, which moves backwards upon firing, locked to the breech bolt in the known way. At a certain point the laterally disposed locking parts release the breech which continues the backward movement in an arc shaped path. The arrangement of the path of the bolt is claimed to possess certain merits which are dealt with fully in the patent. Accepted July 22, 1909.

27,166 (1908). **Rimless Cartridge Cases.** L. B. Taylor. Rimless cartridge cases such as are dealt with in patent No. 10,113, 1889 are modified by the patentee in order to allow of the use of a smaller breech bolt recess, of a smaller bolt, and of the interchange of barrels with different chambers and calibres in the one action. The rim for these purposes is simply turned down so that the base of the larger cartridge is of smaller diameter than the body of the case. A uniform size of base is suggested for different sizes of cartridges whilst the rifle with which interchangeable barrels to accommodate them might be used is of the falling block type described in patent No. 5,098, 1906. Accepted July 22, 1909.

27,643 (1908). **Ammunition Conveying Device for Ordnance.** Fried Krupp, Germany. The type of hoist which is adapted to be swung to assume a position behind the breech of the gun to allow of ready transference of the ammunition to the chamber is simplified to render it an accessory to rapid loading. The ammunition is transferred from the hoisting cage directly to a transfer receptacle which is rigidly connected to a part of the mounting and takes part in the elevation of the gun barrel. From thence it is transferred to the loading cage which can be caused to swing behind the gun. Accepted July 15, 1909.

2,576 (1909). **Cocking Mechanism for Break Down Guns.** O. Osborne & Co., Ltd., and C. Ryland, Birmingham. (*See Selected Patents*).

8,128 (1909). **Bird Scaring Automatic Gun.** W. Roeder, Germany. By means of clockwork mechanism a number of cartridges, arranged side by side in explosion chambers are fired at predetermined intervals. The mechanism revolves a shaft which carries a number of tappets adapted to engage successively with the strikers which fire the shots. The strikers are pulled upwards to recock them. Accepted July 22, 1909.

10,303 (1909). **Automatic Gun Rear Supports.** Société Anonyme des Anciens Establissements Hotchkiss & Cie, Paris. Rear supports for automatic guns of the type described in patent No. 10,149, 1907 are dealt with in the present specification. By means of the support, which entails the use of two concentric screws of opposite pitch arranged one within the other, the gun may be either rapidly or slowly raised or lowered while at the same time it is held steady against the shoulder and the gunner and fired with, it is claimed, as much precision as if it were on a rigid mount. Accepted July 22, 1909.

12,506 (1909). **A Perchlorate of Ammonia Explosive.** B. E. D. Kilburn, London. (Agent for *C. Pieper, Germany*) (*See Selected Patents*).

SELECTED PATENTS.

A PERCHLORATE OF AMMONIA EXPLOSIVE.

12,506 (1909). B. E. D. Kilburn, London (Agent for *C. Pieper, Germany*). The improvement of perchlorate of ammonia explosives accounts for the publication of this patent. It has already been proposed to use this substance in combination with carbohydrates such as sugar or starch and also in combination with nitrate of potash or soda.

The present invention covers a compound of the three, the perchlorate of ammonia and the nitrate being mixed in about the same molecular proportions. The relative quantities of carbon and oxygen are arranged so that as far as possible complete combustion takes place. As an example of the new compound the following may be quoted: Starch 44%, perchlorate of ammonia 32%, and sodium nitrate 24%. Starch of various kinds and in different forms may be used the percentage being varied as is found necessary. The approximately equal molecular proportion of the perchlorate of ammonia and the nitrate must on no account be upset. A suitable binding medium may be employed or the explosive may be used in powder or solid form compressed or otherwise.

Very little residue is left on combustion, the flame temperature is low and the explosive power it is claimed is high. Accepted July 8, 1909.

APERTURE SIGHT CONSTRUCTION AND MANUFACTURE.

21,516 (1908). H. Greener, Birmingham. The aperture sight dealt with in this patent is of the well known Lyman type, and has been specially designed with a view to production at the lowest possible cost. Certain parts are formed from steel stampings or blanks.

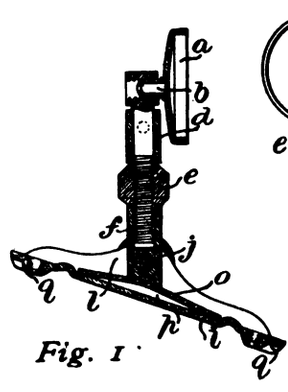


Fig. 1

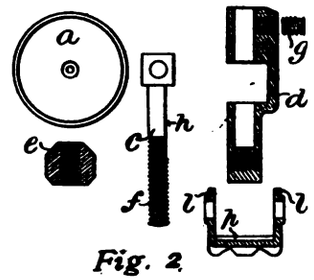


Fig. 2

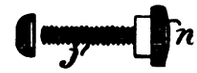


Fig. 3

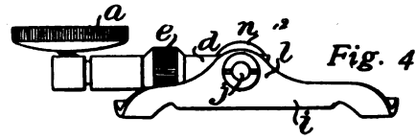


Fig. 4

The device is illustrated in the drawings here reproduced. The aperture through which the rifle is aimed is pierced in the centre of the disc *a*. The disc is attached by means of the screw nipple *b* to the top of the pillar *c* which is adapted to be moved up or down relatively to the leaf *d* by the internally screwed collar *c*. This collar, as is shown, works in a recess in the leaf *d* and engages with the screwed part *f* of the pillar *c*. The latter is kept from turning in the leaf by the keeper screw *g*. This bears against the flat *h* formed on the side of the pillar.

The leaf is pivoted to the base *i* of the sight by the transverse screw *j* which is supported in plain bearings on the upstanding flanges *l* formed on either side of the base. When the screw *j* is turned by means of the milled head *n* the leaf and the pillar and disc are carried either to one side or other of the bed. Adjustment to allow for wind may thus be made. The sight is held firmly in the upright position by the spring *o* which engages with the flat bottom of the leaf. When not needed, the leaf may be folded down as illustrated.

Manufacturing cost is kept down to the lowest possible point by forming the leaf *d* from a stamping or casting, and the base *i* and disc *a* from blanks. The nipple *b* is produced by forming hole stud in the centre of a circular blank, the edges of the disc being turned up to form the circular flange. The outside of this flange may, if desired be milled or knurled. Two or three methods of forming the disc in a circular manner are set out in the patent.

The flanged base *i* is made from a blank containing sufficient metal to allow of the formation of the side flanges *i* of the well *p* for the spring *o*, and of the rifle stock seatings *q* at either end. Accepted July 15, 1909.

COCKING MECHANISM FOR BREAK DOWN GUNS.

2,576 (1909). C. Osborne & Co., Ld. and C. Ryland, Birmingham. This cocking mechanism for break-down sporting guns is operated in the usual way, that is during the dropping the barrels prior to loading. In the usual mechanism a cocking lever is mounted on the same centre as the barrels hinge on. In this new arrangement a cocking lever, crank-shaped instead of substantially straight, is mounted on a pivot lying at the rear of the barrel joint pin. It can be assembled with the other parts before they are mounted on the action body. The patentees claim that the mechanism is more simple than that now in use and that besides being quick to respond when the barrels are dropped, it is easy and smooth in action.

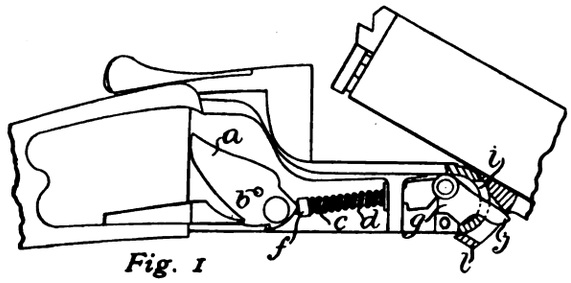


Fig. 1

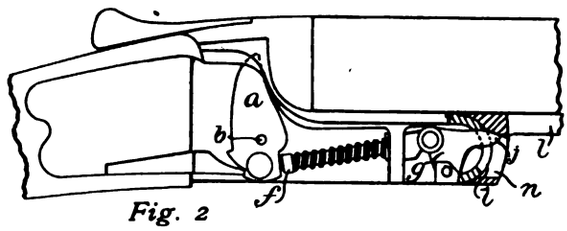


Fig. 2

The accompanying drawings will give a clearer idea of the parts and their arrangements. To the hammer *a*, below its pivot *b*, is connected the rod *c* carrying the coil spring *d* confined between the abutment *e* and the nut *f*. The rod *c* is directly connected to the rear arm of the crank-shaped cocking lever *g* which is pivoted in the knuckle joint. The latter has a slot *i* in which the fore arm *j* of the cocking lever *g* works. The fore-end *l* fits against the face of the knuckle joint and has the slot *n* (on each side in the case of a double barrelled gun) in alignment with the slots in the knuckle joint. The top side of the fore-end slot is downwardly inclined in a forward direction. Bearing against this inclined side is the fore arm *j* of the cocking lever *g*. Slots are provided on the inner side of the knuckle joint to enable the cocking lever to be passed into position and to allow the hammer, mainspring rod with its spring, and the cocking lever, to be fixed (when completely assembled) in position on the action body.

Upon opening the gun the fore arm *j* of the cocking lever *g* is depressed. The cocking lever is turned sharply on its pivot and it pulls the hammer *a* through the rod *c* against the action of the spring *d* into the cocked position. Accepted July 1, 1909.

METAL CARTRIDGE CASE MANUFACTURE.

22,283 (1908). W. D. Fox, Leeds. The improvements introduced into the manufacture of metal cartridge cases are intended to prevent, or at least to decrease, the tendency of the case to split, either spontaneously after manufacture or when fired. The patentee explains that splits result from unequal expansion and elongation due to the metal being of varying degrees of hardness.

Recognising that, as in the case of the ·303 cartridge, the head and the part of the body adjacent to the head must be hard, the following system of manufacture of solid drawn cases is suggested. It should be borne in mind that in the ordinary way the partly made case is not annealed between the final drawing and the head forming operations.

The patentee either completely anneals the whole, or the walls only, of the partly manufactured case at the stage between the final drawing and the head forming operations. He prefers to anneal the whole case because the head formation process renders the head and the part of the case immediately adjacent thereto as hard as is required. In this way it is claimed the case is made of equal softness right through its body. Accepted July 29, 1909.

THE "LEONARD" SINGLE TRIGGER MECHANISM.

14,159 (1908). S. A. Leonard, Cheltenham. Simplicity and efficiency are the principal claims in connection with this "three pull" mechanism, by which the two barrels of a gun may be discharged deliberately through the medium of but a single trigger. The mechanism may be adapted for attachment to any of the known types of double-barrelled guns—hammer or hammerless.

The parts are illustrated in the drawings appended. The single trigger *a* is pivoted in the usual way in the trigger block. When it is pulled, the influence of the spring *b* has to be overcome. The trigger carries the vertical pin *c* on which the sear lifting blade *d* is allowed a limited rotary movement sufficient to carry it from one lock to another. The spring-pushed plunger *e* is mounted in the trigger. It tends always to force the blade *d* round on its pivot to the left hand lock.

When the gun is broken down for loading, a rod is forced back towards the blade by the movement of the top lever. The rod end engages with the projection on the side of the blade and forces the whole of the latter round on the pivot *c*. The chamfered rear *g* of the blade wipes across the chamfered ends *h* and *i* of the stop *j* and forces this part backwards against the pressure

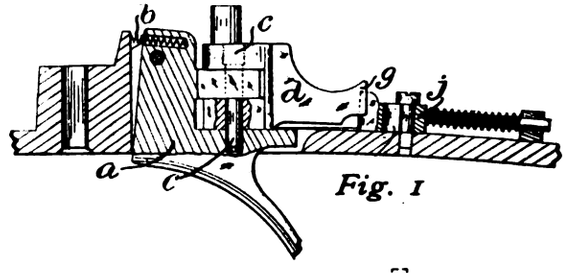


Fig. 1

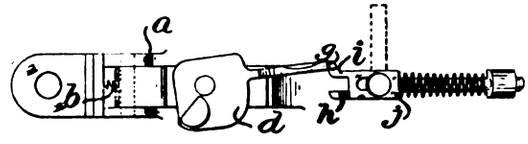


Fig. 2

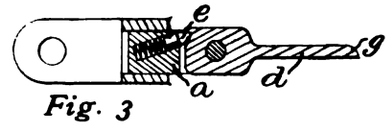


Fig. 3

of its spring. When the gun is cocked the blade occupies the right hand position as is shown. When the trigger is pulled to fire the right hand barrel the blade is lifted above the projection *i* on the stop *j* and is impelled over towards the left hand lock by the plunger *e*. Its movement is arrested midway by the projection *h* which is higher than the other *i*. There it is held until the involuntary pull due to the recoil following the first discharge again raises it and allows it to clear the stop *i*, and to assume the position beneath the left hand sear.

If, after cocking, it is desired to fire the left hand barrel first the part *l* is used to pull the stop back to allow the blade to be pushed over by its spring from right to left.

Special means are set out in the patent for turning the blade over from left to right when it is attached to a hammer gun. A sliding limb is operated by a pin on the tumbler. A projecting arm on this limb turns the trigger blade over from one side to the other against the pressure of the spring plunger *d*. Accepted July 5, 1909.

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CONTENTS.

CURRENT TOPICS.

The Bull's-eye Controversy—With Mr. F. A. Gould rests the credit of having drawn the badger in the bullseye controversy. This is an extract from a letter he wrote in *The Observer*:—"It is asserted that the competitors at the N.R.A.'s annual Bisley meeting are a "small clique who represent only themselves." This is entirely contrary to fact. The 1,240 competitors for the "King's" and "St. George's" prizes are the survivors of a series of competitive eliminating trials. For instance, in my Corps over 200 men compete with the utmost keenness for 20 entries. The same process goes on all over the country, and the 1,200 actual competitors represent probably 10,000 to 12,000 men who have essayed to fill their places; and there are other thousands of Territorials who are ever striving to attain to the same high standard." This is how Mr. Solano opens his reply:—"Mr. Gould has avoided every single fact of national importance at issue in this question. He treats it entirely from a personal point of view with consistent inaccuracy as to facts." He concludes by saying:—"Expert military authority has declared that the Bisley principles are opposed to service shooting and to training for war. Mr. Gould does not agree with this opinion. I have pointed out that he and others who support his case are in the position of enjoying a State subsidy to the value of £5,000 a year, paid from public funds for their private amusement. If this state of affairs is considered from the point of view of public interest and national safety, it is impossible for any sane man to justify Mr. Gould's view of it. It is a national danger for confessedly ignorant civilians to oppose the military authorities in regard to questions vital to national security." The points at issue seem never to lose their interest. The man who shoots is denied the credit of understanding the elements of his favourite sport. The soldier, who as a rule shoots extremely badly, is accorded a position of higher authority. Next, comes Mr. Solano.

The Shooting Season.—Everywhere the feeling seems to exist that the shooting season is not turning out so black as it was first painted. The explanation is that nobody can precisely estimate the head of partridges until the clearance of the crops exposes them to view. This year's wet weather has caused an inordinately late harvest, with the result that even at the time of writing the last of the corn has still to be cut. The usual labour has thus been diverted from the root crops, whose luxurious growth further provides an exceptional amount of covert. The second growth of grass, the lucerne, clover, and other green crops are all unusually strong, so providing not only additional covert in themselves but delaying the season when a raid is made on the roots and other winter food for cattle. Whilst, therefore, the general belief that partridges would prove at best but half a crop compared with good seasons, the exceptions are so numerous as to make it possible to hope that a better average will be recorded when the total bags come to be made up. Possibly some of the salvation from disaster arises from the increasing appreciation of partridge shooting by the best class of sportsman. The leaving of better stocks on the ground, and the adoption of more efficient precautions during the nesting season, are every year revealing additional possibilities in the most sporting of our game birds. The enhanced price of corn has also added its share of good, by increasing the area of cultivated land,

so that the total result tends to ameliorate the evils of a bad season. Take, for instance, as an example the serious effects of a lack of water on high chalk lands, and other places which suffer so severely in times of drought. The principle of the self-filling pond which derives its supply of water from the nightly deposit of dew has now been reproduced in the form of a water pan which needs filling but once in a season, and is capable of daily supplying the wants of a given number of birds without ever running dry. These and other items in the equipment of the game preserver are tending to improve the general condition of affairs. Therefore, though guns may last too long for the taste of the gunmaker, the opportunities for their use are undoubtedly extending. Even the motor car, which seemed at first to absorb so much money that would otherwise have been spent on guns, is now proving its usefulness by rendering easy of access many shoots which lacked a tenant because of their unfavourable situation.

The Military Automatic Rifle.—By the publication of a list of conditions to be fulfilled by automatic rifles proposed for adoption as service weapons the War Office has undoubtedly advanced progress. On the basis of present knowledge there are many reasons for believing that the necessary mechanical parts to carry out automatic loading involve a prohibitive addition of weight and complication to the rifle. Automatic re-loading in the light of an ideal, possesses the strong justification that it shortens the time interval between the first and the second round to that which exists in a double-barrel sporting rifle. Experience with automatic shot guns suggests that the facile third and succeeding discharges are more likely to engender waste of ammunition than to serve a useful purpose; but possibly war conditions are different. The specification as a whole seems eminently sound, though it may be criticised by the inventor as asking rather a lot. On the other hand it is possible that the demand will stimulate the supply. The specification of cartridge, especially as regards trajectory, exactly reproduces Ross conditions; and for this Sir Charles deserves all possible credit as a substitute for the hard cash that he will not get. The statement that loading must be effected by means of clips or chargers is justified in one sense, but perhaps not in another, since one of the greatest conveniences of some of the existing automatic weapons is the facility they afford for feeding into the magazine from time to time single cartridges to replace those which have been fired away. Whilst very much questioning whether the automatic system can within, say, the next ten years, be adapted to military conditions, no second opinion can exist concerning the extremely practical course which has been taken for clearly defining the ideal, so as to give inventors a lead, and at the same time crystallise into rifles any ideas and inventions that may be floating around. As a magazine rifle the Lee-Enfield suffered a good deal from the desire to combine in the same weapon single fire shooting and magazine loading. Analogous with this condition is the one now made that the automatic rifle shall be capable of hand operation should any of the self-loading parts become deranged. Hard and fast adherence to a condition unduly difficult of fulfilment might give other nations, willing wholeheartedly to back the new system, an advantage over us. Provided, always, that the published conditions are regarded as tentative, rather than of cast iron rigidity, the most unqualified blessing can be accorded to the War Office in its effort to lead in the matter of rifle design.

Next Year's Bisley Sights.—Bar mishaps, and changes of plan at the last moment, the conditions for next year's sights at Bisley have been finally settled by the issue of a specification to all intents and purposes the same as that which governed the meeting just passed. No one can help regretting the continuance of the rules which specify the existence of duplicated arrangements for performing one and the same function. The rule states that elevation must not be given by a screw, but fine adjustments may be so made. The whole of the sight adjustments of the service rifle from 200 to 800 yards are contained roughly speaking within a vertical height of ·8 of an inch on the aperture backsight; and yet notwithstanding the specification of a fixed battle sight, in addition to the aperture, there must be two methods existing side by side for changing the elevation from one range to another. Considering that the Bisley aperture sight represents an endeavour to anticipate the future requirements of the army the above ·8in. adjustment will in the weapon of the future, as specified in the automatic rifle conditions, be reduced to rather less than ·3 of an inch. It goes without saying that manufacturers will on their own initiative provide additional or alternative parts for remedying defects which were disclosed by the practical test accorded to them during and since the last meeting. The shooting man is so thoroughly convinced of the advantage of the aperture sight that it may now be accepted as a desirable adjunct for all military rifles. At one time there existed, and quite justifiably, a certain amount of nervousness that the War Office might forbid the use of any such attachment to Government property rifles. That they had this power nobody disputes, especially as the fitting of one sight involves the dismantling of others, and, therefore, to a certain extent rendering the rifle inefficient in the mind of a person inclined so to argue. Now that there has been an opportunity of convincing the authorities that the device is really of a useful nature there is hope that future alterations of pattern may include the provision of additional facilities in the framework of the weapon for fixing the new kind of sight. So important is it to fix an aperture sight with due regard to the other mechanism of the rifle that the old plan which has hitherto sufficed of fixing the sight to the rifle, should now give place to the alternative one of fixing the rifle to the sight. The idea intended to be conveyed is that the aperture sight is so vitally important that the design of the body and the breech fittings should be carried out with due regard to the necessity to mount an aperture at a particular situation with reference to the position of the shooter's face and eye. Compromise in some undesirable form is necessary when the sight is adapted to an existing rifle constructed on the old lines where the most desirable position for the backsight was invariably free from encumbrances.

DEVELOPMENTS IN SPORTING GUNS.

There is no doubt that the future of sporting gunmaking depends in a large measure upon developing to the utmost the science of gun building with reference to everything that is contained in the term gun fitting. A recent instance where a shooter was dissatisfied with his weapon resulted in carrying out a series of tests at the plate. It became apparent that the gun threw the charge on the average nine inches lower than the point aimed at on the 40 yards target. The general effect of a constant deviation of this character is that the shooter is usefully employing only three-quarters of the charge contained in the cartridge. Patterns erring in the upward direction are much more excuseable than those with a downward tendency. The general effect of such an error as the one named would easily be to degrade a shooter, naturally belonging to the first rank, to an inferior position. The tendency to use light charges, not only from 12-bores but also from guns of 16 calibre, necessitates far greater attention than has ever before been given to the utilisation to the greatest advantage of every pellet in the charge. Disputes between gunmaker and customer as to whether barrels correctly centre their charge on the spot aimed at betray the possibility that errors have been made in the fixing of stock and other material dimensions.

The recent growth of popularity of the 16-bore introduces a new set of questions, which, as long as the 12-bore alone had to be considered, settled themselves automatically. A gunmaker recently received an order for a 16-bore to weigh about 6 lbs. The gun ultimately produced weighed 5lbs. 13oz., being thus out of touch to the extent of 3oz. with the opinion of many of the best gunmakers that weapons of this calibre should never be made to weigh less than 6 lbs. The above weight was apportioned as follows :—

Barrels	2 lbs. 14 oz.	=49·5 per cent.
Stock and Action ..	2 ,, 7½ ,,	
Fore-end	0 ,, 7½ ,,	

The general practice in 12-bores is for the barrels to represent about 46 per cent of the total weight of the gun. This would give 2 lbs. 10½oz. barrels for the above weight of 16-bore, a value that comes much nearer sound practice than the real figure. For instance, here are the weights of a 16-bore gun by Powell of Birmingham, which was remarkable for pleasant handling properties, and at the same time had a size of stock which satisfied the eye as well as the hand :—

Barrels	2 lbs. 10½ oz.	=44·5 per cent.
Stock and Action ..	2 ,, 15½ ,,	
Fore-end	5½ ,,	
Total Weight ..	5 lbs. 15½ oz.	

The two sets of figures are eloquent in showing, first, how not to build, 6-bore guns, and second, the proper fulfilment of technical requirements in respect thereto. The first gun was a thorough disappointment to the owner, and proved itself clumsy in handling and quite incapable of firing a full charge. This was because the stock had been unduly starved in dimensions, so achieving the generally fragile appearance which is associated with a lady's gun, though in the present instance the customer was a man. A West End assistant was recently heard to brag that it had taken him three hours to persuade a sportsman, genuinely desirous of having a 16-bore, into taking a 12. Mis-spent energy of this description is preferable to taking an order for a class of gun of which the leading principles of design have not been fully worked out.

Whether or not the time has come for forwarding another development tending to emphasise the difference between recent and old guns is not quite certain, but there is nevertheless a great deal to be said in favour of more highly choking the right barrel than has hitherto been customary. Up till ten years ago the sportsman was in the habit of ordering the right barrel to be cylinder and the left some degree of choke, varying from half to full, and gunmakers were in the habit of giving a concealed choke to the right cylinder barrel to close in the shooting to the desired extent. From the time when the late Mr. Walsh resented the introduction of improved cylinder boring as a breach of faith, till now, when it is everywhere accepted as the most open shooting boring permissible for modern sport, it has steadily grown in popularity. Within the last twelve months the definition of improved cylinder boring has been moved up from 140 pellets out of 304, viz. 46 per cent., to 50 per cent., which means an extra dozen pellets in the 30-inch circle at 40 yards. Even so it is open to question whether sporting conditions really require that the right barrel should be less heavily choked than the left. With driven birds the first barrel cannot be delivered too early at the advancing pack or covey. The chance single shots which present themselves during walking or driving are quite as often distant as near. The bird that presents a fast crossing shot at 30 or 35 yards from the gun, gives a clean kill or a clean miss chance from a half-choke barrel, but the area of spread of an improved cylinder has an immense proportion of space containing only odd pellets, which are liable to wound rather than bring the game promptly into the bag. It is well understood that the cylinder system of boring owes its popularity to the general assumption that most game is shot at very short ranges. This may be true in a large number of instances where shooters refrain from taking the longer shots in the belief that they are out of range. There is, however, a large proportoin of even short-range shots where the bird is visibly hit, but not stopped by cylinder barrels, where it is reasonable to suppose that a greater degree of choke would have avoided the inhumane middle course. The whole subject bristles with opposing arguments of the most evenly balanced character ; and yet out of the whole medley of ideas there seems to arise the possibility that the best gun may be the one where both barrels give identically the same shooting, viz. 60 per cent. of the pellets in the circle at 40 yards. This would correspond with a pattern of 184 pellets of a full charge of No. 6 shot, which would be reduceable to 153 pellets if the charge was $1\frac{1}{16}$ oz. of No. 5½, or 139 pellets of No. 5 size.

THE LOADING DENSITY OF SMOKELESS POWDER.

The more that the loading of smokeless powders is standardised on general principles, rather than with regard to the idiosyncracies of samples, so it becomes more and more necessary that powders shall strictly conform to the conditions they are advertised to fulfil. Not only must the density of the powder be such that the three-dram measure shall be filled by a weighed three-dram charge, but more important still the powder when loaded into the cartridge must give a back pressure on the wads which will prevent any loosening of the contents in the course of the kind of treatment a consignment would receive, say in travelling by goods train to Scotland. Too much back pressure is as bad as a deficiency, because the turnover is liable to come undone. Then again the compression of the powder charge by the act of ramming must so far amalgamate the granules that they will be incapable of re-arranging themselves under the influence of vibration, so as to occupy a smaller space, thereby diminishing the back pressure originally created.

One of the most useful means of bringing powders into line in respect to their behaviour under compression would be the introduction of apparatus capable of recording the diminution of height of a given column of powder under the compression of a known weight. A piece of apparatus working on these lines has lately been constructed from the simplest of materials. The chief item was a piece of gauge glass tube of the kind ordinarily employed for recording the height of water in a steam boiler. This was set up vertically in a suitable stand with means for closing and opening at will the two ends. So as to feed the powder to be examined into the tube in a uniform manner a funnel was provided with its delivery nozzle in contact with the tap for closing the upper end of the glass tube, all on the lines adopted for making an ordinary densimeter. The amount of powder to be utilised for the experiment is the usual nine drams, viz. three ordinary 12-bore charges. The tube not having been graduated in C.C's the height of the powder under treatment is measured in inches and decimals. When the height of a particular charge in its natural uncompressed state has been recorded the funnel is removed, and a brass rod heavily weighted at one end is let down gently into the tube until it comes to rest on the face of the powder. The weight found most satisfactory for the intended purpose was judged by a preliminary test to be in the neighbourhood of 4 lbs. The combined weight of the knob and brass rod came out finally at 4lbs. 4¾oz., and as comparative results only were required this odd value was not reduced to a round figure total. The interior diameter of the glass tube being about $\frac{9}{16}$in. a half-inch brass rod was found to give a nice clearance with the sides, whilst properly pressing down the face of the powder. A number of odd samples of powder were then subjected to test, and the results appear in the accompanying table.

At this stage of what is no doubt a more or less new test to apply to smokeless powders it has been judged best to deal anonymously with the various samples of powders quoted in the table of results. It will be somewhat of a revelation to the present generation of gunmakers to realise that black powder is well-nigh incompressible. Those who were familiar with its loading in the old days will remember quite well the difficulty of inserting the full three-drams and 1⅛oz. into the 2½in. case. It is a historic fact that the $2\frac{9}{16}$in. length of the 2½in. case was adopted as an answer to complaints concerning the inadequate capacity of the original length of cartridge. For ordinary smokeless powders a compression in the neighbourhood of one-fifth to one-quarter of an inch in a total of four inches odd seems to cover the most satisfactory samples. Those which run in the neighbourhood of one-third of an inch are undoubtedly soft, and would be likely to give trouble on that account. One powder only sustained the weight with a reduction of a mere tenth of an inch in the height of the column. The present instalment of results by no means exhausts the possibilities of extracting interesting information from the proposed new test. It would, for instance, be extremely useful to record the amount of further compression due to a double load. Well-made powders certainly very soon reach the stage at which further additions of weight produce very little result. Powders would certainly be faulty which showed a material amount of reduction when other powders remained practically unaffected by the same treatment.

Results of Examination of Various Powders to Test their Relative Compressibility.

Powder	Length of Three 3-dram Charges.		Difference.
	In Natural State.	Compressed	
Black.	4·54 in.	4·50 in.	·04 in.
	4·53 ,,	4·51 ,,	·02 ,,
	Av. **4·54** ,,	**4·51** ,,	**·03** ,,
A Smokeless.	4·42 in.	4·22 in.	·20 in.
	4·42 ,,	4·24 ,,	·18 ,,
	Av. **4·42** ,,	**4·23** ,,	**·19** ,,
B ,,	4·40 in.	4·15 in.	·25 in.
	4·40 ,,	4·15 ,,	·25 ,,
	Av. **4·40** ,,	**4·15** ,,	**·25** ,,
C ,,	**4·33** in.	**4·00** in.	**·33** in.
D ,,	4·48 in.	4·08 in.	·40 in.
	4·50 ,,	4·10 ,,	·40 ,,
	Av. **4·49** ,,	**4·09** ,,	**·40** ,,
E ,,	4·68 in.	4·37 in.	·31 in.
	4·65 ,,	4·38 ,,	·27 ,,
	Av. **4·67** ,,	**4·38** ,,	**·29** ,,
F ,,	4·28 in.	4·18 in.	·10 in.
	4·29 ,,	4·20 ,,	·09 ,,
	Av. **4·29** ,,	**4·19** ,,	**·10** ,,
G ,,	4·20 in.	3·89 in.	·31 in.
	4·22 ,,	3·88 ,,	·34 ,,
	Av. **4·21** ,,	**3·89** ,,	**·33** ,,

LECTURES TO YOUNG GUNMAKERS.

LXI.—THE EFFECT OF DECREMENT IN PRESSURE TESTING.

A very important problem which closely concerns gunmakers and powder makers alike is the relation which exists between pressure, as measured, and the absolute value which exists in the gun. So long as Eley's lead crushers are used by everybody the problem as to whether the results are given in true units or not is immaterial provided the information is comparative. Since copper has come into use it has thrown a considerable amount of new light on the subject of pressure in shot guns. For the everyday work of the factory its use involves many difficulties and complications which are entirely absent with lead. Clever and ingenious as was the idea of the conical shaped copper, originally introduced into this country by Colonel Holden and afterwards adapted for shot guns, the irregularities of sporting nitro compounds make it quite impossible to ensure giving them an advance crushing sufficiently close to the expected pressure to eliminate the error known as dynamical crushing. The tables for the translation of remaining length into tons pressure, assume that the load acts in the same manner as a weight gently let down on to the copper until the crushing has reached the stage at which the copper is capable of supporting the superimposed weight. If the weight is put on with a run the copper gives way to a greater extent than happens when the reverse proceeding is adopted. It should be understood that the weight does not hit the copper a blow in the manner of a hammer, but merely that means must be adopted to control the rate of descent during the process of compression. If the force exerted represents three tons, and the copper begins to give way at one ton, then whilst it is compressing from one length to the other all moving parts are gathering momentum. This effects a further crushing in addition to that representing the value of the force which has been exerted.

In the measurement of shot gun pressure it is usual when working with lead, to adopt the Eley table, which was compiled from experiments with a weight acting for a measured interval of time. Lead is so plastic that the crushing continues as long as it is under compression. This is a general statement true only for loads exceeding what is known as the "flow" point of lead, but as practically all pressure testing takes place above the flow point the time element must come into play. The table of translated values is thus at the best only an approximation, but experience has proved its great value as a means of judging the strength of smokeless powders. When copper is used advantage is taken of the fact that the flow point does not occur till a load of 20 tons on the square inch section has been reached. The effect is that when a pressure has been registered under favourable conditions the record is absolute, and can be utilised as such in calculations of barrel strength and so forth; but unfortunately, however carefully an experiment may be conducted, it is impossible invariably to use copper crushers which have been shortened beforehand so near to the pressure, due to occur, as to eliminate the very considerable error which arises when the actual pressure experienced is considerably greater than the amount anticipated. The following table of comparative lengths and tons of pressure will assist in making clear what is meant :—

Extract from Eley's Table for Conical Copper Crushers for Shot Guns. Original length of Copper ·500 of an inch.

Remaining Length.	Tons. Per sq. in.	Remaining Length.	Tons. Per sq. in.
·495	·75	·445	3·30
·490	1·15	·440	3·50
·485	1·47	·435	3·71
·480	1·75	·430	3·93
·475	2·00	·425	4·15
·470	2·25	·420	4·36
·465	2·50	·415	4·58
·460	2·70	·410	4·80
·455	2·90	·405	5·01
·450	3·10	·400	5·23

It will be seen that the whole range of pressure between nothing and 5¼ tons is included in the tenth of an inch reduction of the copper's length from the original half-inch. This tenth of an inch may for the present purpose be considered in five sections, each of ·020in. If the original and the remaining length of the copper are both contained within this specified amount of limit the decrease of length is assumed to be moderate, and not to introduce dynamic errors. But powders unfortunately are far less regular than this, as may be shown by taking actual figures. For instance between ·400 and ·420 the corresponding pressure is from 5·23 to 4·36 tons. This represents nearly a ton margin, and it might be thought that a series of five results could be easily contained within such ample limits, but in practice things frequently work out a different way. For instance, a copper measuring ·465in. and representing 2·50 tons pressure may be used, and its length may be reduced only five points, say to ·460in. representing 2·7 tons pressure. The experimentalist has no means of judging whether the result is medium, or high or low, with reference to the rounds that will succeed it. For safety's sake he next uses a crusher measuring ·475in., thereby aiming at a decrement of ·015 instead of the ·005 which the first round gave him. The idea is that if the next pressure were materially lower the record would not be lost by failure to show any compression. The margin of decrement is, therefore, increased by utilising a copper ·475in. long, which will register any pressure exceeding two tons. Nothing, however, can meet the risk that the first round was a low shot, the lowest say of the series. By the working of chance the second round may be the highest, so that the copper ·475in. in length, is reduced to ·445, which represents the quite ordinary pressure of 3·30 tons. Now the difference between these two lengths is ·030, and it is well known that a decrement of this amount is excessive, and produces erroneous results. The extent of the error can only be ascertained by testing a number of similarly loaded cartridges with coppers of different length. This *The Field* has lately carried out, and to overcome sundry difficulties connected with the relatively irregular

behaviour of smokeless powder, the bulk of the testing was done with black powder. The general results show that, accepting the usual practice of adopting as correct all readings where the decrement does not exceed ·020, over-readings, due to excessive decrement, may be corrected by deducting half the decrement in excess of ·020. The following table of results, illustrating the working out of the process, has been taken from the columns of our contemporary :

Pressure Results to test the effect of using different lengths of copper crushers, and the treatmsnt proposed for correcting the over-registration which ensues.

Smokeless Powder Results.

	Recoil.	Length of Crusher before use and after.		Decrement corrected by Rule.	Corrected Length
1.	9·35 in.	**·465** in.	·458 in.	7 stet	·458 in.
2.	9·74 ,,	,,	·430 ,,	35–7	·437 ,,
3.	9·70 ,,	,,	·435 ,,	30–5	·440 ,,
4.	9·46 ,,	,,	·435 ,,	30–5	·440 ,,
5.	9·38 ,,	,,	·450 ,,	15 stet	·450 ,,
Av.	9·53 ,,		·442 ,,		·445 ,,
			=**3·42** tons.		=**3·30** tons.
6.	9·34 in.	**·475** in.	·445 in.	30–5	·450 in.
7.	9·50 ,,	,,	·457 ,,	18 stet	·457 ,,
8.	9·60 ,,	,,	·426 ,,	49–14	·440 ,,
9.	9·54 ,,	,,	·443 ,,	32–6	·449 ,,
10.	9·44 ,,	,,	·437 ,,	38–9	·416 ,,
Av.	9·48 ,,		·442 ,,		·448 ,,
			=**3·42** tons.		=**3·18** tons.
11.	9·52 in.	**·485** in.	·423 in.	62–21	·444 in.
12.	9·42 ,,	,,	·442 ,,	43–11	·453 ,,
13.	9·76 ,,	,,	·419 ,,	66–23	·442 ,,
14.	9·40 ,,	,,	·445 ,,	40–10	·455 ,,
15.	9·54 ,,	,,	·435 ,,	50–15	·450 ,,
Av.	9·53 ,,		·433 ,,		·449 ,,
			=**3·80** tons.		=**3·14** tons.

Results with another Smokeless Powder.

	Recoil.	Length of Crusher before use and after.		Decrement Corrected by Rule	Corrected Length
1.	9·84 in.	**·425** in.	·425 in.*	nil	·428 in.
2.	10·18 ,,	,,	·412 ,,	13 stet	·412 ,,
3.	10·08 ,,	,,	·424 ,,	1 stet	·424 ,,
4.	10·24 ,,	,,	·420 ,,	5 stet	·420 ,,
Av.	10·09 ,,	,,	·421 ,,		·421 ,,
			=**4·32** tons.		=**4·32** tons.
5.	10·14 in.	**·435** in.	·418 in.	17 stet	·418 in.
6.	9·98 ,,	,,	·425 ,,	10 stet	·425 ,,
7.	10·20 ,,	,,	·412 ,,	23– 1	·413 ,,
Av.	10·11 ,,	,,	·418 ,,		·419 ,,
			=**4·45** tons.		=**4·41** tons.
8.	10·16 in.	**·445** in.	·408 in.	37– 8	·416 in.
9.	10·10 ,,	,,	·399 ,,	46–13	·412 ,,
10.	10·10 ,,	,,	·415 ,,	30– 5	·420 ,,
Av.	10·12 ,,	,,	·407 ,,		·416 ,,
			=**4·93** tons.		=**4·54** tons.

*Say ·428.

It is of course impossible to resist the conclusion that, if all readings where the decrement exceeds ·020 are erroneous to the extent of half, a proportionate degree of error must exist when the decrement is less than the purely arbitrary limit which has been adopted. It becomes in fact a question of endeavouring to ascertain what system of allowance brings us nearest the truth. The *Field* results certainly show very clearly indeed that the coppers receive their load on a dynamical basis. The lectures in which this aspect of the subject was academically treated showed that with dynamical loading the true pressure is arrived at by dividing the decrement by two, and it really looks as though the *Field* results might be brought into closer accord with theory by adopting ·010 decrement as the limit beyond which all further decrements are taken at half their value.

The whole subject is one of very real practical interest to gunmakers as well as powder makers. Carefully devised experiments on the lines of those here reported may succeed in bringing us nearer to true values than has hitherto been regarded as possible. Any new light that is thrown on the behaviour of sporting nitro compounds by means of experiments carried out with copper crushers can be applied to lead by shooting cartridges ot similar loading to others which have previously been examined with the aid of copper. One of the practical uses of such tests will be to ascertain whether the degree of pressure which seems to be a necessity for the proper burning of smokeless powders is in reality so severe on the gun as the figure value makes it appear.

Black Powder Results.

	Recoil.	Length of Crusher before use and after		Decrement Corrected by Rule	Corrected Length
1.	11·82 in.	**·465** in.	·444 in.	21 stet	—
2.	11·56 ,,	,,	·455 ,,	10 ,,	—
3.	11·64 ,,	,,	·451 ,,	14 ,,	—
4.	11·62 ,,	,,	·448 ,,	17 ,,	—
5.	11·64 ,,	,,	·445 ,,	20 ,,	—
6.	11·74 ,,	,,	·445 ,,	20 ,,	—
7.	11·74 ,,	,,	·444 ,,	21 ,,	—
8.	11·72 ,,	,,	·451 ,,	14 ,,	—
9.	11·62 ,,	,,	·451 ,,	14 ,,	—
10.	11·66 ,,	,,	·448 ,,	17 ,,	—
Av.	11·68 ,,		·448 ,,		
			=**3·18** tons.		
11.	11·60 in.	**·475** in.	·443 in.	32–6	·449 in.
12.	11·60 ,,	,,	·442 ,,	33–6	·448 ,,
13.	11·58 ,,	,,	·445 ,,	30–5	·450 ,,
14.	11·72 ,,	,,	·440 ,,	35–7	·447 ,,
15.	11·52 ,,	,,	·443 ,,	32–6	·449 ,,
16.	11·62 ,,	,,	·439 ,,	36–8	·447 ,,
17.	11·60 ,,	,,	·454 ,,*	21 stet	—
18.	11·64 ,,	,,	·442 ,,	31–5	·447 ,,
19.	11·66 ,,	,,	·430 ,,*	45–12	—
20.	11·76 ,,	,,	·428 ,,	47–13	—
Av.	11·63 ,,		·441 ,,		·448 ,,
		*Av. without these ·442 = **3·42** tons.			=**3·18** tons.
21.	11·64 in.	**·465** in.	·430 in.	55–17	·447 in.
22.	11·68 ,,	,,	·433 ,,	52–16	·449 ,,
23.	11·64 ,,	,,	·433 ,,	52–16	·449 ,,
24.	11·56 ,,	,,	·434 ,,	51–15	·449 ,,
25.	11·66 ,,	,,	·428 ,,	57–18	·446 ,,
26.	11·64 ,,	,,	·429 ,,	56–18	·447 ,,
27.	11·66 ,,	,,	·428 ,,	57–18	·446 ,,
28.	11·56 ,,	,,	·437 ,,	48–14	·451 ,,
29.	11·56 ,,	,,	·437 ,,	48–14	·251 ,,
30.	11·60 ,,	,,	·431 ,,	54–17	·448 ,,
Av.	11·62 ,,		·432 ,,		·448 ,,
			=**3·84** tons.		=**3·18** tons.

ROUND THE TRADE.

The offices of the Société Générale pour la fabrication de la Dynamite, late of 12 Place Vendome have recently been united with those of the Société Centrale de Dynamite at 67 Boulevard Haussmann, Paris.

The Marlin Firearms Company have forwarded a coloured engraving entitled "Quail Shooting in England" which certainly justifies the Company's claim that it represents a very high standard of artistic merit. The artist, Percival Rosseau, has certainly produced a very pleasing sporting scene

Mr. Charles Lancaster, whose association with the ·280 cartridge has brought him much kudos, has introduced a single barrel rifle for firing the same, utilising the Mauser action. It is rumoured that other firms beside Mr. Lancaster are learning to appreciate the position of precedence which the ·280 cartridge possesses for all forms of soft skinned game where extreme flatness of trajectory is a prime essential.

The firm of Dan. Fraser & Co., gunmakers of Edinburgh, have issued a notice to the effect that they will present £1,000 to the winner of the All-Comers Aggregate at the next Bisley Meeting, provided such winner shall, throughout the several competitions embraced in the aggregate, have used an Ommundsen service rifle purchased by him from the firm on or after the present date. The aggregate includes what are known as the newspaper competitions, viz., *The Daily Graphic*, *The Daily Telegraph* and *The Graphic* and the "Alexandra." The firm further undertake to pay £50 to the separate winners of these competitions, and also of the Stock Exchange. The rifles are priced at nine guineas, cash with order, and are guaranteed to be tested and sighted by Mr. Ommundsen, who it will be remembered took charge of the firm's London office in Dover Street about a year ago.

A good deal of interest has been aroused by the success which has attended the issue of Cube Schultze powder. The three-dram charge weighs 30 grains, thus constituting a second member of the class which carries one stage further the process of weight reduction which 33-grain powders first introduced. Though the amount of weight for a given bulk is so extremely small, the principles of manufacture which have been adopted enable the powder grains to stand up to the pressure of the rammer even more solidly than is the case with any other powder, except black. It is generally understood that the principle adopted is to make up in the first place a heavier powder than is ultimately intended to be produced, and, after granulation, and hardening, to wash out the surplus material, leaving a porous grain of solid and substantial structure, at the same time highly susceptible to ignition by the cap flame. The ballistics of the powder have been fully examined and reported upon in a recent issue of *The Field*, and from the report there given it seems that the powder can be pronounced highly reliable, and in every way satisfactory. Especially is this true of the patterns which were obtained with all charges, except 1⅛oz. This particular charge, which is the accepted maximum for a 12-bore, necessarily emphasises the effects of the August weather, during which the experiments were made. Allowing, therefore, for the general toning down of high values, which marks the advance of autumn weather, it is possible to adopt an attitude of entirely unqualified approval of the behaviour of Cube Schultze as exemplified in *The Field* tests. The gunmaker will note with satisfaction that the pressures rule within the three-ton limit, and that the velocity, whilst always good, shows no undue tendency to creep above the 1100 f.s. limit. The recoil is throughout extremely moderate, a result which naturally follows from the reduction of powder weight which as a means of diminishing r coil is only second to the reduction of the shot charge.

The Lancashire Explosives Co., Ld. have taken new offices at 43, Castle Street, Liverpool.

The directors of the Roburite Explosives Co., Ld. have declared the usual interim dividend on the fixed ten-per-cent. basis.

A case at Nottingham under the Pistols Act turned upon the non-production of a gun licence by the purchaser, one statement being that he promised to buy one the same day, the other that he claimed to have one at home. In so far that the Act requires production of the licence the seller was lightly treated in being allowed to pay the costs without having a conviction recorded against him.

The periodical *South Africa* in reviewing the import returns of the dependencies comprised within its scope finds reason to claim that the improving conditions which it had foretold are being realized. The following comparative values of imports under the heading Arms and Ammunition show that the aggregate result is favourable, but patchy in detail. The first value refers to June 1909 and the second to June 1908:—Cape Colony £4,899 against £5,945; Southern Rhodesia £2,098 against £2,467; Natal £8,155 against £8,419; Transvaal £12,691 against £9,596; Orange River Colony £2,948 against £1,429. In other words whilst two out of five Colonies have retrogressed, the other two raise the combined total from £27,856 to £30,791.

Major H. P. de la Bère has contributed an interesting article to the September number of the *United Service Magazine*. In it he summarises in a very brief manner some of the leading constructional points of military rifles, and he concludes his essay with some distinctly suggestive comments upon automatic rifles for military purposes. He summarises their defects, as at present known, under the following heads:—(1) Uncertainty of action. At the crucial moment some little spring or stud gives out, rendering the automatic action useless. (2) Faulty ejection and difficulty of safely discharging the fired cases with reference to persons in close vicinity to the shooter. (3) Faulty feed. Owing to the rapidity with which the bolt works, jams in feed are by no means infrequent. (4) Corrosion and charring with gas-operated rifles, which after a time would impair their serviceability. (5) Inability to withstand the presence of water or sand in the working parts. (6) Increased weight and clumsiness. (7) Increased cost.

A card of loading instructions published by our contemporary *The Sporting Goods Review* has just been received, and although it has attained the twelfth year of publication it is still possible to congratulate its authors, for the powder trade shares the responsibility of its production, on notable improvements in the loads recommended. A careful scrutiny of each company's set of recommended loads discloses the satisfactory circumstance that the openings for further improvement are well-nigh exhausted. This does not mean that progress has stopped or will stop, but merely that, whilst previous issues contained undoubted examples of loads which did not tally with the cartridges they were intended to fill, the card now in the hands of loaders will bear the most careful scrutiny. One obvious misprint of a $\frac{7}{64}$-in. wad, where $\frac{7}{8}$-in. is intended, no doubt arises from one of those unfortunate mishaps to which all printed matter is liable. Otherwise the card seems to express the united wisdom of the powder trade under the able editorship of Mr. Stone. It is at last acknowledged by inference that no powder of a standardized brand needs to be humoured in the loading. All are treated alike, so that the competition which exists between them is restricted to their behaviour when they have been loaded under standard conditions. Copies of the card can be obtained from 68 Aldersgate St. on the usual terms, viz. 4d. post free for the paper edition and 9d. on cardboard.

The Wilkinson Sword Co., Ld. have removed from 27 Pall Mall to No. 53 in the same thoroughfare.

Two applications for Letters Patent have been filed during the current month by Mr. F. Marten Hale for methods for preventing backflash and muzzle flame in cordite and other propellants without interfering with existing ballistics or the stability of such powders.

In answer to a question in the House of Commons Mr. McKenna stated that the Admiralty purchased in March last 387 acres of land and 240 acres of foreshore in the neighbourhood of Rosyth for an explosives factory. The price paid was £30,000, which works out at a trifle under £48 an acre.

A new Order in Council has been issued under the Explosives Act, the effect of which is to diminish the distances prescribed in orders 5 and 6 of the year 1875 with respect to B, C, or D, division stores from protected works, it having been found that the distances specified were greater than public safety requires. It is now prescribed that notwithstanding anything contained in the said orders—(1) the occupier of a store licensed for the keeping of gunpowder or for the keeping of explosive other than gunpowder whether with or without gunpowder to whatever division such store may belong, shall not be required to maintain a greater distance than 25 yards between the store and a mineral or private railway worked by the said occupier—provided that the door or doors of the said store be kept closed and secured when and so long as any locomotive driven by steam is within a distance of 50 yards of the store; (2) the distances required by the said Orders to be maintained between a store of Division B, C, or D and a "protected work," as defined by the said Orders in Council Nos. 5 and 6, shall when such "protected work" is in the occupation of the licencee, and is completely screened from the store by a natural or artificial mound of earth or other suitable material not less than 3ft. thick at the height of the eaves of the said store, be reduced by one half. Nothing in the Order shall be deemed to apply to a workshop established in connection with a store under the provisions of Section 47 of the Explosives Act, 1875.

Sir Ernest Hatch, Bart., who was appointed last year to enquire into the application of the "particulars" section of the Factory and Workshop Act to persons employed in certain industries, has issued his report, cartridge making being one of the sections dealt with. His observations cover the principles adopted in piece work manufacture connected with cartridges, and the methods of giving out the work and making payment for the same. He found that the workers were not made sufficiently acquainted with the measure of production, nor were they sufficiently explicitly informed of the prices payable for the different operations. He also found that where the "gang" system is employed the share of each member should be more specifically laid down than is at present the case. He accordingly recommends:—(1) That in all cases the workers shall be provided with (*a*) particulars of the rates payable for each operation, and (*b*), where the "gang" system obtains, of the share rates of each member of the gang. (2) That, except when the kind of work to be done is obvious from the materials used, and the kind of work is indicated on the price list by a name that is self-explanatory or by a clear description, particulars of the nature of the work to be done shall be given, together with the material, either on a ticket or slip which the worker may retain, or by an entry in the worker's work-book. (3) That such particulars of the quantity of work done as affect the wages payable to each worker shall be furnished as soon as possible after the completion of the work either in a form in which they can be retained by each worker, or on a placard posted where the worker can easily see it.

The final dividend of the B.S.A. Company brings the distribution for the year up to 10 per cent., as against 15 per cent for the previous twelve months. The report and accounts were received at the moment of going to press, but not in time to allow for dealing with them in this issue.

Colt's Patent Firearms Company share with Eley Bros. the manufacturer's credit for Warrant-Officer Raven's brilliant feat at a recent Bisley shoot for the North London Rifle Club's spoon. At the usual 20 yards target with 2-in. bull he fired the eight tickets with which he had provided himself, and no less than six of them resulted in possibles. At the disappearing target his one other shoot resulted in 41 out of a possible 42, viz. five bulls and one shot in the next adjourning ring.

An explosion took place on the 17th ult. at the Waltham Abbey Government factory in one of the houses devoted to the pressing of cordite. Details will, it is hoped, be made public as soon as the facts have been enquired into, because it is as a rule unusual for cordite to do anything more serious than break into flame should the presence of grit or other foreign matter give rise to a dangerous amount of friction. The machine seems to have been blown to pieces, and several workmen were injured.

Mr. Marten Hale has conducted another of his highly successful demonstrations of the rifle grenade at the Cotton Powder Company's Works. Present on the occasion were several distinguished visitors, amongst them Capt. Stuyck Y. Garrido, of the Spanish Artillery who is in this country for the purpose of superintending a consignment of the grenades for use in his connection with the operations in Morocco. He has already earned the distinction of being the first to use these grenades in actual warfare.

Major Cooper-Key's report on the accident last July at the Blackbeck gunpowder mills of Messrs. F. C. Dickson & Co. refers to the operation of corning or granulating gunpowder as perhaps giving rise to more accidents than any other process in the manufacture of black powder. In the present instance he found no reason to advise the jury of the coroner's inquest that any unusual circumstances or grounds for blame could be alleged, and a verdict of accidental death was given in respect to the two workmen who had lost their lives. Since then, however, the usual sorting over of the debris has resulted in the discovery of a copper strip, bearing the marks of toothed rolls, which is it assumed was drawn into the machine, so giving rise to sufficient friction to cause explosion. This instrument was used for facilitating the passage for refractory pieces of press cake into the "crackers" or rolls. Though he considers that no blame can be attached to the user of this instrument, at the same time he is of opinion that for the future, strips of ash or sycamore should be used.

The British South African Explosives Company has issued a circular to all the Transvaal mines announcing that as the result of constant laboratory and mining experiments extending over a period of more than three years, the company has succeeded in producing a modified form of blasting gelatine equal in strength to the 91-92 per cent. standard quality, but which on explosion produces practically no deleterious fumes. The ratio of carbon monoxide to carbon dioxide produced by ordinary blasting gelatine is 1 of carbon monoxide to 7 of carbon dioxide, whereas it is claimed that the ratio for the modified form of blasting gelatine is 1 of carbon monoxide to 20 carbon dioxide. It is therefore evident, the circular says, that the whole question of underground ventilation will become simplified in the future, and that miners will be enabled to carry on their work in better air, which must of necessity improve their working conditions and all-round health and efficiency. The new compound is being used on the East Rand Proprietary Mines with, it is stated, the most satisfactory results.—*Financial Times.*

ABEL ON THE STABILITY OF GUNCOTTON (1867).

By George W. MacDonald, M.Sc., F.C.S.

The earlier of the published researches into the composition and properties of guncotton were speedily followed by accounts of the spontaneous decomposition which the substance was, in many instances, observed to undergo upon more or less protracted exposure in confined spaces to strong or diffused light. These indications of instability, in conjunction with the occurrence of several serious explosions during the manufacture of guncotton, in France and England, afforded apparently good grounds for the general conclusion—arrived at within a brief period after the announcement of Schonbein's discovery, and adhered to until quite recently in all countries except Austria—that this remarkable explosive agent did not in itself possess the quality of uniform permanence essential to its safe manufacture, or to its employment with any degree of security from accident, in warlike or industrial operations. It is unnecessary to refer in detail to the results of the numerous observations published before 1860 upon the nature of the spontaneous changes which particular specimens of guncotton had suffered. In the brief prefatory review of published investigations upon the production and composition of guncotton, contained in the paper on those subjects which was communicated to the Royal Society in 1866, it was shown that the products obtained by individual operators in submitting cotton to the action of nitric acid varied greatly in composition, and that, with only one or two exceptions, these could not be viewed as representing the definite substance producible by the most complete action at a low temperature of a mixture of the strongest nitric and sulphuric acids upon purified cotton-wool (or nearly pure cellulose). The behaviour and results of the decomposition of such specimens, or of others of more recent date prepared (for lectures or similar experimental purposes) without special regard being paid to their composition or purity, afford but little information that can be accepted as bearing upon the question of stability of guncotton when produced by a system of operation which is now known to furnish uniform products in a condition of comparative purity. There can be no question that the variations in composition of the different specimens of guncotton, the decomposition of which has received investigation at different hands, exerted a most important influence upon the period for which they withstood the destructive effects of heat and light, and upon the *degree of rapidity* with which chemical change when once established, proceeded from stage to stage. The *products* of change described by different observers have also varied somewhat in their characters, partly on account of the variations in the guncotton itself, and partly because different experimenters have examined the products of its metamorphosis at different stages. The accounts published by De Luca, Bonet and Blondeau, between 1861 and 1865, of their investigations into the changes which guncotton undergoes spontaneously, include nearly all the results previously described in one or other of the published papers on this subject. The following is a general statement of the changes which guncotton, preserved in bottles partly, or perfectly closed, has been observed to undergo by exposure to light, and of the nature of the products of decomposition. In the first instance nitrous vapours make their appearance, the atmosphere in the vessel becoming sometimes of a deep orange tint. The guncotton acquires considerable acidity, exhibits a perculiar pungent odour, and generally contracts, so that it eventually occupies only a small proportion of the original volume.

During this period a considerable proportion of nitric acid accumulates in the mass, and the decomposition proceeds after a time with increased rapidity, especially if the vessel be exposed to sunlight. The contracted guncotton gradually becomes more or less friable, its explosiveness is notably reduced, it yields a highly acid extract to water, in which, besides nitric acid, small proportions of glucose, of formic and oxalic acids, and of cyanogen have been detected. The material sometimes contracts to such an extent as to form a very compact somewhat hard mass, but in general it ultimately passes over with more or less rapidity into a brownish gum-like mass, which at first is rendered very porous by the evolution of gas-bubbles, and which becomes lighter in colour and friable after a time. This ultimate product of the decomposition of guncotton has been found to contain glucose and oxalic acid in considerable proportions, besides a gum-like substance, formic acid, cyanogen, and an organic acid which by some observers is considered to possess novel characters, while Divers believes that he has identified pectic and parapectic acids in the product of a decomposed specimen. The amorphous mass has also been found to evolve ammonia when heated with a solution of potassium hydrate. In some instances the guncotton is described as having undergone other intermediate changes, but the greatest discrepancies exist between the observations of even the most practised experimenters regarding the periods within which the decomposition of guncotton has become manifest, and the conditions under which the changes have occurred. In some instances the first signs of decomposition were observed after exposure of the guncotton to daylight for several years, in others a few days' exposure sufficed to establish the change.

Some observers state that the material has been preserved in the dark for very protracted periods without change, others (*e.g.* quite recently De Luca and Blondeau) show that, even in the dark, guncotton undergoes decomposition within a comparatively short period. Such conflicting observations afford convincing proof of great variations in the composition or degree of purity of the materials experimented upon. The exposure of guncotton to heat has, by most observers, been found to accelerate its decomposition considerably; but here again great discrepancies are presented by different accounts of the behaviour of the material under the influence of different temperatures; thus, spontaneous explosion has been brought about in some instances by brief exposure to a degree of heat which, in others, has only produced a comparatively very gradual

decomposition. The most interesting and important of recent observations upon the influence of heat on the stability of guncotton are those described by Pelouze and Maury in their recent report upon Baron Von Lenk's system of manufacturing guncotton, and upon the composition and properties of the products which it furnishes. They describe a number of results obtained with specimens of guncotton which, it is to be inferred, were all produced according to Von Lenk's directions, and which, therefore, provided these were strictly adhered to, and such an adherence ensured the uniformity of the products, should have furnished reliable data regarding the powers of purified guncotton to resist the destructive effects of heat. The principal results arrived at by Pelouze and Maury are as follows: they found that all specimens which were heated to 100°C became decomposed in more or less time; a few minutes exposure to that temperature sufficed in every instance to determine the evolution of nitrous vapours. They describe the results of decomposition as susceptible of variation at will; either the guncotton might be brought to explode, or the various forms of decomposition already described by other chemists might be established; or finally, it might be made to furnish simply a small black residue presenting the appearance of carbon, from which ammonia might be disengaged. Identically the same results were obtained by exposing specimens of guncotton to temperatures of 90° and 80°C with this difference, that the phenomena of decomposition, instead of appearing in a few minutes, were not exhibited until after the lapse of several hours. It is further stated that pyroxylin is decomposed at 60°C. (140°F.), and even at 50°C. (122°F.); after the lapse of several days dense vapours filled the vessel containing the specimens, but no explosions of guncotton occurred in the experiments conducted at those temperatures. Great stress is laid, however, upon an instance of explosion which occurred with a specimen of guncotton prepared according to Von Lenk's process, immediately upon its coming into contact with the metal of an oil-bath, the temperature of which was only 47°C. (116·6° F.) at the time Pelouze and Maury afterwards refer to the instances of spontaneous decomposition of guncotton at ordinary temperatures observed by other chemists, and to certain specimens, among a number prepared at Bouchet in 1847, which had undergone alterations such as have already been described. These were examined for sulphuric acid, and none was detected; hence the conclusion is drawn that these samples had been perfectly washed, and that their spontaneous change could not be ascribed to imperfect purification. It is argued that instances of change have been observed to occur under ordinary atmospheric conditions, similar to those established in guncotton at higher temperatures; that, because exposure to the latter had occasionally brought about spontaneous explosion, it is possible for instances of spontaneous decomposition at *ordinary* temperatures to result in explosions, and that, consequently, it is right to conclude that the storage of large quantities of guncotton is attended by great risk of explosion. In further support of this conclusion the observations are recorded, that the most perfectly washed guncotton becomes acid by long exposure to sunlight; that some pyroxylin, which was alkaline at first, after exposure for several weeks to light, in contact with the sides of a glass flask, exhibited an acid reaction; and that, even when guncotton is preserved in the dark, this acidity invariably becomes manifest in course of time. Finally, without referring to any single instance in which an explosion or even an appreciable development of heat has been observed as resulting from protracted exposure of guncotton to strong daylight or sunlight, Pelouze and Maury conclude that the indications of gradual decomposition furnished by certain specimens of guncotton under those conditions, are sufficient proof of the liability of this material, as now manufactured, to explode spontaneously, when stored in considerable quantities. The researches into the manufacture, composition, and properties of guncotton, upon which, as a member of the Government Guncotton Committee, I have been engaged for nearly four years, have included, from their very commencement, careful observations and a great variety of experiments, with both small and large quantities of material, bearing upon the influence exerted by light and heat, and by various modifications introduced into the system of manufacture, upon the stability of guncotton produced in accordance with the general directions laid down by Von Lenk. It is obvious that, although most of these experiments have furnished very decisive results within a comparatively brief period, there are others which become the more valuable and the more fully conclusive in their character, the longer the period of their duration. It is considered, however, that the data which even the latter class of experiments has already furnished possess sufficient scientific interest and practical importance to warrant their present publication, in addition to those obtained by numerous experiments instituted with the view to ascertain whether and to what extent the results of researches recently published in France upon the spontaneous changes of guncotton, apply to the material manufactured in this country during the last four years. The experiments and observations carried on at Woolwich may be classed as having for their objects:—(*a*) The determination of the influence of light and of long protracted storage, under ordinary conditions as to temperature, upon the stability of guncotton; (*b*) The investigation of the behaviour of guncotton upon exposure, under varied conditions, to artificial temperatures, and to such elevated natural temperatures as are occasionally experienced in particular localities; (*c*) The examination of the influence exerted upon the stability of guncotton by special modes of preparing and preserving it.

A few observations have been made upon specimens of guncotton which either were prepared by myself or came into my possession previous to the commencement of the present inquiry, but all actual experiments have been instituted with samples of products of manufacture obtained at Hirtenberg, Stowmarket, and Waltham Abbey, some modifications having been introduced, in special instances, in the ordinary system of operation at the last-named manufactory, with the view to ascertain the nature and extent of their influence upon stability.

CONDITIONS TO BE FULFILLED BY AN AUTOMATIC RIFLE.

THE following memorandum has been issued by the War Office notifying to inventors the desirable points of an automatic military rifle. Any rifle submitted for consideration under these conditions should be addressed to the Director of Artillery not later than May 1, 1910. Only rifles in a complete state can be accepted, and 300 rounds of ammunition for the purposes of a preliminary trial should accompany the weapon.

1. The rifle should be as simple, strong, and compact as possible, and the mechanism should be well protected from the entrance of sand, rain, or dirt, and free from risk of derangements due to accident, long wear and tear, rough usage on active service, exposure to wet or sand, or fouling from long continued firing. It should be easily cleaned and inspected, and, if after long use any part breaks down, it should be easily and cheaply repaired. Such parts of the mechanism as require to be cleaned and oiled by the soldier should be capable of being stripped without the use of tools.
2. Filling the magazine and loading the cartridges into the chamber should be done with ease and certainty.
3. Cartridges may be rimless.
4. As regards the ballistics of the rifle, the range for a maximum height of trajectory of 5½ feet must not be less than 800 yards.
5. The weight of the bullet, which should be pointed, must not be less than 150 nor more than 180 grains.
6. The calibre must not be less than ·27 inch nor greater than ·28 inch.
7. The working pressure must not exceed 21 tons to the square inch at 80 degrees Fahrenheit.
8. The rifle must be as light as possible, and, in any case, must not exceed 9½lbs. with magazine empty and without bayonet.
9. The rifle must be capable of being used either as an automatic-loading rifle or as a magazine rifle, the change from one to the other being simply and rapidly effected. The rifle must work correctly as an automatic rifle, both with and without the bayonet fixed; the bayonet being attached to the fore-end and not to the barrel.

When used as a magazine rifle, the bolt or block must work freely by hand, without excessive force having to be used.

The magazine must contain not less than five cartridges, and is to be filled either by means of a "charger" or a "clip."

The rifle is to fire only one shot for each pressure of the trigger.

After the last round in the magazine has been fired, the fact should be indicated by the bolt remaining open, or by some other conspicuous arrangement.

10. The direction in which the fired cases are ejected should be such as not to incommode the firer or men at his side.
11. The bolt or block supporting the base of the cartridge must, at the moment of firing, be locked positively to the barrel, or to some part securely attached to the barrel, and must not depend merely on its inertia, on friction, or on the pressure of springs to resist separation of the breech bolt or block from the barrel on discharge; it must be impossible to fire the cartridge by pressing the trigger until the locking is complete.
12. An efficient safety device must be provided to prevent the rifle being fired when the safety device is used, and, on putting the safety device out of action, the rifle must remain cocked and ready for firing.

Memorandum for Inventors.

1. *Instructions how to submit.*—Persons who desire to submit any invention for the consideration of the Army Council should do so by letter addressed to the Secretary, War Office, London.

2. The letter should state the nature of the invention and give sufficient particulars to enable its merits to be fully considered, and adduce any evidence there may be of the usefulness of the invention obtained by actual previous experiment. Any drawings, models, or samples which it is desired to submit should either accompany the letter or be sent separately at the same time, or if bulky, particulars should be given as to the place at which the samples or models can be inspected if necessary. All designs, plans, drawings, models, samples, or papers submitted are at the owner's risk, and the Department cannot accept any responsibility for damage to them should such occur.

3. *Patented Inventions.*—The letter should also state whether the invention is patented or provisionally protected in the United Kingdom, and if not patented or provisionally protected, the fact should be stated. If patented or provisionally protected, the number and date of the Patent or Provisional or Complete Specification should be quoted.

4. The attention of inventors is drawn to Section 29 of the "Patents and Designs Act, 1907," whereby it is enacted as follows:—

"A Patent shall have to all intents the like effect as against His Majesty the King as it has against a subject.

"Provided that any Government department may, by themthemselves, their agents, contractors, or others, at any time after the application, use the invention for the services of the Crown on such terms as may, either before or after the use thereof, be agreed on, with the approval of the Treasury, between the department and the patentee, or, in default of agreement, as may be settled by the Treasury after hearing all parties interested."

5. *Terms.*—The letter should also state what remuneration or terms the inventor would ask if the Army Council should desire

(i.) To acquire exclusive use of the invention.

(ii.) To acquire unrestricted use of the invention in His Majesty's Service, but also allowing the inventor a free hand to let others use it.

If no remuneration is desired the fact should be stated.

6. *Expenses.*—Expenses or loss of time incurred before or after the submission of an invention will give no claim unless authority for such expenses has been previously given by letter signed by the Secretary of the Assistant Secretary of the War Office, or by the Director of Artillery, and the liability will be strictly confined to the limits of expenditure authorised in such letter.

7. Should the Army Council consider it desirable to try an invention, the inventor will, as a general rule, be required to bear the expense of the provision of the article, its carriage, fitting up and removal, but the question whether such expenses shall in special cases be finally borne by the Crown or by the inventor will be decided by the Army Council according to the circumstances of the case.

8. *Retention of Description.*—The Army Council reserve the right to retain for future reference any designs, plans, drawings, models, samples, or papers forming an essential part of the description of the invention which may be forwarded; but if the inventor desires their return, the Army Council will not refuse it unless they think there is good reason for doing so. It is desirable, however, that the inventor should keep copies.

9. *Adoption of the Invention.*—Should the invention be adopted into His Majesty's Service, terms for its use will be

fixed by subsequent agreement, and such terms will include the supply of two copies of all designs, drawings, patterns, and particulars relating to the invention which may be considered necessary by the War Department; and it is to be understood that all such designs, drawings, patterns, and particulars will be absolutely at the disposal of His Majesty's Government for all purposes whatever, and that for them reasonable prices only will be paid by the War Department to cover the cost of draughtsmanship and manufacture.

10. No claim for remuneration for an invention will be held to be established unless in the invention has been adopted into the Service.

11. All claims for remuneration will be carefully considered; but any award which may be made will only be payable to the claimant when approved by the Treasury, and money is available from funds voted by Parliament for such purposes.

NOTE.—*Officers and Subordinates.*—Paragraphs 5 and 9 of the above Memorandum do not apply to the inventions of officers, non-commissioned officers, or soldiers of the regular forces, or civilians or other persons employed under the War Department. Such persons are required to obtain official permission before obtaining a patent; their remuneration will be decided by the Army Council, and their inventions, if patented, are dealt with under special regulations, which give them no right of appeal to the Treasury under Section 29 of the "Patents and Designs Act, 1907."

(Signed) E. W. D. WARD.

War Office, August 1, 1909.

APPLICATIONS FOR PATENTS.

AUGUST 23—SEPTEMBER 18, 1909.

19,335. Breech Mechanism. R. J. W. Brown.
19,352.* Ammunition Conveying Apparatus. P. A. Newton.
19,354. Small Arm Sights. H. E. S. Holt.
19,442. Air Gun Pellet Holder. F. J. Lea.
19,480. Target. E. Whitaker.
19,494. Gunnery Calculating Apparatus. H. Elliott.
19,536.* Sighting Devices. A. Calichiopulo.
19,538.* Sighting Telescopes. L. C. R. H. F. von Berlepsch.
19,588.* Automatic Small Arms. N. Pieper.
19,589.* Automatic Firearms. N. Pieper.
19,756. Firing a Blasting Charge. J. Cartwright.
19,837.* Ammunition Conveying Apparatus. J. T. Cowley.
19,874. Launching Projectiles. H. A. Sanders.
19,916.* Ordnance Projectiles. E. Schneider.
19,922.* Ordnance Projectiles. E. Schneider.
19,950.* Recording Target. L. Horti and J. Vilagossy.
19,951.* Disappearing Target. L. Horti and J. Vilagossy.
20,126. Ordnance Loading Apparatus. Armstrong, Whitworth & Co., Ld., R. Matthews, and C. Wale.
20,128.* Recoiling Barrel Gun Brakes. Rheinische Metallwaaren und Maschinenfabrik.
20,134.* Detonating Pellets for Cyclists' Pistol. C. Polster.
20,235. Straight-pull Rifle. G. MacLeay.
20,243. Ordnance Sighting Apparatus. A. T. Dawson and G. T. Buckham.
20,277.* Automatic Firearms. H. D. Fitzpatrick.
20,313.* Safety Device for Firearms. O. Imray.
20,360.* Projectiles. Fried Krupp.
20,452. Targets. A. Lester and I. K. Rogers.
20,466.* Ordnance Telescopes. Fried Krupp.
20,473. Ordnance Sighting. W. A. Burns.
20,503. Small Arms Sights. Birmingham Small Arms Co., Ld. and G. Norman.
20,633.* Time Fuses. A. Reichwald
20,720. Gun Sights. D. V. Johnstone.
20,982.* Pivotted Carriage Guns. Fried Krupp.
21,265. Explosives. T. P. Middleton.
21,266. Explosives. T. P. Middleton.
21,272. Explosives. F. M. Hale.
21,299. Ordnance Elevating and Sighting Apparatus. A. T. Dawson and G. T. Buckham.
21,305. Explosives. F. M. Hale.
21,332. Small Arm Sights. Birmingham Small Arms Co., Ld. and G. Norman.
21,383.* Automatic Firearms. A. Berthier.

*These applications were accompanied by complete specifications

SPECIFICATIONS PUBLISHED.

AUGUST 26—SEPTEMBER 23, 1909.

COMPILED BY HENRY TARRANT.

9,854 (1908). **Machine Gun Breech Mechanism.** T. K. North, London. In breech driving mechanism of automatic machine guns the cam through which the swinging lever is actuated is formed with a double curve. One part is shaped to give a rate of compression and expansion of the spring which will assure an approximately constant force on the swinging lever independent of the degree of compression of the spring, while the other curve is formed to increase the resisting force, thereby to create a buffering effect at the end of the working stroke. Accepted August 6, 1909.

16,280 (1908). **Automatic Pistol Mechanism.** J. C. White, U.S.A. (*See Selected Patents*).

16,511 (1908). **Ordnance Firing Gear.** Lt. A. T. Dawson, and G. T. Buckham, London. In patent No. 15,014, 1907, firing gear lock mechanism is dealt with. This is improved with the idea of eliminating danger in case of a hang fire. The lock which is moved laterally in the box slide to open the cavity through which the vent sealing tube is introduced or extracted, may be operated by the gunner standing at the side of the gun without actuating the breech mechanism. Accepted August 5, 1909.

16,515 (1908). **Firing Mechanism of Ordnance.** Lt. A. T. Dawson, and G. T. Buckham, London. The firing mechanism described in Patent No. 5,211, 1908, is improved. The device described is intended to prevent the vent sealing tube retainer from being displaced by the shock due to the slamming to of the breech and to prevent the tube from being jerked out of position. Two sets of lever mechanism are arranged with respect to each other so that when the breech is unlocked they come into positive relationship and when the breech is locked they come into inoperative relationship. Accepted August 5, 1909.

16,824 (1908). **Automatic Rifle Mechanism.** H. Sunngard, and H. Sundby, Norway. This automatic rifle is constructed so that it may be operated by the gases of combustion or by hand through the medium of a bolt handle of usual construction. The gas is conducted back to the breech through a channel running half way up the barrel. This communication may be cut of when it is desired to operate the rifle by hand say for instance in the case of a sticking cartridge where strong primary extraction is required. Accepted August 10, 1909.

16,870 (1908). **Time Fuse for Projectiles.** S. Hoffmann, Germany. This fuse is situated at the base of the projectile. It contains material which is ignited by the flames from the propellant. A sheath over the top of the fuse may be turned up or down to regulate the amount of material which shall be burned before the exploder is reached. Accepted August 11, 1909.

17,066 (1908). **Rifle Mechanism.** L. Martinez,-Silva, Colombia. A new form of bolt action for rifles is described in this patent. The bolt has a chamber in which the explosive carrying part of the cartridge is accommodated. Other novel features are introduced. Accepted August 13, 1909.

17,257 (1908). **Target Construction.** M. M. Paterson, London. Figure or other targets are constructed of metal and are divided up into dish-shaped sections. At the centre or bottom of each dish lies a contact which completes an electrical circuit when struck by a bullet so to bring about the automatic registration of the value of the shot. The dished surfaces guide the bullet to the contact no matter at which part of a section it strikes. Accepted August 12, 1909.

17,371 (1908). **Testing Ordnance Sighting.** W. A. Burns, Inverness. For testing the correctness of the sighting of ordnance a telescope is employed having cross wires intersecting at its optical axis and a pointer whose tip lies on this axis. A mirror is mounted correctly in a vertical plane at right angles with the axis of the bore of the gun. When the telescope is adjusted so that its axis is parallel with the line of the sight when the sights are at zero the reflection of the tip of the pointer and the point of intersection of the cross wires must coincide if the sights are correctly positioned. Accepted August 12, 1909.

17,767 (1908). **Fuse for Fireworks.** W. E. Lake, London. (Agent for *The American Fire Cracker Mfg. Co., U.S.A.*). This fuse for fireworks consists of twisted strips of paper which enclose an explosive composed of 38% of potassium chlorate, 26 % of potassium nitrate, 17 % of sulphur and 19 % of charcoal. The patentees claim that such a fuse is cheap to produce, it burns slowly with a visible flame, and it is not affected by dampness. Accepted August 19, 1909.

18,379 (1908). **Bullet Construction.** E. Spencer, Australia. The patentee constructs his bullet or ordnance projectile so that it shall be rotated by atmospheric action. Spiral or helicoidal passages are arranged to run through the bullet so that during flight the air passing through them shall turn the bullet on its longer axis. Accepted Sept. 1, 1909.

19,334 (1908). **Chlorate of Potassium Explosive.** J. E. Holmes, Canada. Chlorate of potassium and granulated sugar are thoroughly mixed together in equal parts, and one *per cent.* of sulphur is added. The explosive thus formed has to be electrically ignited by fuse or other similar means. It is claimed to be powerful and quite safe to handle. Accepted Sept. 2, 1909.

19,445 (1908). **Air Rifle Construction.** A. H. Hill, Handsworth. (*See Selected Patents*).

19,901 (1908). **Training Gear of Naval Ordnance.** Lt. A. T. Dawson, and G. T. Buckham, London. The training gear of naval quick firing ordnance of the centre pivot type contains worm and worm wheel mechanism with which, the patentees say, there is considerable wear giving rise eventually to much backlash. They introduce, to overcome this defect, a wedge block which is interposed between the worm bracket and the mounting. Accepted August 12, 1909.

20,010 (1908). **Measuring Wind Velocity.** Sir H. S. Maxim, London. A plate of a certain area is arranged to receive the full pressure of the wind. By means of levers this pressure is communicated through a spiral spring to a pointer which indicates the velocity on a scale whose divisions are equal. Accepted Sept. 2, 1909.

23,088 (1908). **Hinged Locks for Sporting Guns.** L. B. Taylor, Birmingham. The lock mechanism of the Anson and Deeley type of double barrelled gun action is contained on the bottom plate which is hinged at its rear so that when a catch is released the plate may be swung down and the lock work exposed. The subject of detachable locks has been dealt with in the inventor's patents Nos. 17,731, 1897, and 10,567, 1907. Accepted August 12, 1909.

24,720 (1908). **Report Silencer for Firearms.** W. Kristandt, Germany. (*See Selected Patents*).

24,433 (1908). **Sporting Gun Support.** W. T. Pugh, Kingston Hill. This device is intended to relieve the hands of the shooter of the weight of his gun whilst he is waiting to shoot. The rest hangs down from a waist belt and consists of loops which take under the butt of the gun. Accepted August 26, 1909.

4,658 (1909). **Incendiary Projectiles.** P. Lentz, Germany. Hooks are attached to the sides of a projectile designed specially for balloon destruction. When the shell is fired centrifugal force throws the hooks outward so that they may cling to the fabric of a balloon or airship. When the projectile strikes detent mechanism brings about the ignition of the chemical contents of the shell which set fire to the balloon. Accepted August 26, 1909.

11,695 (1909). **Barrel Recoil Ordnance.** Fried Krupp, A.-G. Germany. Two accumulators are so arranged that the gun barrel compresses one when it recoils and the other when it runs out again. One affects the opening and the other the closing of the breech in an automatic fashion. Accepted Sept. 2, 1909.

SELECTED PATENTS.

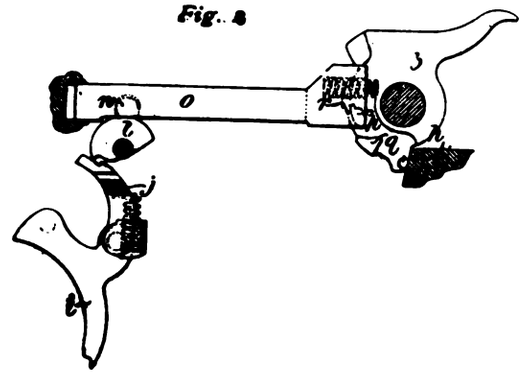
AUTOMATIC PISTOL MECHANISM.

16,280 (1908). J. C. White, U.S.A. In the preamble of his patent the inventor says :—" Experience has taught that uniformity of charge in cartridges used in automatic fire arms is not to be had. Whether this is due to careless workmanship or to something inherent in the manufacture of cartridges I am not aware, but the fact remains that an excess charge in cartridges is very common and may result in rendering the firearm inoperative and in injury to the operator. At the same time a charge less than normal would also tend to render the firearms inoperative. My invention has for its object to obviate these objections and particularly to provide an automatic firearm of very few parts which will operate equally well under variations of charge.

" To these ends my invention consists in so constructing the firearms that the pressure of the gases in the barrel acts to prevent the opening of the breech block or receiver until after the pressure in the barrel has fallen to the desired point, or when the piece is fired the pressure in the barrel acts to prevent the opening of the receiver or breech block until the pressure in the barrel has fallen to such a relatively low point that the breech block or receiver will be actuated properly and without danger by that relatively low pressure. In some cases the parts may be adjusted so that the breech block or receiver is locked against opening until the pressure is entirely exhausted so long as it is freed before energy

Fig. 1

Fig. 2



of the recoil is exhausted, the main feature of my invention is that the opening of the breech block or receiver is retarded by means controlled by the pressure of the gases in the barrel through the cartridge, which in the best form of my invention acts through a control member that moves with and preferably forms part of the breech block or receiver."

The parts occupy the position illustrated in Fig. 1 immediately after the striker has fallen on the cap of the cartridge. The pressure of the gases drives the bullet out of the barrel and tends to force the empty cartridge case and the breech parts backwards. The latter it eventually does. The breech block *a* is forced backwards against the periphery of the hammer *b*, the pivot pin *c* of which has to stand the pressure. This pin holds the hammer and the receiver *f* together the hammer being free to rotate. The pressure directed through the breech block endeavours, therefore, to force the hammer and receiver rearwards but the hammer cannot move unless it is rotated also because of the engagement of the projection *g* on its bottom with the abutment *h* on the frame of the pistol. Friction between breech block and hammer, says the patentee, is " sufficient to overcome the tendency of the hammer to rotate on its pivot, until the gas pressure on the breech

block is reduced to the desired point." The backward movement of the hammer automatically cocks it through the tripping device mentioned. The parts are pulled forward ready for the next discharge by the spring *s* which pushes one way against the frame of the pistol and the other against the tubular extension of the receiver *f*.

The trigger and sear parts are better illustrated in Fig. 2. When the trigger *i* is pulled against the pressure of the spring attached to the dog *j*, the last named is caused to turn the block *l* on its pivot and through its lug *n* to push the sear bar *o* backwards. This movement disengages what may be called the sear nose *p* from the bottom of the lug *q* and so allows the hammer to drop and to fire the cartridge that may be in the barrel.

When the automatic action recocks the trigger the sear nose *p* wipes across the back of the lug *q* and allows the nose to catch beneath the lug and to hold the trigger again in the cocked position. The top lug *r* on the side of the hammer is provided for holding the latter at half cock if necessary. The arrangement of the breech block, the striker and striker spring will be readily understood from a glance at Fig. 1. Accepted July 31, 1909.

REPORT SILENCER FOR FIREARMS.

24,720 (1908). W. Kristandt, Germany. The silencer described in this patent is of the cylinder or shell type which is attached to the muzzle of the firearm. The shell is conical in shape and is provided all along with slots larger at the outside than the inside. Arranged inside the shell are " resistances " which are designed to break up the powder gases and to dissipate their force so that they may escape gradually through the slots mentioned.

Fig. 1

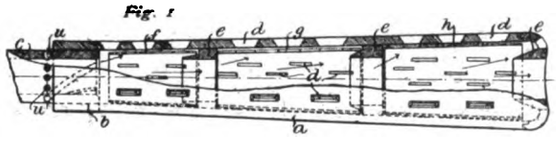
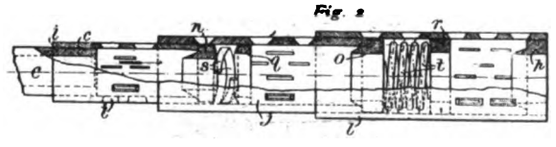


Fig. 2



In Fig. 1 of the appended illustrations *a* is the conical shell which has its largest diameter at the front. It carries the cylindrical rear end *b* by which it is attached to the muzzle *c* of the gun or rifle. Arranged right along and all round the walls of the shell are the slots *d* which are, as is shown, larger on their outsides than their insides. The " resistances " *e*, consisting of rings with sharp rear extensions, are fixed at intervals inside the shell. The front end of the shell terminates also in a resistance *e*. The tubes or liners *f*, *g* and *h* are so placed inside the shell that they may be turned by means of a separate pin or other appliance to cover up or partially or wholly expose the slots. This arrangement is made to adapt the silencer for different bores of firearms. When the gases reach the silencer they are thrown violently against the resistances and are turned back and brought more or less to a standstill so that they may escape quietly through the slots *d*.

In Fig. 2 a modification of the invention is illustrated. Instead of one long shell three tubes *i*, *j* and *l* of different diameters are employed. One is screwed over another. On the front ends of the tubes are the collars *n*, *o* and *p* which have wedge-shaped rear extensions similar to the resistances in Fig. 1. The fixed collars *q* and *r* are provided as abutments for the spiral springs *s* and *t*, which are designed to force the collars *n* and *o* up into the teeth of the gases when they arrive with the usual force at the muzzle.

To increase the efficiency of the silencer the patentee may provide the small holes *u* in the muzzle *c* of the barrel.

The following are the patentee's claims as they appear at the end of his specification :—

1. A report silencer for guns, of the type referred to, comprising in combination with the barrel of the gun, a shell designed to be screwed with its rear end on said barrel and conically enlarged towards its front end and provided on its whole surface with a number of elongated slots conically enlarged towards their outer sides for the purpose set forth.

2. A report silencer for guns of the type referred to, comprising in combination with the barrel of the gun, holes in the front end of the latter, a shell designed to be screwed with its rear end on said barrel and conically enlarged towards its front end and provided on its whole surface with a number of elongated slots conically enlarged towards their outer sides, for the purpose set forth.

3. A report silencer for guns of the type referred to, comprising in combination with the barrel of the gun, a shell designed to be screwed with its rear end on said barrel and conically enlarged towards its front end and provided on its whole surface with a number of elongated slots conically enlarged towards their outer sides, and conical tubes arranged in said shell so as to lie flat on the inner walls of the latter and provided with similar elongated slots to those in said shell and adapted to be turned, all for the purpose set forth. Accepted August 12, 1909.

AIR GUN CONSTRUCTION.

19,445 (1908). A. H. Hill, Handsworth. The idea of this patentee is to overcome the trouble of a loose breech joint which has usually to be put up in air guns or rifles with a drop down barrel, i.e. the type in which the barrel is used as a lever for compressing the piston spring. He introduces a supplementary lever which is used to slide the barrel into or out of positive locking engagement with the breech body.

The gun is illustrated in its closed position in Figs. 1 and 2. Fig. 3 shows the position occupied by the barrel when it has been dropped down to its fullest extent to force the plunger back through the link against the resistance of the plunger or piston spring. To release the barrel so that it may be turned down, the lever *a* is pressed round on its pivot to the position shown in dotted lines in Fig. 1. This action brings the cam-shaped projection *b* (Fig. 2) up against the shoulder *c* on the underside of the barrel and forces the barrel forward against the pressure of the spring *d*. In either of its two positions the lever bolt *e* is held by the flat spring *f*. When the lever bolt pushes the barrel

Fig. 2

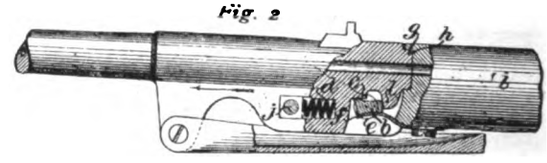


Fig. 1

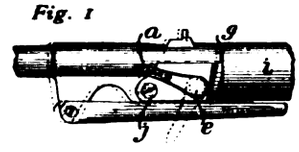
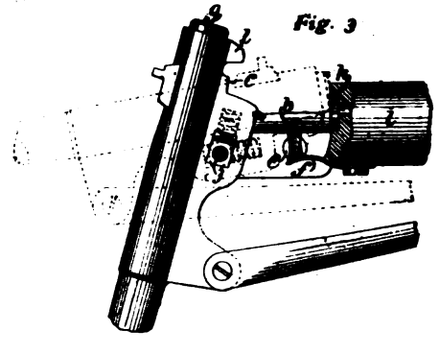


Fig. 3



forward the projection *g* on the rear of the barrel is disengaged from the recess *h* in the face of the body *i* and the barrel is free to be turned down on the joint pin *j* for the purpose specified.

When the gun has been recocked and reloaded the barrel is turned back so that the lever *a* may be pressed upwards to allow the spring *d* to slide the barrel rearwards. The projection *g* is carried into positive locking engagement with the recess *h* and is locked in this position by the cam shaped part of the bolt *e* which bites up against the back projection *l* on the underside of the barrel. The patentee claims that this construction gives what is wanted in break-down air guns, viz. a breech joint at which air cannot escape. Accepted August 26, 1909.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

American Ordnance Developments.—The brief and business-like summary which the United States Chief of Ordnance has issued in respect to the year 1908 sets an example to our own officials which they seem constitutionally unable to follow. The American army is not a large asset in international politics, but a useful parallel nevertheless exists in respect to the position of the service arm in their country and ours. Like ourselves, they had drifted about, and in endeavouring to achieve originality adopted something inferior to the best rifle on the market. The army being armed with the Krag-Jorgensen, the navy took a line of its own with the Lee straight-pull, in combination with an extra small bore cartridge which turned out a technical failure. These mistakes did not cause a tithe of the trouble and discussion which the defects of the Lee-Enfield and its cartridge are continually creating. Nevertheless, the Ordnance Department quietly set to work and produced a most efficient rifle on Mauser principles. When the pointed bullet first flashed across the horizon, the Americans were ready prepared with a rifle capable of doing justice to this latest development in cartridge design. In due course manufacture was switched over from one model to the other, and in the report under notice details are given of the financial and other considerations which arose during the period of transition. This plan of keeping up with the times from year to year curiously contrasts with our own issue of a manifesto endeavouring to anticipate the automatic rifle of the future. The study of metallic fouling was originally taken up in England, and satisfactory means for its removal were devised before other nations became interested in the problem. The importance of the subject having thus been demonstrated, the American ordnance department has lost no time in making its own experiments. If something useful is evolved one can be quite sure that it will be quickly put into use. The statutory number of officers authorised by the organisation of the American Ordnance department is 85, and the actual number in the corps is given as 69. The department may certainly be congratulated on the active and efficient efforts of this comparatively small number of workers.

Accidents on Rifle Ranges.—At the time of the Bisley Meeting, when a fatality occurred on the revolver ranges, several persons were heard to remark that the period of immunity had come to an end with startling suddenness. Several other shots, beside the one referred to, were accidentally released at Bisley, whilst from other parts of the country reports have constantly been coming to hand of shots fired otherwise than in accordance with the regulations. One of the latest mishaps resulted in a particularly sad fashion at the Balham rifle range. A young fellow there lost his life under conditions where even the coroner's jury felt unable to exercise the usual privilege of being wise after the event. Considering the death-dealing potentialities of every loaded firearm it is remarkable that so few accidents occur in the course of a year. This protection from an ever-threatening danger is partly due to the efficiency of the gunmaker's art, and in a further measure to the instinctive care which the marksman is trained to develop. Recent happenings suggest that in both departments more special precautions might for the future be taken. A start should certainly be made by so co-ordinating the design of ·22 rifles and cartridges that bullets should not be left behind in the chamber when an unfired cartridge is extracted for one reason or another, the most usual being a miss-fire. Shooters, miners and humanity at large perpetrate more

foolishness after a miss-fire has occurred than in the course of all their other experiences put together. The temptation to do the wrong thing would be greatly minimised in ·22 rifle shooting if the cartridge could be removed intact. Some makers carry out this requirement better than others, but rifles themselves differ as regards the degree of tightness at the lead. Unfortunately the ·22 cartridge with its heeled bullet is especially bad from the point of view of fastening the bullet; and ill luck further has it that the best shooting is most often obtained with a loosely held bullet and a rifling that grips it the moment the breech is closed. So much for the technical side of accidents due to miss-fires. Shooters are unquestionably in need of constant reiteration of the advice to be cautious where they point their firearms. Those who possess the instinct of care most strongly ingrained in their character and behaviour, constantly find themselves on the point of breaking the rules they most sacredly regard. Carelessly constituted persons, and especially those in indifferent health, are far greater sinners, and yet there is no more difficult task than to bring these matters to the notice of the perpetrator, without either permanently injuring his feelings, or conversely stirring up within him an attitude of resentment which defeats the intended object.

Our Lecture on the Balance of Guns.—The fact that the series of monthly lectures is ostensibly addressed to young gunmakers does not of course prevent them from at times giving information to those of a wiser generation. The modesty of the title is chiefly useful as an excuse for the explaining of elementary principles, which it would be foolishness to suggest that the practical man had not either long before mastered or decided to do without. The present lecture on gun balance represents a modest attempt to formulate certain general principles, with a view to testing them later on by practical measurements. There can be no doubt that the question of balance is understood in its entirety by the makers of "best" guns, viz., which are really best in all that counts towards high quality. The most experienced judges of balance are generally the least able to explain their ideas in scientific language. The estimation of balance is largely a special muscular sense, almost as little capable of reduction to first principles as the mental processes of the poet and the artist. On the other hand, whilst no one would attempt to usurp these functions by rigid text book methods, there is some hope that the principles of gun balance can be resolved into a few simple rules, not perhaps going the full length of perfection, but at any rate showing in what direction perfection lies. The utilitarian aspects of the question are of considerable importance, in so far that there will be no difficulty in specifying absolute weights and points of balance for the main parts of a gun. Given a definite ideal the arrangement of the allotted metal in the allotted places is reduced to a process of specifying dimensions. If these conform with sound practice they can be incorporated into daily routine, and the levelling up of the cheaper grades of gun should follow as a natural consequence. This could not be otherwise than beneficial in a trade where the differences between the products of to-day and fifteen years ago are hard enough to appreciate, even when they have been carefully explained.

Storage of Powders on Registered Premises.—The prosecution and fining of a prominent West End firm for an infraction of the explosives regulations, under circumstances which at any rate did not appeal to the magistrate as requiring only a nominal fine, calls attention to a question which has lain dormant for some years past. It is well known that an exceptionally well organised system of deliveries is required to maintain a cartridge filling department if the Mode B system of storage is the only one available. Many firms have in consequence given up the attempt to work under such difficult conditions, and others do so in the hope that their organisation may not break down, and at some time land them with an excess of powder in hand. With the comparatively generous provisions which exist under the Mode A system of storage the conditions are reasonably favourable, but there are many old-established firms in occupation of premises where it is absolutely impossible to find the necessary six feet square of open yard in which to erect a store place detached from a dwelling house. The fifty pounds limit, which otherwise prevails, suffices for the loading of some eight to ten thousand cartridges according to the nature of the powder, but under practical working conditions the problem loses this elementary simplicity. A gunmaker must be prepared to supply many kinds of powder at a moment's notice, and when the fifty pounds is divided over several varieties, and space has continually to be found for fresh arrivals, the limit storage of fifty pounds is very rapidly reduced to an average quantity nearer thirty pounds. Assuming fifteen of these to be more of less special samples held in anticipation of emergency orders, the active stock comes nearer fifteen or twenty pounds than the more generous sounding total limit. This would allow for ten pounds of each of two kinds of powder, viz. sufficient to fill about four thousand cartridges in all. In a seasonal business where most of the trade is concentrated in a few months of the year such quantities are absurdly inadequate. At the same time cartridge filling is not so profitable a business that it pays to organise a separate department in more roomy premises situated in a neighbouring thoroughfare. Therefore, most gunmakers have little option but to continue as heretofore giving the bulk of their orders to the factories, whilst preparing on their own premises only the small and special lots which are called for unexpectedly, and require to be dealt with at short notice.

The New Ballistic Tables.—As a supplement to the *Text Book of Gunnery* there has now been published a volume comprising just the re-worked ballistic tables, which are the foundation of trajectory and other calculations relating to projectiles. The new values are substantially different from the old, and they have no doubt involved an infinity of labour, but even so the writing of the ordinary species of review is a task rendered almost impossible by the nature of the contents of the book under notice.

THE GUN TRADE, 1850 to 1900.

So constantly is Colonel Hawker's list of the gun trade for the year 1826 referred to on matters concerning the history of firearms that it has been decided to publish a piece of work, which has lain in our possession undealt with for nearly ten years. When the fraudulent marking of guns was in process of being brought to an end by the series of prosecutions carried out by the Gunmaker's Association, a complete list of gunmakers was compiled from the old London directories of the previous fifty years. At one time the Gunmakers' Association considered the idea of publishing this list and selling copies at a price to cover the cost of printing, but the idea was abandoned. The present method of publication will at any rate render the information which the list contains accessible to all who may desire to avail themselves of it. An alphabetical arrangement of the names has been adopted, and in view of the considerable size of the manuscript it is necessary to deal with it in instalments.

HENRY ADAMS, 18, Gray's Inn Road, 1850–8.

ROBERT ADAMS, Henry Street, Bermondsey, 1858; 76, King William Street, E.C., 1859–65; 46, Pall Mall, 1866.

ADAMS & CO., 9, Finsbury Place South, E.C., 1870–80; 32, Finsbury Pavement, E.C., 1881–94; 22, Denmark Street, Soho, 1897–9.

THE ADAMS PATENT SMALL ARMS CO., Ld., 391, Strand, (JOHN ADAMS started with Company as Managing Director), 1864–74. THE ADAMS PATENT SMALL ARMS MFG. Co., Ld., 1875–93; 40–42, Crampton Street, S.E., 1893; The "Ld." was dropped from the Company's title in 1892.

G. T. ADCOCK, 3, Gray's Inn Lane, W.C., 1861–3; 22, Gray's Inn Road, 1864–78.

HENRY ADKIN (Agent for John Smith & Son), 4, Thavie's Inn, Holborn, 1850–9.

WILSON AGER & Co., 4, Railway Place, E.C., 1868.

H. ALARD FILS & Co., 61, Great Tower Street, E.C., 1896–1900.

THOMAS F. ALLPORT, 3, Ashland Place, Paddington, W., 1889–95. HERBERT J. ALLPORT, 1896.

CHARLES E. ANDREWS, 15, Swallow Street, Piccadilly, W., 1900.

C. W. ANDREWS, 6, Great Winchester Street, E.C., 1882–93; C. W. ANDREWS, Ld., 1894–1900.

JOHN ANTLEY, 37, Turner Street, Commercial Road, E., 1864.

HENRY M. APPLETON, 51, London Wall, E.C., 1869–72.

CHARLES ARMBRUSTER, 8, Vernon Place, Bloomsbury, 1864–5.

ARMS AND AMMUNITION Co., 143, Queen Victoria Street, E.C. (and Birmingham), 1891–4; ARMS AND AMMUNITION Co., Ld., 1895–1900.

ARMSTRONG & Co., 5, Newman Street, Oxford Street, W., 1897.

MRS. ASHTON, 1, Swallow's Gardens, Goodman's Fields, E., 1850–5; J. ASHTON & Co., 1856–7; MRS. ASHTON, 1858.

R. & W. ASTON & Co., (Agents for G. S. Melland), 38, Lime Street, E.C., 1864 only; RICHARD AND WILLIAM ASTON (no agent), 26, Crosby Hill Chambers, E.C., 1869.

HENRY ATKIN, 43, Upper Manor Street, Chelsea, S.W., 1862–70.

HENRY ATKIN, 18, Oxenden Street, Haymarket, 1877–90; 2, Jermyn Street, 1891–1900.

HENRY E. ATKINS, 877, Old Kent Road, 1874–87.

AUTOMATIC RIFLE SYNDICATE, Ld., 9, Victoria Street, S.W., 1896–1900.

BADMINGTON SCHOOL OF SHOOTING, 98, New Bond Street, 1900.

E. BAKER & SON, Size Yard, Whitechapel Road, E., 1850–2; 49, Tenter Street, E., 1853–4; 7, Union Street, Whitechapel, E., 1857–60.

THOMAS KIRSLAKE BAKER, 34, St. James's Street, S.W., 1850; 88, Fleet Street, E.C., 1851–2; 88, Fleet Street and Blackhouse Court, 1853–6; 88, Fleet Street, 1857; FREDERICK THOMAS BAKER, 1858–81; 88, Fleet Street and 21, Cockspur Street, S.W., 1882–98; 88, Fleet Street and 29, Glasshouse Street, 1899–1900.

THOMAS K. BAKER, 1, Stonecutter Street, E.C., 1850; 88, Fleet Street, E.C., 1851. (Separate entries in directories).

FREDERICK BARNES, 3, Union Row, Tower Hill, E., 1850; 3, Union Row, 109, Fenchurch Street and 67, Minories as FREDERICK BARNES & Co., 1851–6; 109, Fenchurch Street, 1857–1900.

JOHN EDWARD BARNETT & SONS, 134, Minories, 1850–9; 134, Minories and Brewhouse Lane, Wapping, 1860–74; 134, Minories and Duncan Street, Leman Street, E., 1875; Duncan Street, E., 1876–1900.

F. BARTON & Co., 49, Lime Street, E.C., 1896–1900.

E. BAYLISS & SON, 42–44a, Cannon Street, 1874–6.

BENJAMIN BEASLEY, 4, St. James's Street, 1865.

JAMES BEATTIE, 205, Regent Street, 1850–64; JAMES BEATTIE & SON, 1865–1879; J. BEATTIE & Co., 104, Queen Victoria Street, E.C., 1881–94.

HENRY BECKWITH, 33, Fieldgate Street, E., 1858–63; 33, Fieldgate Street, and 58, Skinner Street, 1864–5; 58, Skinner Street, 1866–8.

WILLIAM A. BECKWITH, 58, Skinner Street, Snow Hill, 1850–5; 58, Skinner Street, and New Buildings, Fox & Knot Court, King Street, Snow Hill, 1856–7; 58, Skinner Street, 1858–68.

BEDFORD BROS., 11, Little Moorfields, E.C., 1867.

FREDERICK BEESLEY, 22, Queen Street, Edgware Road, W., 1879–84; 85, Edgware Road, 1885–92; 3, St. James's Street, 1893–99; 2, St. James's Street and 2 Pickering Place, S.W., 1900.

BENJAMIN & BURLEZ, 20, St. Mary Axe, 1861–6; HENRY BENJAMIN & Co., 1867, 1871; HENRY BENJAMIN, 1872–74; HENRY BENJAMIN, 36, St. Mary Axe, E.C., and 61½, Fore Street, E.C., 1875–7; 61½, Fore Street, 1878–80; 1, Moorfields, 1881–2.

BENJAMIN BROS., 11, Little Moorfields, E.C., 1869–71.

BENJAMIN PISTOL SYNDICATE, 24, Jewin Crescent, E.C., 1898.

BENTLEY AND PLAYFAIR, 20, High Holborn, 1885–9; 9, New Broad Street, 1891–2; 60, Queen Victoria Street, 1893–1900.

A. BEVINGTON, 298, Regent Street, 1887; 12, Lime Street, E.C., 1888–90.

F. J. BIGGS, Ironmonger Lane, E.C., 1876; 19, Gracechurch Street, E.C., 1877–83; Leadenhall Buildings, E.C., 1884–6.

CHARLES O. BIRCHAM, 124, Poplar High Street, E.C., 1867–90; CHARLES O. BIRCHAM & SON, 1891–1900.

BIRMINGHAM SMALL ARMS AND METAL Co., Ld., Small Heath Birmingham, 1883–4; 6, Great Winchester Street, E.C., 1885–1900.

WILLIAM BISHOP, 170, New Bond Street, (Agent for Westley Richards), 1850–71.

THOMAS BISSELL, 76, Tooley Street, E.C., 1857; 75, Tooley Street, 1858–69; 73, Tooley Street, 1870–5; 73, Tooley Street and 30, Star Corner, E.C., 1876; 75–77, Cranham Road, Rotherhithe New Road, E.C., 1877–86; Reopened at 98, Hollydale Road, Peckham, S.E., 1889–91.

BLAGDON SHOOTING SCHOOL, Malden, Surrey, 1900.

JOHN A. BLAKE & Co., 253, Wapping, 1850–2; 253, Wapping and 35, Upper East Smithfield, 1853–4; 35, Upper East Smithfield, 1855–64.

V. & R. BLAKEMORE, 46, Leadenhall Street, 1867–74; 8, Lime Street, E.C., 1875–97.

JOHN BLANCH & SON, 29, Gracechurch Street, E.C., 1850–1900.

E. J. BLAND, 17, Brook Street, W., 1897–8.

THOMAS BLAND & SON, 106, Strand, 1876–86; 106 and 430, Strand, 1887; 430, Strand, 1888–1900.

JOHN BLISSETT, 321–322, High Holborn, 1850–6; 322, High Holborn, 1857–66; JOHN BLISSETT & SON, same address 1867–75; 98, High Holborn, 1876–7; JOHN BLISSETT, SON AND TOMES, 1878–83, same address.

THOMAS BLISSETT, 16, Water Lane, E.C., 1864.

EDWARD AND WILLIAM BOND, 45, Cornhill and Hooper Square, Goodman's Fields, E., 1850–5; 42, Leadenhall Street and Hooper Square, E., 1856–60; Hooper Square, E., 1861; EDWARD P. BOND, Hooper Square, 1862–1870; EDWARD AND WILLIAM BOND, 4, Northumberland Alley, Fenchurch Street, E.C., 1871–9.

C. G. BONEHILL, Belmont Works, Birmingham, 1884.

THOMAS BOSS, 73, St. James's Street, S.W., 1850–9; THOMAS BOSS & Co., same address, 1860–1900.
CHARLES BOSWELL, 126, Strand, 1884–1900.
JOHN BOSWORTH, 47b, Richard Street, E., 1864–5.
JAMES BOTT & SON, 38, Lime Street, E.C., 1890–1900.
PETER BOURDEVEAUX, 34, Hart Street, Bloomsbury, 1864–5.
JOSEPH BOURNE & SON, 82, Mark Lane, E.C., 1877; 4, Cullum Street, E.C., 1879–81.
JOSEPH BOURNE & SON, (3, 4, & 5, Whittall Street, Birmingham), 1883–4; 7, St. Mary's Row, Birmingham, 1885–1900.
WILLIAM BOYLE, 86, Leadenhall Street, 1893–4.
BOZARD & Co., 33, New Bond Street, 1888–95; 8, Bennett Street, S.W., 1896–7; BOZARD, BEDINGFIELD, PHILIP & Co., 4, Panton Street, 1898; BOZARD & Co., 4, Panton Street, 1899–1900.
BRAEDLIN ARMOURY Co., Ld., Birmingham, 1884; BRAEDLIN ARMOURY Co., 63, Cornhill, 1886–95; 13–14, Abchurch Lane, 1896–8.
JOEL B. BRANDON, 119a, Oxford Street, 1873–7.
BREECH LOADING ARMOURY Co., Ld., 4, Pall Mall, 1866–8.
BREECH LOADING GUN Co., (Leitch's Patent), 29, Great Portland Street, W., 1861–4.
SYDNEY J. BRENNAN, 155, Upper Thames St., 1899–1900.
EUGENE BREWER, 37, Queen Street, E.C., 1877–8 and 1880–1; 9, New Broad Street, 1882–5.
GEORGE BRIDEN, 30, Bow Street, W.C., 1856 only.
BRITISH AND FOREIGN LEE ARMS Co., Ld., 23, Queen Victoria Street, 1900.
BRITISH MAGAZINE RIFLE Co., Ld., 13, Austin Friars, E.C., 1896–1900.
EDWARD BROOKS & SON, 1, Fenchurch Street, E.C., 1853–4.
BROWN AND MANNETT, 26, New City Chambers, 1867–74.
HENRY BRUIE, 13, Clayton Street, Caledonian Road, 1855.
WILLIAM BUNN, 22, Chester Street, Kensington Cross, 1857.
EDWIN BURROWS, 110, Cannon Street, 1878.
J. H. BURTON, 18, Parliament Street, S.W., 1867.
G. G. BUSSEY & Co., Rye Lane, Peckham, 1870–83; G. G. BUSSEY & Co., Ld., 1884–9.
EMMANUEL H. CADIOT, 72, Gracechurch Street, E.C., 1875.
CAHEN, LYON & Co., see Christy & Co.
CALISHER & TERRY, 28, Norfolk Street, Strand, 1864–5; 117–118, Leadenhall Street, 1869–70.
GEORGE CARR, 9, Chamber Street, Goodman's Fields, E., 1864–5.
CARTER-EDWARDS PATENT BREECH LOADING Co., 209, Gresham House, Old Broad Street, E.C., 1869–70.
FREDERICK W. CARTER, 27a, Ridinghouse Street, W., 1898.
ALFRED CARVER, 1, Graham Street, Pimlico, 1889–93.
ROBERT CARVER, 2, George Yard, Princes Street, Soho, 1865–1879.
JOHN CHAMBERLAIN, 23, Birchin Lane, E.C., 1869–76; RICHARD JOHN CHAMBERLAIN, 1877; R. J. CHAMBERLAIN, 81a, Gracechurch Street E.C., 1878–80
RICHARD J. CHAMBERLAIN, 9, Railway Approach, S.E., 1875.
JOHN CHAMBERS, 46, Lambeth Street, E., 1854–67.
WILLIAM CHILD, 280, Strand, 1850.
JOHN CHINN (Agent), 26, Bartlett's Buildings, 1853.
T. CHRISTY & Co., (Agents for Cahen, Lyon & Co.), 1868–73, 155, Fenchurch Street, E.C., 1868–75.
CHARLES CHURCHILL, 16, Laurence Pountney Lane, 1869.
E. J. CHURCHILL, 8, Agar Street, Strand, 1892 1900.
CLABROUGH BROS., 52, Leadenhall Street, 1893–5.
CHARLES CLARK (Agent), 26, Bartlett's Buildings, Holborn, 1854; 10, Upper Berner Street, Commercial Road, E., 1857.
GEORGE CLARK & Co., 10, Craven Buildings, Drury Lane, 1870.
CHARLES CLEMENT, 63, Queen Victoria Street, 1890–1.
CLEMENTS & SON, 106a, Fenchurch Street, 1891–4.
COCHRAN'S BREECH LOADING FIREARMS Co., 43, Parliament Street, S.W., 1868.
BENJAMIN COGSWELL, 224, Strand, 1850–62; COGSWELL & HARRISON, 223–224, Strand, 1863–79; 223–224, Strand, and 142, New Bond Street, 1880–1; COGSWELL & HARRISON, Ld., 226, Strand, and 142, New Bond Street, 1882–94; Strand, New Bond Street, and 29a, Gillingham Street, 1895–1900.
JOHN COLE, 29, Great Portland Street, W., 1866–72; 13, Newman Street, W., 1873–93; 27a, Ridinghouse Street, W., 1894–7..
EPHRAIM COLESBY, 1, Black Horse Alley, Fleet Street, E.C., 1857–9.
FREDERICK COLLINS (Agent), 7, Beaufort Buildings, Strand, 1861.
JAMES COLLINS, 115, Regent Street, 1850–4
COLT GUN & CARRIAGE Co., Ld., 34, Victoria St., S.W., 1900.
COLONEL SAMUEL COLT, 1, Spring Gardens, 1853; 1, Spring Gardens and Thames Bank, Pimlico (factory), 1854–6; 14, Pall Mall and Thames Bank, 1857; 14, Pall Mall, and 27, Chandos Street, 1858; 14, Pall Mall and 37, Chandos Street, 1859–60; 14, Pall Mall only, 1861–3; COLT'S PATENT FIREARMS MANUFACTURING Co., (F. von Oppen, first representative), 14, Pall Mall, 1864–91; 26, Glasshouse Street, S.W., 1892–1900.
J. T. COOK & SONS, 6, Well Street, Wellclose Square, 1850–5.
COOPER & GOODMAN, 23, Abchurch Lane, E.C., 1876–80.
G. C. COOPER, 131, High Holborn, 1890–3.
J. R. COOPER & Co., 52, Eastcheap, E.C., 1850–3.
WILLIAM COUTTS, 58, King Street, Soho, W., 1871–5; 11 Gerrard Street, Soho, 1876–94.
GEORGE CRABB, 18, Brewer Street, Golden Square, 1883.
J. H. CRANE, 2, Castle Court, Birchin Lane, E.C., 1866; 3, Royal Exchange, 1867–77; 6, St. Swithin's Lane, E.C., 1878–9.
HENRY CRESSALL, 5, King Street, Holborn, 1856–7; WILLIAM CRESSALL, 45, Bedford Row, 1858–73.
WILLIAM G. CUMMING (Agent), 135, Fenchurch Street, 1871; 9, Railway Approach, London Bridge, 1873–4.
JOHN DARBY, 7, Ridinghouse Street, 1866–70.
GEORGE H. DAW, 57, Threadneedle Street, E.C., 1861–5; 57, Threadneedle Street, E.C., and 2, New North Buildings, Chapel Street, E.C., 1876–7; 57, Threadneedle Street only, 1878–9; G. H. DAW & Co., 1880–7; 166, Fenchurch Street, E.C., 1888–9.
G. H. DAW & Co., Sweeds Court, Great Trinity Lane, 1870.
DAW GUN Co., 19, Great Winchester Street, 1890–2.
FRANK DAY, 1 and 2, Fenchurch Street, E.C., 1878–80.
GEORGE & JOHN DEANE, 30, King William Street, E.C., 1850–1; DEANE & Co., 30, King William Street and 1, Maze, Tooley Street, 1852–3; DEANE, ADAMS & DEANE, 30, King William Street and 1, New Weston Street, Tooley Street, 1854–1855; 30, King William Street, and 2, New Weston Street, 1856–7; JOHN DEANE & SON, 30, King William Street, E.C., 1858–72.
CH. DE GRELLE & Co., 19, Basinghall Street, 1884; 130, London Wall, 1885–8.
ALEXANDER DEMARET, 4, St. Mary Axe, E.C., 1893.
BERNARD DENYER, 336, Oxford Street, 1850; 131, Holborn Hill, 1851–75.
HERBERT DICKINSON, 2, Little Prescot Street, 1854–7; 3, Little Prescot Street, and 31, Frith Street, Soho, 1858–61; 2, Union Row, Minories, and 31, Frith Street, Soho, 1862–71; 2, Union Row, Minories only, 1872–1900.
DONALD, ATKEY & Co., 33, Cornhill, E.C., 1872–5.
JAMES D. DOUGALL, 59, St. James's Street, 1864–82; 8, Bennett Street, S.W., 1883–7; JAMES D. DOUGALL & SONS, 1888–93.
FREDERICK DOWLING, Castle Court, Castle Street East, W., 1865–9; 21, Eversholt Street, N.W., 1876–7.
LALOUX DRESSE & Co., 47, Basinghall Street, E.C., 1881–4; 4, St. Mary Axe, 1897–1900.
DRISKET & WAROUX (Liége), 39, Monkwell Street, E.C., 1870–2; 1, Wood Street Square, 1873; A. DRISKET & Co., 1, Wood Street Square, 1874–6.
FERD. DRISSEN, 19, Basinghall Street, 1876; 115, Leadenhall Street, 1877–8; 21, Leadenhall Street, 1879.
F. DUMOULIN & Co., 9–11, Wilson Street, 1898–9.
EDWARD DYBALL, 24, Markham Street, Chelsea, 1862–7.
FRANK DYKE & Co., 21, Addle Street, Aldermanbury, 1893–4; 5, 6, and 7, St. George's Avenue, E.C., 1895–1900.
EDWARD EAST & Co., 1 and 2, Fenchurch Street, 1874.
WILLIAM EATON & Co., 35, Finsbury Circus, and 98, London Wall, E.C., 1868.
SAMUEL G. EGAN, 157, Tachbrook Street, Pimlico, 1888–93.
CHARLES & HENRY EGG, 1, Piccadilly, 1850; HENRY EGG, 1851–1869; HENRY WILLIAM EGG, 1870–80.
DURS EGG, 4, Pall Mall, 1850–4; 4, Colonnade, Pall Mall, 1855–65.

LECTURES TO YOUNG GUNMAKERS.

LXII.—THE SCIENCE OF BALANCE IN FIREARMS.

The qualities in a shot gun which are comprised in the single word "balance" are little understood and even lack definition. The present attempt to achieve precision may err from want of sufficient ground work of practical knowledge, but enough has been definitely established to ensure at least a substratum of truth in most of the theories and figures which will be advanced as the treatment of the subject progresses. The object of imparting definite balancing properties to the scatter gun is that the sportsman may quickly and accurately align it on any object, stationary or moving, which he may desire to shoot. Sluggish resistance to change of position on the part of the gun implies a misplacement of weight, in other words a faulty balance. The most elementary test of balance is to ascertain the position of the centre of gravity of the gun by finding its point of balance on a fixed fulcrum. Though a good gun balances at the right place, so also may a bad one, as may easily be shown by a simple diagram. A suitable model for demonstrating problems of balance consists of a rigid bar, a fulcrum, and a series of moveable weights. Here for instance is a view of the simplest conditions it is possible to conceive :—

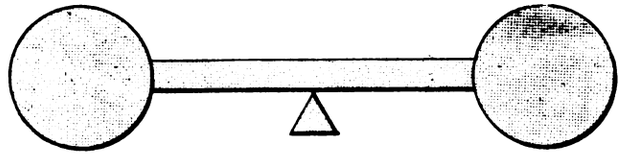


Fig. 1.—Central balance by two equal weights at an extreme distance.

Unfortunately, such a test brings the enquirer very little nearer the problem he is desirous of solving, since the whole of the conditions expressed in the above diagram are equally reproduced in the one which next appears.

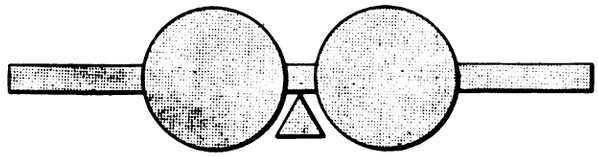


Fig. 2.—Central balance by the same two weights brought close together.

Treating the arrangement illustrated as a dumb bell of the kind used for athletic exercises it will be instantly obvious that for all movements in which the two ends of the bar are displaced in parallel and equal amounts there is no great difference between forms 1 and 2. The dead lift and the action of carrying from one place to another would not be greatly influenced by the distance of the weights from the balancing centre, But the moment an exercise takes the form of rotating the bar, or in fact giving it any kind of movement where the two ends have unequal or opposite tendencies, the Fig. 1. arrangement would illustrate a maximum of inertia whilst the other would give the user far better control. For just the same reason that the weight of a fly-wheel is concentrated on the periphery, so for any given weight the Fig. 1. arrangement produces a maximum of inertia, Fig. 2. intermediate and Fig. 3, which next appears, minimum resistance to relative motion.

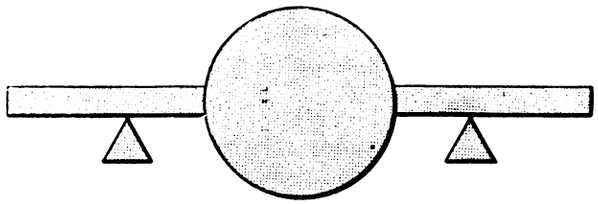


Fig. 3.—The same total weight centrally disposed to provide perfect "balance."

The gun differs from any of the foregoing examples in the fact that the balancing centre must not be disposed in the centre of its length. Thus, a gun may be said to balance more after the following fashion.

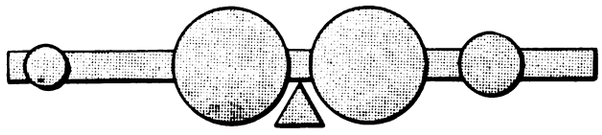


Fig. 4.—Gun style of balance with most of weight near the centre.

Against this last diagram it may quite fairly be objected that though a gun may be tested for balance by means of a single fulcrum it is in reality manipulated by the shooter's two hands, and therefore can only be judged by a system of test involving two points of support. This theory was fully developed by Dr. Mias in the columns of the *Field* some years ago, and he advocated a system of duplicate suspension from spring balances as follows :—

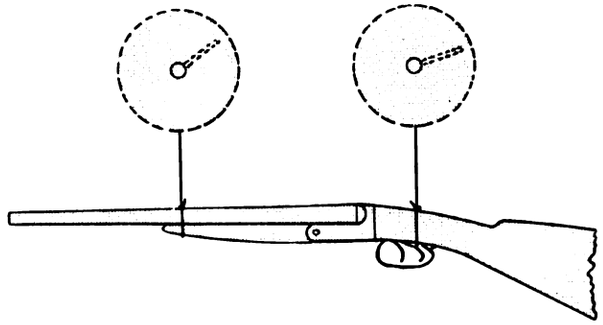


Fig. 5.—Measuring the relative weight taken by the two hands.

This attempt at a solution of a most difficult problem perfectly demonstrates certain points concerning the disposal of the metal and other parts of guns and rifles, but it draws no distinction between the conditions illustrated in diagrams 1 to 4. It would for instance be entirely incapable of showing a difference for an arrangement such as that shown overleaf. There can be little doubt that the doctor intended his test to carry the analysis of balance beyond what the ordinary fulcrum test could accomplish.

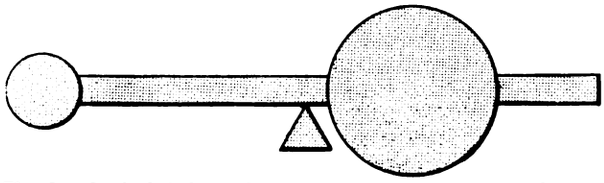


Fig. 6.—Central balance from unequal weights having the same total value and the same balancing centre as in the previous diagrams.

But Dr. Mias's arrangement occupies the same position towards the one-fulcrum test of balance that a ready reckoner table does towards the ordinary process of arithmetic. It simply saves calcution. Knowing the balancing centre of a gun, and having determined the distance from that centre of the right and left hands respectively, it is a sum in simple proportion to decide how the total weight of the gun is divided between the two supports. The underlying rule is that the weight sustained at each place is in inverse proportion to their respective distances from the balancing centre. Therefore, so far as regards the *distribution* of the weight of the gun between barrels, action and stock, and be it understood also its relative distribution within these details, the Mias test of two spring balances goes no further than the simple fulcrum test. Now, it was Major W. B. Wallace, *p.a.c.*, the talented Chief Inspector of Small Arms, who defined with absolute precision, probably for the first time, the principle of testing balance in fire arms. His definition of what constitutes perfect balance is open to criticism, but his treatment of the scientific problem is sound and merits the appreciation of all interested in the elucidation of gun problems. In the *Journal of the United Service Institution of India* of July 1905 (See A. & E., Sept. '05), he referred to the necessity for keeping the length of the radius of gyration small i.e., "the weight of the rifle should be concentrated as much as possible near the centre of gravity." Here practically is the essence of gun balance in a nutshell. At any rate the means of examination and reduction to figure values are obviously to hand, so that theory and practice may be harmonised in order to produce a code of sound general principles. What then is the "radius of gyration"? It is the distance from the balancing centre of the whole gun to the centre of gravity of its dismembered halves.

It would be an expensive process to put the saw through every rifle or other weapon whose balancing properties it was desired to measure. The result would nevertheless be extremely interesting if carried out with reference to all the Military rifles. The point of severance would obviously be the balancing centre, and the whole of the information referring to balance would be derived from the weight of the respective halves, and the location of their respective centres of gravity with reference to the point of severance. The distribution of weight, which is apparent to the eye in the simple forms chosen for illustration in the various diagrams above, could be equally emphasised in all classes of firearms if the proposed test could be applied. Differences of form and material would be duly taken into account, cavities would tell their tale, and the distance of every part from the index centre would be harmonised in one vast sum in arithmetic, of which the answer only was shown. The shot gun lends itself naturally to the proposed treatment, but fortunately without involving its destruction. Theoretically, what is wanted is shown below; but a very near and even more useful approximation is possible without the need to do any damage.

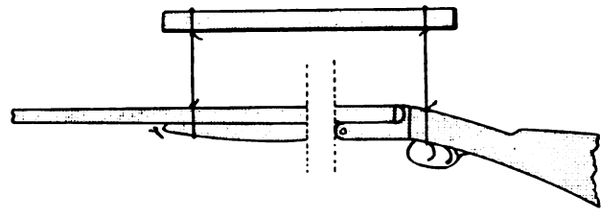


Fig. 7.—True balance is the distribution of weight in the dismembered halves.

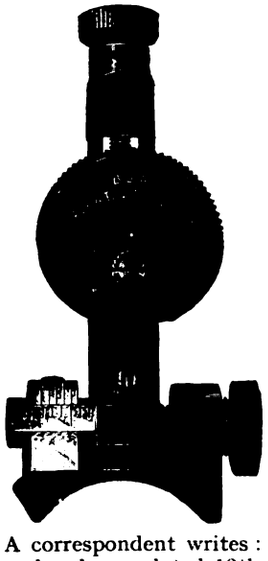
In the case of take-down guns the test for balance can be applied to the barrels and stock and action. Here, then, is the means of reducing the most evasive of the properties of the shot gun to a system of scientific measurement. Records of good models can be collected and classified, so that theory may ultimately fix a type arrived at in the first instance by the skill of the practised worker. The prime essentials of measurement are at the start extremely simple, and it is doubtful whether they will ever need to be carried to the abstruse stage. There will, no doubt, be quantities of figures to arrange and interpret, but they will all run on the same simple basis. Briefly, and speaking only with reference to the limited number of examples which have been examined, good balance consists in the stock and action weighing some ounces more than the barrels, also in the barrels balancing at a point inside ten inches from the face. The balancing point of the stock and action is doubtless of considerable importance, and the wood might be balanced and weighed independently of the action.

From what has been said on the theoretical aspect of balance it will be obvious that the whole difference between sound and unsound ideas on the subject is the difference between the "live" balance and the "dead" balance of a gun. A weapon should feel alive when handled, and to do so it should respond to the directing movement of the arms with the sympathy of the acrobat rather than impose the inert resistance of an obstinate child. On the dead weight system of testing a gun as a whole, barrels heavy forward may be corrected by weighting the butt of the stock. But the resulting increase of Major Wallace's radius of gyration becomes apparent the moment the balancing test is applied to the component parts. A proper understanding of the principles of balance will emphasise the futility of endeavouring to impart handling properties to a gun wrongly conceived in the first instance. Balance begins, and very nearly ends, with the fashioning of the tubes and their assembly in double-barrel form; but the action, and even the choice of a suitable density of wood for the stock are amongst the ramifications of the unwritten science of balance.

ROUND THE TRADE.

It is reported that following a demonstration of Marten Hale's hand grenade the German military authorities have given a trial order.

The King's Norton Metal Co. Ld. have forwarded to this office a 32-page pamphlet which contains a selection and summary of the records and fine performances made at Bisley by the Company's celebrated Palma cartridge. It needs a carefully prepared digest of this nature to bring home the extraordinary advances which have been made during recent years in the accuracy of small bore rifle shooting. Considerable statistical ability has been exercised in summarising the previous performances and bringing them into contrast with the improvements that have since been registered. A number of reproductions of winning targets give the pamphlet an interest for gunmakers and riflemen, which is not only considerable to-day, but will so continue on account of their historical importance. Such a pamphlet coming, as it does, on the top of an uninterrupted run of manufacturing success, entitles the firm to claim that their record is established on the basis not of promises but of past performances. What these performances are this modest pamphlet gives a general idea, but only a match rifleman can appreciate the difficulties which have been met and mastered. A companion edition printed in French is intended for distribution abroad.



The Birmingham Small Arms Company, Ld. have forwarded the accompanying illustration of a variation of their aperture sight which has been designed for the purpose of giving the shooter the choice of a number of different size apertures. The correct centering of the particular aperture which is in use at the moment is provided for by a self-adjusting arrangement which is practical as well as ingenious. The price of the discs is four shillings, subject to trade discount, so that the shooter, who finds that no one size of aperture suits all conditions, will not need to forgo the advantages of the adjustable variety on the score of expense.

A correspondent writes: "The Cuban Government has issued a decree dated 19th August, 1909 bearing upon the importation and sale of arms in the Republic. The principal points of the order are as follow:—The import of fire-arms—except saloon rifles, air-guns, etc.—is not allowed without a special authorisation from the Government of the Interior, and their entry is only permitted then through six ports of the island. The number of firearms which each dealer may have in stock is not allowed to exceed 99. Any number in excess of this will have to be deposited in the arsenal or in some place belonging to the Government. No arms may be drawn out from the Government storehouse until all or part of the 99 in stock have been sold. Military rifles must be kept in the arsenal or some other place appointed by the Government. They cannot be sold without a special permit from the authorities. Not more than 100 cartridges or caps are allowed to be sold with each firearm. The sale of firearms and cartridges must be proved every month by a list which the dealers are bound to deliver to the Secretary of the Interior and upon which the names of the various buyers must be given together with other information."

George A. Leader, the workman who was seriously injured in the recent explosion at the Royal Gunpowder Factory has received a letter from the Army Council in appreciation of his brave conduct and presence of mind in putting into operation the drenching apparatus.

The Society of Engineers of 17, Victoria Street, Westminster asks that publicity may be given to a scheme that has been put on foot for keeping an employment register to assist qualified engineers of all grades in the obtaining of professional employment. Manufacturers and others are invited to communicate their wants.

The Miniature Ammunition Co., Ld., have removed from Dover Street, Piccadilly, which was more fashionable as an address than convenient for the class of business carried on. The new premises are situated in the basement with street frontage to No. 11, Pall Mall, a few doors from the depot of the Colt Co. Such a position is obviously the last word in centrality and convenience, whilst not competing in display with the recognised retail establishments.

Messrs. Hunter & Warren, Ld. of 19, Waterloo Street, Glasgow have forwarded an illustrated leaflet explaining the changes arising from the new Order in Council relating to explosives stores. The text of this order was published in last month's issue, but this does not detract from the additional interest which is imparted by the well informed comments and amplifications of this well-known firm.

Messrs. Westley Richards & Co., Ld. were the unfortunate victims of a prosecution in respect to an excess storage of nitro-compound on their premises at 178 New Bond Street. The infraction of law arose it was explained in consequence of pressure of work preceding the opening of the shooting season. More powder was delivered than could be filled into cartridges before the next delivery was due. Mr. H. G. A. Thorn conducted the defence on behalf of the firm. A fine of £5 with £1 3s. costs was inflicted, and the seized explosive to the extent of 60lbs. was returned to the defendants.

A writer in the *Mechanical Engineer* has lately been calculating the horse power of a six-inch gun firing a 90lb. shot at a muzzle velocity of 1370f.s. He naturally arrives at an astounding figure of horse power, viz. 279,000. Horse power being a rate of doing work, a substantial muzzle energy, and the necessarily short period of its development, implies great activity while the effort lasts. Though horse power is a meaningless term as applied to guns, it is curious that the statistical journalist should hitherto have neglected the great opportunities it provides for the production of impressive values.

According to the paper *Commercial Intelligence* the "Inspector-General of Police in Turkey has issued a notice respecting the sale of arms, a translation of which, as follows, is furnished by the British Chamber of Commerce at Constantinople:—(1) The sale of arms being exclusively reserved to recognised gunsmiths, the sale of same by general shokpeepers is prohibited. (2) Shopkeepers unauthorised by the police to sell arms are called upon to transfer the same to gunsmiths before June 15, or to re-ship them to their destination. (3) Gunsmiths are authorised to sell arms to those provided with an official permit from the Government. They must in case of sale enter in a special register the number of the permit, the name of the buyer, and the place of his residence, the nature and number of the weapon sold, and enter the same remarks on the permit itself. (4) Permits of sale are delivered by the direction of police, and the Mutessarifats of Pera and Scutari, on presentation of a permit to carry arms delivered by the competent department. (5) At the expiration of the above-mentioned delay, the arms which are found in the shops of other than gunsmiths will be seized, and the tradesmen will be indicted before the Court Martial for not conforming to the law and regulations of the Government."

A company has been registered under the title of the International Automatic Arms Syndicate Ld. with a capital of £5,000.

A company has been formed for the working of the Maxim report silencer under licence from the Maxim Silent Firearms Company of New Jersey, U.S.A., and was registered on the 18th ult. The first directors are Hiram Percy Maxim, A. C. T. Veasey, A. J. Davey, and R. J. West.

Major Cooper-Key has issued his report on the explosion at the Chilworth Co.'s black powder factory at Fernilee in Derbyshire, which occurred on 12th August last, the locale of the accident being the corning house there are no special facts to record, and the usual explanation of foreign matter getting into the rolls has had, perforce, to be adopted.

According to the *Chemiker-Zeitung* "The total value of explosives imported into Chili was, in 1907 £306,100 and in 1908, £157,000. In the former year there were 1178·5 tons of dynamite imported of a value of £137,100 and in 1908, 698·5 tons of a value of £80,650. The dynamite is chiefly of German origin. Local manufacture meets the requirements for Gunpowder.

The death is announced of Mr. William Crockart, head of the well-known firm of James Crockart & Son of Blairgowrie. The name should not be confused with that of the other firm, D. Crockart & Co. of Sterling. The deceased was 64 years of age, and had been in poor health for some time past. He was all his life a popular sportsman, and he leaves a widow and two sons, both in the business.

The tables for use with *The Text Book of Gunnery* are purchaseable from the Government booksellers at the price of four shillings per copy. The book is bound in limp covers measuring 10¾ ins. by 7¼ ins. The tables have been greatly extended in range, both as regards velocity and distance. It has presumably been overlooked that the *Text Book of Gunnery* last published was issued as Part I, to which these tables were to rank as Part II.

Two penny booklets, comprising Nos. 1 and 2 of the Trigger Series, have been received from the publishing offices of the *Rifleshot*. No. 1 is entitled *The Book of the Martini*, and deals with the ·22 converted rifle as used by rifle clubs. *What's What in Rifle Shooting* by Wirt Gerrare, editor of the *Rifleshot*: No. 2 in the same series, comprises an alphabetical list of words and technical terms to which brief but suggestive definitions are applied. There are 32 pages, and about half-a-dozen words are dealt with per page, so that the sum total of information afforded is considerable.

The report and balance sheet of the Birmingham Small Arms Co. Ld., though received in September last, came to hand too late for inclusion in the last issue of this paper After making due allowance for depreciation the available profit on the year ended the 31st July last is £84,087. Interim dividends were paid on the 1st April last, and the further final appropriations recommended in the report and sanctioned at the meeting of shareholders, make a total distribution of five per cent. on the preference shares, and ten per cent. on the ordinary shares. A sum of £61,344 is thereby absorbed, so that the carry forward is increased from £22,860 to £45,603. Sir Hallewell Rogers,presiding at the annual meeting held on the 6th ult., made a very interesting statement regarding the position of the Company and its general prospects. He explained various items in the balance sheet and referred to the transference of the £30,000, the amount of the internal reserve fund, to the general reserve, making it £130,000. On the subject of the diminution of profits compared with the previous twelve months he explained that it was the policy of the directors rather to consolidate the interests of the Company with a view to the greater security of the capital than to aim at the immediate payment of large dividends.

From the B.S.A. Company a leaflet has been received announcing the issue of a sporting pattern of the Lee-Enfield chambered and rifled for the 8 millimetre cartridge, the decimal bore of which is ·315 inch. The idea underlying the adoption of this calibre is to supply a rifle lying outside the restrictions of the Indian Arms Act.

The London Armoury Company have received delivery of samples of the Winchester ·22 single-shot musket, which have been made so that the barrel and fore-end can be taken apart from the action by releasing a thumb-catch, and giving a half-turn to the barrel. At the same time the lever must obviously be opened, so as to free the extractor from its seating in the barrel face. This extra convenience has been effected by the well-tried device of interrupting the barrel thread, so providing the conditions of a bayonet joint with a large amount of surface to resist wear. For the future, purchasers will have the option of buying the Company's single-shot rifles in the take-down form.

THE MYSTERY (?) OF METALLIC FOULING.

SIR,—Your American contemporary, *Arms and the Man*, in its September issue, published a leading article under the heading "The Mystery of Metallic Fouling." Since you have given this subject considerable attention in your own pages for several years past, the article in question came to me as somewhat of a surprise, and I can only conclude, that in at least this one point connected with shooting and rifle matters, the Americans are only beginning to discover what ha been well-known in this country for several years past.

Since Captain Hardcastle and Prof. Hodgkinson carried out their experiments as to the nature of metallic fouling, its effect on erosion and its removal, some five years ago, much has been added to our knowledge of the subject and considerable advances have been made in the chemical methods for its removal.

The American article is chiefly taken up by the tabulation of figures. Figures are extremely valuable and absolutely essential to the scientific examination of a subject such as this, but they are only means to an end, and apart from the conclusions to be drawn from their study, of no interest whatever. If we leave them out of the article in question there is not much left, for the conclusions are more or less obvious, and certainly not new to those who have made this subject a special study. To call the article in question the most important that has ever been published on the subject of metallic fouling does injustice to the pioneers and workers in this field in in England. I would ask one or two questions on the subject for the consideration of the authorities at Frankford Arsenal from whence the article in question originates.

Is it not more rational in drawing conclusions on the subject of fouling, to place the prime cause to temperature rather than to velocity? More metallic fouling will be produced on firing 100 rounds of ammunition, M.V. 2,000 f.s., as rapidly as possible from the magazine than on firing 100 rounds of an ammunition of higher M.V. at intervals of five minutes between each round, so as to allow of the barrel cooling off and being maintained at one temperature.

Is K. N. S. known in America? If not, what solution is used for cleaning the barrels in all these fouling experiments, for until some such solution were known, experiments such as described were impossible.

The mystery has been SOLVED by Englishmen, and the metallic fouling has been DISSOLVED by Englishmen. The Americans are quite welcome to what is left of the heading of their article.

L. BARTON

EXTRACTS FROM THE U.S. ORDNANCE REPORT FOR 1908

United States Magazine Rifle, model of 1903.—The entire army has been supplied with the rifle, chambered for model of 1906 ammunition. This rifle has proved to be more powerful, accurate and rapid than the rifle of the Krag-Jorgensen type which it replaced. The regular army and the national guard have now the same weapon. It was at one time doubtful whether a sufficient number of these rifles could be prepared for the entire army and the national guard in time for use during the last target-practice season.

Telescopic sight for the musket.—A sight has been obtained for the use of expert riflemen, and each will be adjusted to a particular rifle and marked with the number of the rifle.

Gallery practice rifle, calibre ·22.—The gallery practice rifle, model of 1903, mentioned in my last report, has been supplied to all regular troops, and a number also to the militia and institutions of learning.

Automatic pistols.—The Colt's automatic pistols mentioned in my report of last year have been completed and issued to the service and School Musketry for trial and report. Two hundred Savage automatic pistols are now being procured and will be issued for experimental tests in a short time. Two of the Colt's automatic pistols, fitted with Powell cartridge indicators, have been issued to the cavalry board for experimental test. This device is to indicate the number of cartridges remaining at any time in the magazine.

Metallic fouling.—Complaints have been received from the service of metallic fouling in the barrels of the model of 1903 rifles, resulting from the use of the model of 1906 ammunition. Several experimental solutions have been tried to remove this deposit of cupro-nickel. Further experiments are being made with bullets coated with graphite, and with the barrels of the rifles lapped with rotten stone and oil to remove all rough surfaces. Experiments are also being conducted at the School of Musketry with reference to furnishing the service an allowance of some solution and oil to be used by the troops in cleaning rifles, including the removal of metallic fouling. The department has never been able to secure any positive evidence of bad results from metallic fouling in actual firing.

New Ammunition.—When the excellent qualities of the new ammunition became apparent to the department a rather important decision had to be made in regard to it; this was, whether the ammunition should be definitely adopted and the manufacturing facilities of the department be turned over to its production, abandoning that of the previous model, or whether the ammunition should first be given something of a trial in service. The confidence of the department in the new ammunition was such that the first method was followed, with the result that all of the manufacture of ammunition since the time when the department became satisfied as to the excellence of the new model is of that model, and no time nor money has been wasted.

Automatic machine gun, calibre ·30.—The reports received from Maxim automatic machine guns, calibre ·30, model of 1904, during the year have been generally satisfactory. Additional guns and tripods have been completed and a number are under manufacture. A test of a much lighter gun of the same general design will be conducted within the next few months to determine its suitabliity for adoption. Barrels chambered for model of 1906 ammunition have been ordered and will be issued before the next target-practice season. When this is accomplished, the model of 1903 ammunition becomes obsolete; consequently the number of rounds authorised for expenditure this season is practically limited only by the accuracy life of the old barrels. All Colt and Gatling guns have been called in for rechambering. The coast artillery will be supplied with these types, and the Maxims with part of the Colts will be issued for the mobile army. Requisitions from the organised militia will be filled by the issue of Maxims.

Guns and Mortars.—As stated in my report for the year ended June 30, 1906, the 14-inch gun has been adopted for future construction in place of the 12-inch gun of the model of 1900 for the defence of wide channels and harbours where the highest power is required. In the design of the 14-inch gun the question has arisen as to which of the two methods of construction (concentric cylinders or wire wound) is the more advantageous from the standpoint of accuracy life of the gun, the use of a relatively large or of a relatively small powder chamber and propelling charge. Under the former set of conditions the maximum pressure corresponding to the prescribed muzzle velocity will be appreciably less than under the latter conditions; but the powder charge will be correspondingly greater, and experience has indicated that erosion is affected not only by the maximum pressure of the powder gases, but also by the weight of the propelling charge in guns of the same calibre.

Erosion.—In my annual reports for the three preceding years I have referred to the problem of erosion, to its effect on the accuracy life of cannon, and to some of the remedial measures to be adopted to counteract its influence. While the experience of the past year has added little to the sum total of our knowledge as to the actual causes which produce the phenomenon of erosion or wearing away of the bores of cannon, extensive tests with the ·30-calibre rifle have shown very clearly that it is three or four times as rapid with this rifle with a propelling charge of nitroglycerine powder as with a propelling charge of nitrocellulose powder, notwithstanding the fact that the weight of the charge of the nitroglycerine powder is less than that of the nitrocellulose powder, while the maximum pressures are nearly the same in both cases. The temperature of combustion of nitroglycerine powder is in the neighbourhood of 3,200° centigrade, while that of nitrocellulose powder is about 2,500° centigrade. The above facts would indicate that erosion is very closely connected with the temperature of the gases of the propelling charge, and it is very probable that were it practicable to so modify the composition of our smokeless powders as to reduce materially the temperature of combustion, erosion would be a much less serious factor than at present. So far as known no practicable method of appreciably reducing the temperature of combustion of nitrocellulose powder has as yet been developed, although experiments having this object in view are receiving serious consideration by powder manufacturers both in this country and abroad.

Powder.—The most marked advance during the past year has been in the smokeless powder for small-arms ammunition. Early in the year, with the co-operation of the powder manufacturers, a series of experiments were conducted, having for their object the improvement in the ballistic and non-erosive qualities of the powder for small-arms ammunition, either by changes in the dimensions of the grain or by a change in the composition, or both. Satisfactory results obtained permitted the adoption of the present high-service muzzle velocity for the calibre ·30 musket. The improvements in this powder have continued, and that now used is similar in composition to the smokeless powder for cannon, and by its adoption the life of the musket as measured by the number of rounds that can be fired with accuracy, is, under the same ballistic conditions, three of four times as great as with the nitroglycerine powder formerly used.

ABEL ON THE ACTION OF LIGHT AND HEAT UPON GUNCOTTON (1867).

By George W. MacDonald, M.Sc., F.C.S.

The want of uniformity in power to resist the destructive action of light, exhibited by different specimens of guncotton with which chemists have experimented, has been additionally exemplified by the behaviour of numerous specimens of guncotton which have from time to time come into my hands or were prepared by me, previous to 1862. I will limit my notice of such specimens to two examples.

In the autumn of 1846 a small quantity (one or two pounds) of guncotton was prepared by me at the Royal College of Chemistry according to directions which had been made public in Germany a short time previously. The product, which was insoluble in mixtures of ether and alcohol, was obtained by immersing carded and purified cotton-wool of very high quality for a few minutes in the prescribed mixture of nitric and sulphuric acids, afterwards exposing it for several hours to a current of water, then digesting it in a cold dilute solution of potassium carbonate, and finally washing it in pure water. The larger proportion of the product was gradually expended in lecture-experiments, but a specimen has been preserved by me up to the present time. For sixteen years it was simply enveloped in paper and kept in a drawer much used; at the expiration of that period, when it was found to be perfectly unchanged, not exhibiting the slightest acidity or odour, it was transferred to a stoppered bottle, in which it has been since exposed to diffused daylight for four years. This specimen still remains perfectly unchanged.

Messrs. Hall of Faversham had the goodness, about three and a half years ago, to disinter at my request a sample of a large quantity of guncotton manufactured by them in 1847, and which they buried upon the occurrence of the disastrous explosion at their works in that year.

This sample was much discoloured when received, but the fibre was strong, and the material did not appear to have undergone any change. Its explosive properties were, however, considerably inferior to those of guncotton prepared according to Schönbein's or Von Lenk's directions; and, upon analysis, it furnished results corresponding very nearly with those required by the formula $C_{18}H_{23}O_{15}7NO_2$, or collodion guncotton, of which the composition was determined by Hadow. It was, moreover, readily soluble in a mixture of ether and alcohol, and furnished a good collodion-film. It is most probable, therefore, that a deficiency in the strength of acids employed in its production had led to the manufacture, in this instance, of soluble and less explosive guncotton by Messrs, Hall. A specimen of this material, after having been very carefully washed, was dried and enclosed by me in a stoppered bottle, in which it has remained exposed to diffused daylight for upwards of three years. A piece of litmus paper, enclosed with the guncotton, exhibited faint signs of reddening within three months after the first exposure, and within twelve months it was bleached. At this time the guncotton possessed a faint but decided cyanic odour; no nitrous vapours were perceptible within the bottle, either then or at any more recent period up to the present time, though the odour of the guncotton has now become more pronounced, and is indicative of nitrous acid. The substance has at present a marked acid reaction; it has not as yet altered either in explosiveness, strength of fibre, or other properties, but the odour and slight development of acid are undoubted indications that the material which for sixteen years was preserved in a moist condition in the dark without any apparent change, has during three years exposure to light furnished slight indications of a spontaneous change. It was a specimen of guncotton prepared by Messrs. Hall in 1847, and preserved by Percy since that year in a stoppered bottle, exposed to light, which had gradually become converted into a light brown semi-fluid gum-like mass, described by Hofmann as having exhibited all the properties of ordinary gum, and as being interspersed with crystals of oxalic acid. It is therefore not improbable that the specimen of Messrs. Hall's manufacture, above referred to, may, by long continued exposure to light, eventually furnish more important indications of spontaneous change than have hitherto been developed in it. There can be little doubt that the quality of the cotton operated upon by Messrs. Hall in the production of the specimens above referred to (and certainly in the instance of that examined by me), was considerably inferior to that of the material employed by me in 1846, and the character of the guncotton produced demonstrates that the conditions essential to the production of the most explosive material were not fulfilled by the method of manufacture pursued by those gentlemen in 1847. It is equally certain that the great importance of as complete a purification as possible of the cotton employed and of the product obtained was not fully recognized at that period, and that consequently, although a small laboratory operation carefully conducted according to the prescribed directions might furnish a pure product of great stability, the operations of manufacture had not been established with the precision essential to the attainment of satisfactory results.

The following are the results obtained up to the present time by exposure to light, under various circumstances, of guncotton prepared and purified according to Von Lenk's directions. Exposure to strong daylight and to sunlight, either in the open air or in confined spaces for a few days (two or four), develops in the guncotton a very faint aromatic odour; and if litmus-paper be allowed to remain in close contact with the confined material, it acquires a rose-coloured tinge similar to that produced by carbonic acid, and recovers its original colour after brief exposure to air. If, after exposure to light in open air for some days, the guncotton be placed in the dark, in cases which are not air-tight, the odour becomes gradually fainter, and the effect upon the litmus-paper slighter; if the packages containing the guncotton are air-tight, the odour and action upon litmus do not increase during storage for several years (the actual experience gained at Woolwich extends over nearly four years).

If the guncotton be exposed for protracted periods to daylight with free access of air, it speedily loses all odour and power of affecting litmus. If exposure to diffused daylight in confined spaces be continued, the first results of the action of light are, of course, retained; but up to the present time no single indication of their increase has been observed; indeed, the very faint acid reaction described, which was developed at first, has frequently disappeared, probably in consequence of the neutralising action of small quantities of earthy carbonates contained in the guncotton. But if the material be exposed continuously in a perfectly confined space to the action of sunlight or strong daylight, it furnishes, after a time, much greater evidence of change than that already described. The acidity gradually becomes more manifest; the odour increases, and becomes in time somewhat pungent and indicative of the presence of very small quantities of nitrous acid; and litmus-paper, if confined in the vessel with the guncotton thus exposed, becomes entirely bleached after two or three months. Although specimens of guncotton always undergo some spontaneous change under these very special circumstances, the decomposition proceeds with extreme slowness; and the results of the observations instituted by me, are therefore, in this respect quite at variance with those recently published by De Luca, who states that the specimens operated upon by him decomposed upon exposure to sunlight, some on the first day of the experiment, others after several days' exposure.

Experiments showed that (1) Guncotton in an ordinarily dry condition undergoes very slow change indeed when freely exposed in closed vessels (either containing air or with air excluded) to strong daylight and to the light and heat of the sun, the effects upon the material, during upwards of three years exposure, being to diminish its explosiveness somewhat by the reduction of a portion of the trinitrocellulose to lower cellulose-products. The material, when purified by washing in alkaline water after this very severe exposure to light, is still guncotton possessing useful explosive properties, and exhibiting no greater tendency to change than the original material. (2) If the space in which the guncotton is enclosed be kept saturated with aqueous vapour, the substance undergoes decidedly more rapid and considerable change, though, even under these circumstances, guncotton prepared according to the system now in use is much less rapidly decomposed by severe exposure to light than has been the case with specimens of guncotton previously experimented upon. Samples of guncotton which had been submitted to a less perfect purification than usual, afforded indications of being somewhat more rapidly affected by prolonged exposure to strong daylight and sunlight.

Experiments which proved that the preservation of guncotton in an atmosphere saturated with moisture rendered it somewhat more prone to alteration by long-continued exposure to light, have been confirmed by other experiments still in progress, in which known quantities of moist and wet guncotton are exposed to light in confined spaces, in comparison with dry guncotton. Thus, in one of these experiments, perfectly dry guncotton and guncotton in a damp condition have been enclosed in large stoppered bottles and exposed side by side to strong daylight and sunlight. After the lapse of two (summer) months they were carefully dried and their weights determined. The sample which had been exposed saturated with water to light had lost 0·33 per cent.; the weight of the dry sample indicated a loss of only 0·02 per cent. They were then again exposed in the wet and dry condition for four months; the total loss in weight of the sample exposed in a wet condition was then found to amount to 0·6 per cent.; that of the dry sample only to 0·14 per cent. (after six months' exposure). A trifling oxidation at the expense of oxygen in the water, established by the agency of sunlight, is doubtless the cause of the slight but decided influence which, under these circumstances, water has been observed to exert upon the permanence of guncotton; an influence which is quite opposed to that exerted by the presence of water in guncotton stored in the dark, or exposed to high temperatures, as will be presently demonstrated. The statement made by De Luca that when once decomposition has been established in guncotton, resulting in the development of nitrous acid, the progress of the change cannot be arrested, is not borne out by the results of numerous observations made by me. Many specimens of guncotton which, by exposure to high temperatures (100° and 90°C.) or by very long-continued exposure to lower temperatures (50° to 65°C.) have suffered considerable change, resulting in the development of nitric peroxide and of other products. These samples have been afterwards preserved in glass bottles, both tightly closed and partially open, and freely exposed to light for periods ranging from one to three years, without undergoing additional change. In a few exceptional instances, further decomposition has after a time been established by the influence of light; but in those the guncotton was impregnated to a considerable extent with free (nitric) acid. Such specimens, in case they were then thoroughly washed, a slightly alkaline solution being employed in their first purification, have afterwards not been found, up to the present time, to exhibit any greater tendency to decomposition, by exposure to light, than the original guncotton.

Effects of Heat upon Guncotton.

The behaviour of guncotton under exposure even to comparatively high temperatures is subject to very considerable modifications, which may be in great measure determined by the conditions of treatment. Illustrations of this were obtained at an early period of these investigations, in experiments instituted with the view to ascertain the average temperature at which guncotton explodes.

Exploding-point of guncotton.—The apparatus employed in the experiments on this subject consisted of a small air-bath fitted with a thermometer and closed with a mica plate, having a little circular opening in the centre, through which the guncotton might be introduced, and which was kept closed when not in use. The mode of operating was modified in various ways. In the first instance the guncotton was combed out into a very loose condition, and allowed to rest upon metal in the air-bath. The tempera-

ture of the latter was then raised very gradually from 15°C. to 204°, or 205°C. When the time occupied in the passage to the maximum temperature was two hours and upwards, the guncotton did not explode at all (in six experiments), but gradually became dark brown, quite friable, and deprived of all explosive properties. When a considerably shorter time (about one hour) was occupied in the attainment of the maximum temperature, the guncotton exploded on one or two occasions, but not until its temperature had reached 205°C. In the next experiments, the guncotton was employed in very small compact masses, and, resting upon a wooden support, was exposed to a continuously increasing temperature. The passage from 15°C. to the exploding-point ranged in these experiments from forty-five minutes to two hours. The results obtained varied between 136°C. and 138·5°C.

Another series of experiments was instituted for ascertaining in what particular mechanical condition the guncotton exploded most readily and at most uniform temperatures; and ultimately the material was employed in the form of pieces of loosely twisted strand about 20 mm. long, and its exploding-point was determined by first raising the atmosphere of the air-bath to 105°C., then allowing the specimen to fall upon a diaphragm of wire gauze in the air-bath, at once increasing the temperature as rapidly as possible, and carefully reading the thermometer until the explosion occurred.

The result of eight observations varied between 147°C.—151·5°C. These last experiments, which appear the most trustworthy, indicate that the average temperature at which the guncotton explodes when in a condition most favourable to its rapid heating, is about 150°C. In two observations, in which the guncotton was in a very open condition, the temperature being raised more rapidly than usual, the explosions occurred when the thermometer indicated 145° and 143·5°C.; and in the experiments preceding these, which were differently conducted, compact guncotton being exposed to heat for a considerable time, the point of ignition ranged between 136° and 138·5°C.

Schrotter, Redtenbacher, and Schneider, in their report upon Von Lenk's guncotton, mention that 136°C. is the *lowest* temperature fixed by Von Edner at which this material explodes.

APPLICATIONS FOR PATENTS.

SEPTEMBER 20—OCTOBER 16, 1909.

21,522. Projectiles. G. A. Poole.
21,576. Rifle Shooting Apparatus. H. M. N. Milton.
21,614. Windgauge Sight. H. R. Hart.
21,636. Breech Loading Small Arms. P. T. Godsal.
21,650.* Firearms. F. Hartmann.
21,708.* Assembling Barrels of Sporting Guns. A. Delchef.
21,941. Bullets. C. Bauer.
22,027.* Trigger Mechanism. P. Mauser.
22,085. Rifles. T. R. R. Ashton.
22,095. Safety Explosive. E. W. Steele.
22,103. Safety Guns. O. E. Scott.
22,115. Ordnance Elevating Gear. A. T. Dawson and G. T. Buckham.
22,132. Sighting Devices. A. T. Dawson, A Calichiopulo and J. T. Peddie.
22,196.* Ordnance. W. D. Smith.
22,419. Carbide of Calcium Cartridges. A. Barnett.
22,463.* Firearms. E. H. Searle and W. D. Condit.
22,490.* Automatic Firearms. F. Castle.
22,619. Sight Attachments. Birmingham Small Arms Co. Ld., and G. Norman.
22,919. Ordance Sighting Apparatus. F. Wigley, R. Redpath and T. A. Petrie.
23,048. Firearm Barrels. L. B. Taylor.
23,095.* Automatic Firearms. R. Frommer.
23,099. Firearms. H. W. Gabbett-Fairfax.
23,288. Percussion Fuses. J. R. Hoyle and H. B. Strange.
23,296.* Projectiles. Fried Krupp.
23,302.* Electric Time Fuses. J. Gillies and C. D. McPhee.
23,373. Directing Gun Fire. P. W. Gray and T. Cooke & Sons, Ld.
23,374. Directing Gun Fire. P. W. Gray and T. Cooke & Sons, Ld.
23,508. Ordnance. E. C. Kingsford.
23,519. Ordnance Loading Gear. C. Holmstrom and R. Redpath.
23,535. Automatic Firearms. A. L. Chevallier.
23,540. Automatic Gun. J. Cymbalist.
23,564. Automatic Small Arms. W. J. Whiting.
23,596. Target Apparatus. J. Dean.
23,648.* Shooting Device. H. W. Lake.
23,768.* Telemeters. V. Colzi and F. Bardelli.

*These applications were accompanied by complete specifications

SPECIFICATIONS PUBLISHED.

SEPT. 30—OCT. 21, 1909.

COMPILED BY HENRY TARRANT.

12,953 (1908). **Sighting Device for Q.-F. Field Guns.** Capt. P. Gargalidis, Greece, and G. Condeas, Paris. A number of plates, similar in form but of different sizes are arranged so that they may be given lateral and rotary movements. The plates correspond with different strengths and directions of wind and are used to set the sights automatically to compensate the divergence due to this extraneous influence. Attention is drawn to patent No. 3,029, 1904. No claim is made to the sighting devices described therein. Accepted Sept. 17, 1909.

15,917 (1908). **Driving Bands of Projectiles.** S. O. Cowper Coles, London. A method of electrolytically depositing copper driving bands on projectiles form the subject of this patent. The projectile is first cleaned with acid and the parts other than those which receive the bands are insulated. The projectile is then placed in an electro zincing bath such as is dealt with in patent No. 22,203, 1893 and 2,999, 1895. A coating of zinc is deposited. After this it is transferred to an alkaline copper depositing bath (consisting for example of double cyanide of potassium and copper) and eventually to an acid copper depositing bath (Patent No. 6,963, 1907) where a sufficient thickness of copper is collected. The projectile is then heated above zinc melting point to secure perfect adhesion of the copper band. This process it is claimed has many advantages. It saves copper, crude copper can be used, and all the mechanical operations involved in fitting a copper band by the ordinary machine shop methods are saved. Accepted Sept. 27, 1909.

18,530 (1908). **Elevating and Sighting Apparatus for Field Guns.** Vickers, Sons and Maxim, Ld., and G. T. Buckham, London. The apparatus described in a previous patent No. 2,558 of 1907 is improved. The ranging screw is so situated that it does not extend through the pointing screw. No part of the gear projects below the casing at any time during its operation. This gear is employed with gun mountings in which no traversing bar is employed. Accepted Sept. 3, 1909.

18,737 (1908). **Barrel Recoil Ordnance.** Rheinische Metallwaaren und Mf., Germany. This patent deals wih ordnance the barrel of which recoils along the straight path of a guiding member but which oscillates round the axis of the wheels on which it is mounted. The patentees

arrange that this oscillation shall be entirely automatic both during recoil and return no matter what the elevation of the gun may be. A barrel recoiling through approximately the same distance for all elevations is brought to the same final position. Accepted Sept. 7, 1909.

18,849 (1908). **Machine Guns.** A. J. Boult, London (Agent for *F. I. A. T., Italy*). An improved loading system for automatic guns is described. A number of cartridge feed boxes are arranged side by side to slide transversely with the bore. As each box is emptied it is automatically released and pushed on to make room for the next. Accepted Sept. 8, 1909.

18,934 (1908). **Target Apparatus for Miniature Ranges.** S. G. Cater, Launceston. Behind the fixed target a strip of secondary targets is arranged. When a shot is fired it passes through the target, releases a pawl and allows the frame carrying the secondary target slip to fall so that a fresh target is presented behind the main fixed target. A record may then be kept of each individual shot. Accepted Sept. 9, 1909.

19,132 (1908). **Barrel Recoil Ordnance.** O. Imray, London, (Agent for *Rhienische Metallwaaren und Mf., Germany*). In recoil apparatus of the kind described in patent No. 18,737, 1908, improvements have been effected. Before the oscillation of the barrel occurs the recoil disengages the oscillating system from the elevating mechanism, and arrangements are made to facilitate loading, no matter whether the gun is worked with or without the diverted recoil. Accepted Sept. 13, 1909.

19,537 (1908). **Lee-Enfield Rifle Action.** J. Hylard, Australia. Instead of the ordinary ejector screw of the L.E. action a pivoted ejector arm, spring-controlled, is introduced. The inner blade of this works in a slot in the bolt head and ejects the spent cartridge. A new form locking bolt is described as is also a modified shape for the slot which holds the cartridge clip in the charger-loading bridge over the action. Accepted Sept. 17, 1909.

19,926 (1908). **Elevating and Loading Gear of Howitzers.** Lieut. A. T. Dawson, and G. T. Buckham, London. In gear of this description in which the slow or elevating movement is effected from one side of the gun and the quick or loading movement from the other, the shaft carrying the pinion that gears with the elevating rack is made hollow to receive a longitudinally displaceable rod adapted to disengage a locking device that normally retains the mechanism of the elevating gear in its operative connection with the shaft. Means for actuating the rods are described. Accepted Sept. 22, 1909.

20,372 (1908). **Automatic Pistol Mechanism.** J. J. Reifgraber, U.S.A. The mechanism of this pistol is automatically operated much in the usual way. The novel feature consists in so adapting it that the parts after recoiling remain in the rearward position until the butt is firmly grasped. Accepted Sept. 28, 1909.

20,568 (1908). **Automatic Rifle Mechanism.** P. Mauser, Germany. (This patent will be fully dealt with in the December issue of *Arms & Explosives*).

22,835 (1908). **Cartridge-making Machinery.** Nobel's Explosives Co. Ld., Glasgow, and H. D. Hodge, Waltham Abbey. The machinery described in this patent is designed for assembling the wads and liners into the tubes of cartridge cases. This work has usually been done by hand. The tubes are inserted in a wheel to which a step by step motion is imparted. A series of punches successively operate on the tubes in the assembling process mentioned. Accepted Sept. 30, 1909.

23,840 (1908). **Eradicating Erosion in Gun Barrels.** Capt. E. G. Wang, Norway. In front of the ordinary copper driving band of ordnance projectiles, or in a groove in the band itself, the patentee arranges a secondary band of soft material such as lead. This he intends shall completely seal the bore and so prevent the escape past the projectile of the metal cutting gas flames. Between the "tightening" and driving bands asbestos or other packing may be introduced. Accepted Sept. 9, 1909.

26,395 (1908). **Mountings for Rifle Sights.** L. R. Tippins, Mistley. (*See Selected Patents*).

957 (1909). **Automatic Ordnance.** E. C. R. Marks, London. (Agent for *The McClean Arms and Ordnance Co., U.S.A.*). To enable machine guns to be discharged at any rate between ordinary single fire and its highest speed of working under automatic influence the patentees provide a part which is applied to the trigger mechanism. This consists of a rotary member having cam-like projections which is adapted to be rotated by hand at practically any speed through a crank handle. The latter folds out of the way when not in use. Accepted Sept. 16, 1909.

1,664 (1909). **Automatic Pistol Magazine Catch.** W. J. Whiting, Birmingham. This new form of catch is adapted to be relatively disengaged to release the magazine by pressure on a push piece projecting from the grip near the bottom. A carrying swivel is conveniently attached to this catch. Accepted Sept. 30, 1909.

2,570 (1909). **Automatic Pistol Construction.** W. J. Whiting, Birmingham. (*See Selected Patents*).

4,946 (1909). **Barrel Recoil Ordnance.** K. Haussner, Germany. Difficulties have, says the patentee, been experienced with differential recoil guns through either having to return the barrel by hand before the first shot, or, if it is not returned, through the heavy strain the recoil of the first shot places on the gun as a whole. He, therefore, proposes to overcome these drawbacks by providing means for altering the accumulator tension without displacing the barrel. The accumulator is thus relieved when the gun is not being fired. Accepted Sept. 9, 1909.

4,978 (1909). **Incendiary-Shrapnel Shell.** Rheinische Metallwaaren, und Mf., Germany. A compartment containing a rocket charge is arranged in front of the shell and the shrapnel shots are also imbedded in an inflammable, but slowly burning material. The time fuse ignites the rocket charge and the flames issue through channels in the shell. They are adapted to ignite balloons or airships. When the shell bursts burning substance as well as shrapnell is distributed widely. Accepted Sept. 9, 1909.

5,310 (1909). **Time Fuse for Projectiles.** E. Schneider, France. In a time fuse a system of two yoked rings is adapted to work with a fixed ring. The displacement of the former relatively to the adjusting scale increases or decreases the duration of combustion. Flame from the primer can be transmitted from one yoked ring to the other only through the fixed ring lying between them. Accepted Sept. 30, 1909.

7 474 (1909). **Miniature Range Target Apparatus.** H. Smith, Brighton. The targets on this apparatus are connected through beams with pendulums. By means of the latter various movements may be imparted to the target. Accepted Sept. 16, 1909.

7,933 (1909). **Target Apparatus.** E. J. Solano, London. Target apparatus of the kind dealt with in patent No. 11,893, 1908, may by means of the present invention be easily adapted for use as a "thermometer" target, *i.e.* one at which a full power rifle is fired in a confined space. Figures at the bottom of the target are aimed at and the value of the shot which strikes more or less above them is determined by horizontal and vertical scales. Accepted Sept. 16, 1909.

11,252 (1909). **Tracing Projectile Flight.** J. B. Semple, U.S.A. The burning tracer material is situated in a cavity in the base of the shell and is fired by means of a pin and cap. These two are normally kept apart but are pressed into contact by the gases of propulsion. Accepted Sept. 23, 1909.

11,743 (1909). **Range Finders.** F. Ljunggren, Sweden. A horizontally mounted drum is provided with graduations made along a spiral which decreases in radius on its outside. A pointer is connected with the telescope and its end lies on the spiral which has to be turned to alter the inclination of the telescope. The distance of the object is indicated by the pointer. Accepted Sept. 9, 1909.

17,008 (1909). **Field Gun Sighting Gear.** Vickers, Sons and Maxim, Ld., and G. T. Buckham, London. Where a single screw is used to elevate the gun with or without the sighting apparatus, it is adapted by the patentees to be rotated without moving the sliding nut forming part of the sighting apparatus, or to be longitudinally displaced together with the sliding nut for the pointing operation. Accepted Sept. 3, 1909,

SELECTED PATENTS.

AUTOMATIC PISTOL CONSTRUCTION.

2,570 (1909). W. J. Whiting, Birmingham. In a former patent No. 15,982, 1905, this inventor described a " one-piece spring trigger guard " for automatic pistols. This device served the double purpose of holding the barrel and breech slide to the body and of cushioning or buffering the slide at the opposite ends of its reciprocatory movement. An improved construction is dealt with in the present patent. The fastening end of the guard is formed as a " pivotless fulcrum."

Fig. 2

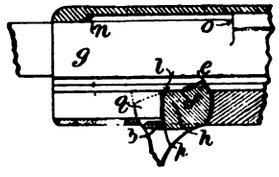


Fig. 3

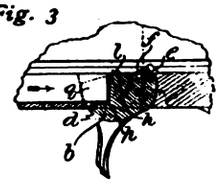


Fig. 1

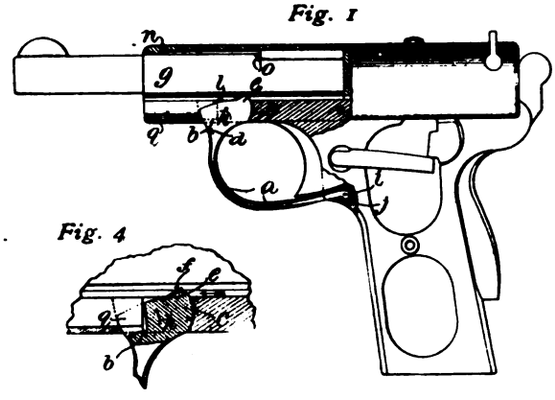


Fig. 4

The guard *a* is clearly shown in Fig. 1. What is called the fastening or locking end *b* has two surfaces *c* and *d* which are shaped to arcs struck from a common centre to the same radius. This end is adapted to work in an opening in the body whose opposite ends are shaped to follow these curved surfaces. The top of the end *b* is provided with the pointed projection *e* which stands up when the guard is in position into a correspondingly shaped transverse slot *f* in the underside of the barrel *g*. The projection *e* is formed to the rear of the point *h* from which the curved surfaces *c* and *d* are struck.

The other end *i* of the guard is sprung up and snapped into engagement with the seating *j* after the " pivotless fulcrum " *d* has been positioned in its slot in the body. An upward tension is thus imposed and this keeps the projection *e* firmly in engagement with the slot *f* in the barrel. The curved top *l* of the part *b* also sits against the bottom of the barrel under the influence of this pressure.

When the breech sleeve recoils after firing its stops *n* contact with the barrel shoulders *o* and tend to carry the barrel rearwards with it. A little play is allowed between the projection *e* and the slot *f* which permits of a slight rearward movement only of the barrel. The impact shocks are at the end of this slight movement taken up (through the inclined surfaces of the projection and slot) by the spring guard the end *b* of which yields a little (see Fig. 3) by dropping within its seating in opposition to the upward thrust mentioned before. When the return spring drives the breech slide forward again the other inclined surfaces of the projection *e* and slot *f* are brought into contact (Fig. 4) ready to cushion the impact of the slide against the breech face of the barrel.

The downwardly extending barrel rib *p* is brought into contact with the front face *q* of the guard at the end of the recoiling movement and the guard is thus prevented from making any angular movement which would tend to spring the end *i* out of the seating *j*. Accepted Sept. 9, 1909.

APERTURE SIGHT MOUNTING FOR L.E. RIFLES.

26,395 (1908). L. R. Tippins, Mistley. The rules of the National Rifle Association permit of the use of an aperture sight provided it is fixed to the Lee-Enfield rifle by means of the fixing pin and spring which in the ordinary way hold the aperture sight stem generally used in conjunction with the long range dial sight situated on the side of the rifle. The patentee has therefore, designed a sight mounting which works on the hinge pin of the side aperture stem, and is adapted to lie over the rear end of the action body of the rifle. The mounting is adapted to be turned up and lifted to permit of the complete withdrawal of the bolt from the action body. It carries a wind gauge sight of any suitable construction. It should be borne in mind that the various ingenious devices described in this and analagous patents have for object to overcome the disadvantages incidental to adapting an aperture sight to a rifle of which the bolt carries various lugs and projections. These would be dispensed with in the case of a rifle designed in the first instance for use with the class of sight under notice.

The mounting is illustrated in the drawings here reproduced. It consists of the bed-plate *a* shaped on its underside so that it seats itself in the normal position closely over the rear portion *b* of action body *c*. In this normal position (Fig. 1) it does not interfere with the proper manipulation of the bolt in the action of ejecting the spent cartridge and reloading the rifle. The forward end of the plate is fitted with the extension *d* which is arranged to engage beneath the charger guide bridge *e*. The base is secured to the rifle by means of the side limb *f* whose rearward end works on the pivot *g* which in the ordinary way forms the hinge pin for the side aperture stem belonging to the rifle.

Fig. 1

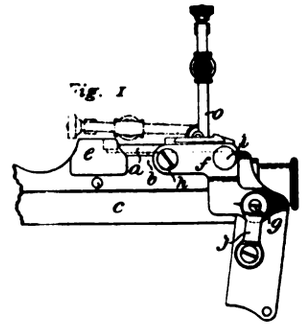


Fig. 2

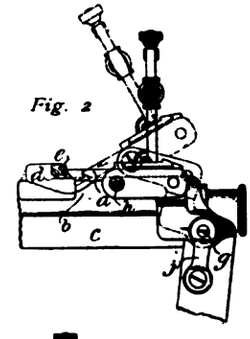
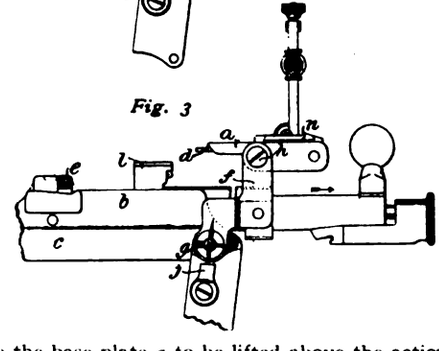


Fig. 3



To enable the base plate *a* to be lifted above the action body (to facilitate the complete withdrawal of the bolt from the rifle) it is hinged to the side limb on the pin *h*. In the ordinary way the limb *f* and the plate *a* are locked together by means of the detachable thumbscrew *i*. The complete mounting is held steady either in the normal or the lifted position by the usual side aperture stem spring *j*, ridges on the inside face of which engage with notches in the end of the limb *f*.

When it is necessary to lift the plate *a* to allow the bolt to be taken out of the rifle the thumbscrew *i* is first removed. The sight is then tilted forward slightly (see Fig. 2) to disengage the projection *d* from beneath the charger guide bridge, the limb *f* is turned up on the hinge pin *g* and the base is thus elevated a sufficient distance above the action body to provide clearance for the passage of the bolt head *l* (Fig. 3).

The bed *a* carries on its top a laterally adjustable windgauge slide *n* to which is hinged the leaf *o* of the sight proper. Accepted Sept. 23, 1909.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

The Bullseye Controversy.—One of the most pleasing aspects of the peace which has been officially proclaimed between the National Rifle Association and the War Office is that there is no longer an opening for the intervention of meddling busybodies. The War Office were badly advised on the general subject of the relation of target shooting to actual warfare. The fact that the one does not include the whole of the other led them up a side street which they followed a long way before discovering that it was a *cul de sac*. Distance judging, and the cultivation of eyesight in reference to the picking out of objects in a country landscape must not be confounded with rifle shooting, however important they may be as attributes to its successful practice. The fallacy in believing that skill in rifle shooting can be dispensed with because of its ineffectiveness when divorced from certain other studies was bound in time to be shown up. The need for rifle shooting remains as great as ever, and the War Office face has been saved by a promised amendment in the rules of the King's Prize competition. No harm can possibly be done by the addition of a new element in the premier shooting competition, so long as genuine skill can overcome the difficulties presented. The importance of eye training in connection with rifle shooting must never be mentioned unless accompanied by a protest against the continuance of a type of rifle and ammunition which render distance judging and the allied arts a much more vital consideration than would be the case if the British troops were armed with due regard to modern developments.

Ballistic Calculations.—Now that the new tables issued in connection with the *Text Book of Gunnery* are beginning to be appreciated and understood, the question is constantly asked whether the authorities were wise in making such far-reaching changes for so small a practical result. Briefly stated the old tables were based on certain laws and assumptions which, whether they were right or wrong, were quite effective for calculating all the required data concerning the flight of projectiles. The practical employment of the tables turned upon the previous fixing by experiment of the properties of the projectile to be dealt with. Having measured one result a constant, usually denoted by the letter "*n*" was evolved. It represented a kind of rubbish basket which contained all the unknown and incalculable factors connected with skin and other resistances incidental to the shape and general characteristics of the bullet. Thus each bullet had its own particular value of *n*, but a fairly good guess could be made in the case of most bullets diverging but slightly from any of the well-known types. Unfortunately, as a result of elaborate experiments and calculations which were primarily for the purpose of enlarging the scope of the old tables it was found that the law of air resistance could be more exactly stated than in the previous tables. The arguments for and against any change which upsets the accepted constants resulted in the alteration being made, and the consequence is that the whole of the calculations of trajectory, remaining velocity and so forth which have ever been made and to-day are of value for reference purposes require to be done over again. It does not follow that the results will be noticeably different, or even more accurate, but merely that the old constants must be abandoned now that the tables to which they apply have been withdrawn and others substituted in their place. The step having been taken, its consequences, however inconvenient, must be faced. Consequently, whilst deploring the disturbance which has been caused, it is necessary that

no time should be lost in ascertaining its full effect with a view to getting some idea where we stand as between the new tables and the old.

The New "Field" Editor.—The announcement that a new editor of *The Field* will take up his duties on the 1st of January next cannot fail to be of special interest to a trade so closely associated as gunmaking has always been with the premier sporting periodical. The association was extremely intimate in the days of Mr. Walsh, a man of extraordinary genius, who seemed equally at home in the most abstruse technicalities of half-a-dozen branches of sport. What he did to promote the better understanding of the science of guns and rifles is better known to many of our readers, who were in daily contact with him, than is possible in the case of the later generation who know him only by his writings. These were brilliant enough in all conscience to ensure for him a permanent position in the literature of gunnery at a time when some of its most interesting developments were taking place. His chief lieutenant in due time became his successor; but although Mr. Toms knew far more about guns than people were in the habit of crediting him with, he lacked the practical grasp which was one of Mr. Walsh's most useful mental characteristics. Mr. William Senior came to the paper ten years ago with a record of good service in the department of angling, such as fully justified his selection for a higher post. The problem created by his recent retirement has been solved by the appointment of Mr. T. A. Cook, a man whose previous career, both as a scholar and a sportsman, justifies the expectation that his administration will be a successful one. As author of the compendious volume which records the results of the great Olympic meeting of last year his claim to know something of all branches of sport rests upon a definite foundation. His other publications and his general accomplishments support the idea that the editorial work of *The Field* will be in safe hands, and that the best traditions of the past will be duly observed whilst striving to do equal justice to present-day requirements. Under Mr. Senior's guidance the columns of *The Field* have reflected his own high literary ideals. Articles have been kept within more compact dimensions than was previously the rule, and writers were encouraged to convey their information in a terse and not too profoundly scientific style. It is certain that his good work in this direction will live long after his connection with the paper has ceased.

A Cartridge Trade Development.—The announcement that the business of Messrs. F. Joyce and Co. Ld. will be transferred to Nobel's Explosives Co. Ld. as from the 1st of January next marks the disappearance of a name which has many interesting past associations. The early history of the modern percussion cap is closely interwoven with the career of Frederick Joyce, the founder of the firm which bears his name. Joyce caps and Joyce waddings were favourites with the early generations of sportsmen, and Joyce cartridges in due course took the position of standard articles. So long as twenty years ago it began to be evident that a very large capital was necessary to deal successfully with the problems of cartridge manufacture on modern lines. The large number of gun trade customers requiring a supply of named cases necessitated the locking up of considerable sums of money in stock, the liquidation of which was regulated by the quality of the game season and other more remote causes. The introduction of smokeless powders not only emphasised the strain, but introduced fresh problems which could only be dealt with by largely increasing the facilities for experimental and general research work. It is, therefore, not surprising that a private company with a modest capital should enter into an alliance with a concern which could develop as it deserved the old established connection which the firm of Joyce had created in the course of many years of successful trading. Nobel's name has by now become very widely known on account of the extensive use by sportsmen of their two powders Ballistite and Empire. It is not, therefore, surprising that so valuable a goodwill should for the future be joined on to the sister branch of cartridge manufacture. The fact that such a step has been delayed until the works had been re-equipped with an expensive outfit of the latest machinery and appliances, provides satisfactory evidence of an intention to maintain the quality of output at the Nobel standard. Developments of this kind can hardly do otherwise than re-act favourably on the trade most intimately concerned, and gunmakers may certainly feel every confidence in the stability and sense of responsibility of any company connected with the Nobel organisation. It is pleasing to note that Mr. Percy Newton will continue to direct the business with which he has been so long connected. Certainly as one of the most popular personalities in the ammunition trade, his many friends will be glad to know that the latest development implies more power to his elbow and enlarged opportunities for the execution of orders.

Lieutenant Dawson's Knighthood.—In an industrial community the Order of Knighthood receives additional lustre on every occasion when a man of Lieut. Dawson's high gifts is appointed thereto. No public or private servant can perform more meritorious work than the organisation and technical direction of labour. Sir Trevor Dawson is one of those men of all-round ability who are able to specialize in several departments of knowledge at one and the same time. Originally chosen for a private appointment because of his high technical qualifications in the construction of big guns for warships, he rapidly achieved fame as an administrator and organizer. The Vickers firm also found in him one with the ability to conduct the most delicate negotiations with foreign governments in connection with the supply of war munitions. The more interested he became in the larger schemes and undertakings of his business the more determined was he that his grasp of technical details should never relax. His career accordingly represents an example to all who aspire to eminence in the engineering profession. Rule number one is to acquire the highest technical qualifications; number two is to master business problems on the best principles of scientific discipline; number three is to hold tight to both acquirements once they have been gained.

THE NEW BALLISTIC TABLES.

UNDER the title "Tables for use with the *Text Book of Gunnery*" a new set of Ballistic Tables have been issued as a War Office publication. As mentioned in the previous issue they are intended to replace those which have hitherto been in use among English artillerists. The tables are seven in number, and with one exception are similar in appearance to those which have appeared in the *Text Book of Gunnery* for many years past. Table I. gives the value of K, C*r* and *p* for velocities from 100 f.s. to 4,000 f.s. It is interesting to note the extent to which this table is given, as indicating the high velocities which modern guns attain; the previous tables of K and *p* were not extended beyond 2,800 f.-s. Tables II. to V. are those of the Time, Space, Inclination and Altitude functions respectively, carried up to 4,000 f.s. Table VI. gives the values of the integral sec $\theta d\theta$. Table VIII. is the "a" or double-entry table, which was first introduced to the English text-books by Mr. Hadcock.

Table VIII. which is somewhat unwieldly in appearance, supersedes the tenuity table which has figured in previous text-books. It is compiled from Glaisher's *Hygrometrical Tables*, "and is useful for obtaining values of the co-efficient of tenuity for all readings of the wet and dry bulb." In the old table the reading of the wet bulb of the thermometer was ignored. It seems only right to say that the refinement introduced in the new table is perhaps more of academic interest than practical utility. However, it is a sign of advance, and shows that the effect of the "error of the day" in official experiments is to be reduced where possible.

It is forty-four years since the Rev. F. Bashforth began the experiments to determine the resistance of the air upon which the old ballistic tables are based. These old tables have served their purpose well, and they cannot be relegated to the dark corner of the bookshelf without thought of the unremitting labour and persistence which Mr. Bashforth spent upon the experiments to obtain the data with which they were constructed. But time has advanced and with it our knowledge of the science of ballistics, and it has been found necessary to carry out new experiments with more modern apparatus to investigate the air resistance.

The projectiles which Mr. Bashforth used had ogival heads of 1½ diameters; the present experiments were carried out with projectiles of 2-calibre head. It is not a matter of great consequence as to what shape of head the projectiles have which are used in experiments for the construction of ballistic tables, as it is only necessary to introduce a coefficient of shape of head into calculations with projectiles differing from the "standard" projectile to make the tables adaptable. It is, however, of interest to give a comparative table of the results of Bashforth's experiments of 1865–1870 and 1878–1879, and the experiments carried out by the Ordnance Committee in 1904–1906 the results of which we are now dealing with:

Table showing the resistance of the air in pounds (*p*) to a one-inch projectile, under standard conditions of shape, steadiness and air density

Velocity.	Bashforth ogive 1½-diams.	1904-6 Experiments ogive 2-diams.
f.c.	lbs.	lbs.
500	0·47	0·48
1,000	2·33	1·86
1,500	10·26	9·68
2,000	17·10	16·25
2,800	35·45	27·26
4,000	—	49·46

The Introduction to the new tables is very brief, and does not contain any explanation as to their use, except in the case of the hygrometrical table. (It is, of course, assumed that the user of the tables will also be in possession of the "Text Book of Gunnery," wherein examples on the use of the tables are given very fully). The laws of resistance of the air, from which Table I. is compiled, are here given in the form

$$Cr = Mv^n,$$

where C is the ballistic coefficient, *r* the retardation (in foot seconds) or resistance per unit of projectile's mass, and M the coefficient which qualifies the assumed law expressed by the index "*n*." The relation between C*r* and *p* is given by the equation $Cr = pg$.

It is to be seen that in two regions, that is, between 1,040 f.s. and 840 f.s. and between 1,460 f.s. and 1,190 f.s. the cubic law of resistance is adopted.

It has generally been assumed hitherto that the quadratic law held good for velocities lower than 800 f.s., but in the new laws pure quadratic law does not enter. For the region of velocity between 0 f.s. and 840 f.s. the law adopted is expressed as

$$Cr = (6{\cdot}8717017 - 10)v^{1.6}.$$

Here the figures within the brackets represent the logarithm of the coefficient M, a notation which Colonel J. M. Ingalls, the American ballistician is believed to have first employed for this purpose.

The American ballistic tables, which were computed by Colonel Ingalls, were based on the laws of resistance deduced by General Mayevski from a discussion of the Krupp firings carried out at Meppen in 1881. These laws are to be found in Colonel Ingall's *Handbook of Problems in Exterior Ballistics*. I have taken the trouble to compute values of C*r* from the American laws for comparison with the values given in Table I. There are differences in the values, but they are small enough to warrant the assertion that the tables of Ingalls are extremely good..

The volume of some 64 pages of tabular matter is very clearly printed, and is bound in limp cloth in a form which will prove of great convenience to those who have to make ballistic calculations. The published price is four shillings. The tables are printed lengthwise of the page, which is rather inconvenient, but makes the use of a larger type for the figures possible; the figures in the old tables were small and trying to the eyes to read. The double-entry table of "a" has of necessity to be printed on folded pages; it would have been well if the limits of velocity had been

indicated at the top right-hand corner of each page. The words "Ballistic Tables" might have been printed on the cover since the title which has been adopted is really only a subsidiary one.

As a matter of historical interest those who carried out the experiments might have been mentioned in the introduction. Though the names of the officers who worked under Professor (now Sir George) Greenhill, F.R.S., in the making of experiments, and in the reduction of the experimental results, also in determining certain new laws of resistance, are well known inside the Service, and amongst a few experts outside, it is not right that labours of so exacting a kind should have been dealt with anonymously.

FURTHER EXTRACTS FROM THE U.S. ORDNANCE REPORT.

One or two paragraphs of interest were held over from last month's selections from the American ordnance report. Four firms, for instance, are named as having received contracts for three million seven hundred and fifty thousand rounds of ·22 rifle ammunition, which most emphatically shows that, whilst many people supposed that the Americans had solved the problem of a practice cartridge to be fired from the service rifle, actually the views of the more sceptical ones have been justified by subsequent happenings. Upwards of two thousand gallery ·22 rifles have been made at Springfield Armoury and fourteen million rounds of ammunition have been purchased for firing from them. The further items are as follows :—

Subtarget gun machines and Hollifield recording target practice rifle rod outfits.—From an allotment made by the Board of Ordnance and Fortification 45 subtarget gun machines and 50 Hollifield recording target practice rifle rod outfits have been procured and issued to the service for trial and report. Bench reloading tools for reloading the service cartridges, calibre ·30, model of 1906, have been supplied to all camps and posts garrisoned by one or more companies. The allowance of ammunition for target practice being based on a monetary allowance for each man participating, by reloading cartridges the troops are enabled to expend about double the amount of ammunition.

Hand grenade.—Experiments during the past year resulted in the development of a satisfactory hand grenade for use in the attack or defence of fortified places when an enemy is close at hand and sheltered in trenches, pits, etc., in such a manner as to be beyond the reach of infantry fire. The hand grenade weighs about one pound and may be thrown by hand a distance of from 100 to 125 feet over an obstacle 50 or 60 feet high. This department is prepared to furnish hand grenades in any reasonable quantity whenever necessary. In the attack of fortified positions, when the besiegers, by trenches or other means, come close to the besieged, projectiles of the grenade class find their principal use, and their weight and design, and the most effective means of propelling them, are receiving consideration.

Colt's Patent Fire Arms Manufacturing Company.—This company has manufactured and delivered, to date, under sub-contracts with Messrs. Vickers, Sons and Maxim, Ld., 85 automatic machine guns, calibre ·30, model of 1904, and accessories. This company has also manufactured and delivered to the department during the year 200 Colt's automatic pistols, calibre ·45, and spare parts. *Union Metallic Cartridge Company.*—During the year contracts have been given for 3,750,000 gallery practice cartridges, calibre ·22, short, and for 100,000 pistol ball cartridges, calibre ·45, both of which have been completed. *Winchester Repeating Arms Company.*—This Company has manufactured and delivered during the year 350,000 rounds of ball cartridges, calibre ·30, model of 1898, and 3,750.000 rounds of gallery practice cartridges, calibre ·22 short. *United States Cartridge Company.*—This company delivered under contract of February 29, 1908, 3,750,000 gallery practice cartridges calibre ·22, short. *Peter's Cartridge Company.*—This Company completed a contract for 3,750,000 gallery practice cartridges, calibre ·22, short. The ammunition manufactured at the Company's works at King's Mills, Ohio, was presented for inspection before the expiration of the contract.

EXPLOSIVES REPORT FOR VICTORIA.

Mr. C. Napier Hake has issued his report on the working of the Explosives Act during last year. It seems that in the period reviewed there has been no modification of the law, and no accidents have happened in the manufacture, transport or storage of explosives. The following table gives the comparative imports for last year and 1907 :—

Name of Explosive.	1908.	1909.
Gelignite	752,550	948,900
Gelatine Dynamite	244,250	310,500
Blasting Gelatine	104,400	120,300
Cheddite	15,000	15,000
Rippite	10,000	6,400
Powder, Fuse	75,000	77,000
Powder, Blasting	202,125	155,000
Powder, Sporting	31,050	26,675
Total	1,434,375	1,659,775
	Total Number.	
Detonators	2,015,000	3,575,800

The net result is a diminution of £225,400. Mr. Hake mentions that the blasting gelatine imported from European ports was far from satisfactory, over ten per cent. of the total importations being condemned. This was partly on account of low stability, and partly owing to the exudation of nitroglycerine. With the exception of two small consignments, which were taken over in connection with submarine work, the whole of the condemned blasting gelatine was destroyed. The gelatine dynamite and gelignite imported during the year were of a very satisfactory nature, all the consignments being passed. Other routine matters are dealt with in the report.

THE GUN TRADE, 1850 to 1900.

(Continued).

ELECTRIC ARMS AND AMMUNITION SYNDICATE, LD., 35, Queen Victoria Street, 1892–4.
RICHARD ELLIS & SONS, 13, St. Mary's Row, Birmingham, 1897–8.
AMOS ELVINS, 41, Queen's Road, Bayswater, 1867.
JOHN EMME, 8, Carlisle Street, Soho, 1860; 25, Portland Street, Soho, and 6, Castle Court, Oxford Street, W., 1864–8; 29, Crown Street, Soho, 1872–5.
JAMES ERSKINE & Co., 27, Finsbury Pavement, E.C., 1869.
EUROPEAN FIREARMS Co., LD., 3, Copthall Chambers, 1865; EUROPEAN BREECH LOADING FIREARMS Co., LD., 43, Parliament Street, S.W., 1868.
EVANS REPEATING RIFLE Co., 16, Worship Street, E.C., 1878.
WILLIAM EVANS, 95a, Buckingham Palace Road, 1883–4; 4, Holden Terrace, Pimlico, 1885–7; 4, Pall Mall Place, 1888–95, ; 63, Pall Mall, 1896–1900.

JAMES FAIRMAN, 68, Jermyn Street, 1850–2; 23, Jermyn Street, 1853–68.
THOMAS WILLIAM FELSTEAD, 12, Haldon Street, Islington, 1854–5.
ALFRED FIELD & Co., 199a, Bishopsgate Street Without, E.C., 1892–3.
JOHN P. FIELD & Co., 14, Upper East Smithfield, E., 1862–6.
CHARLES FISHER, 8, Prince's Street, Soho, 1850–78; 16,, Wardour Street, S.W., 1879–81.
WILLIAM FISHER, 9, Belvedere Road, Lambeth, 1850–1; 9, Belvedere Crescent, 1854–67.
THOMAS FLETCHER, 42, Poultry, E.C., 1866–72.
MAX FLIEGENSCHMIDT, 44, Moorfields, 1887.
RICHARD FORD, 1, Lambeth Street, E., 1860–3, ; 2, Lambeth Street, Hooper Square, E., 1864–8.
ALEXANDER FORSYTH & Co., 8, Leicester Street, 1850–2.
ERN. FREDERICK FRANCK, 4, Cullum Street, E.C., 1879–80.
AUGUSTE FRANCOTTE, 110, Cannon Street, E.C., 1877–83; 19, Basinghall Street, 1884; 130, London Wall, 1885–8; 24, Great Winchester Street, 1889–93.
FRY, MARRIAN & WELLS, 3, Mincing Lane, E.C., 1900.
GEORGE FULLER, 30, Southampton Street, Strand, 1850–5; 280, Strand, 1856–71; 15, Wych Street, Strand, 1872–3; 6, Newcastle Street, Strand, 1874–7; 3, Waterloo Road, S.E., 1878–80.
NICHOLAS FURLONG, 26, Silver Street, Stepney, 1855–7.

ROBERT S. GARDEN, 200, Piccadilly, 1861–3; 29, Piccadilly, 1864–77; GARDEN & SON, 200, Piccadilly, 1878–1886; R. S. GARDEN, same address, 1887–91.
GIFFORD GUN & ORDNANCE Co., LD., Copthall House, Copthall Avenue, E.C., 1892–3.
CHARLES H. GILKS, 3, Union Row, Tower Hill, E., and 37, Minories, 1857; 3, Union Row, and 67, Minories, 1858–9; 3, Union Row, 67, Minories and 327, Wapping High Street, 1860–1863; GILKS, WILSON & Co., only at 3, Union Row, 1864–8; C. H. GILKS & Co., 3, Union Row, 1869–80.
JOHN GLAYSHER, 2, George Yard, Prince's Street, Soho, 1865–8; 12, Denmark Street, 1869–70.
C. GOEDECKE & Co., 5, Grocer's Hall Court, E.C., 1876–7.
SAMUEL F. GOFF., 15, New Street, Covent Garden, 1879; 17, 18, and 22, King Street, Covent Garden, 1884–8; SAMUEL F. GOFF & Co., 17, 18, and 22, King Street, and 32, Brompton Road, 1889.
WILLIAM GOLDING, 27a, Davies Street, Berkeley Square, 1850–3; 3, Mount Row, Berkeley Square, 1855–9.
FREDERICK GOWLING, 21, Eversholt Street, Oakley Square, N.W., 1873–5.
STEPHEN GRANT, 67a, St., James's Street, 1867–88; STEPHEN GRANT & SONS, 1889–1900.
WILLIAM GRANVILLE, 44, Holborn Hill, 1857.
SAMUEL GRAY, 10, Marshall Street,Golden Square, 1851.
ABRAM GREEN, 198, Whitechapel Road, E., 1859–60.
WILLIAM GREEN, 4 and 6, Leicester Square, 1850–5.
WILLIAM GREEN, 138, New Bond Street, 1861–4.
WILLIAM CHARLES GREEN, 91, Wardour Street, 1870.
WILLIAM C. GREEN, 14, Coburn Road, E., 1883–5.
WILLIAM GREENER (Daniel B. Harvey, Agent), 42, Ely Place, Holborn, 1856–8; WILLIAM W. GREENER, 68, Haymarket, S.W., 1878–1900.
GRENFELL & ACCLES, LD., 7, Great St. Helen's, E.C., 1892.
HARSTON C. GREVILLE & Co., 24, Cullum Street, E.C., 1874; 12, Queen Victoria Street, E.C., 1875.
WILLIAM GREY, 41, Old Bond Street, 1858–63; 43, Old Bond Street, 1864–1872.
GRIESSELLICH, NEBEL & Co., 59, Basinghall Street, 1869–70; HENRY GRIESSELLICH & Co., 1871–6.
THOMAS GRIMSHAW, 6, Dorrington Street, Clerkenwell, 1850–6.
GRIMWADE & Co., 54, Queen Victoria Street, 1880.
RICHARD GROOM, 10, Wellington Row, Stepney, 1858.
GUNMAKERS' ASSOCIATION, 1, Arundel Street, 1897.
HENRY GURNEY, 12a, Gloucester Street, Commercial Road, E., 1854–5; JOHN HENRY GURNEY, 1, Red Lion Street, Holborn, 1864–5.
GYE & MONCRIEFF, 60, St. James's Street, 1876–85; 44, Dover Street, W., 1886–7.

EDWIN & GEORGE HACKETT, 37, Gracechurch Street, 1876–8.
W. J. HANCOCK & Co., 308, High Holborn, 1891–5; 5, Pall Mall Place and 308, High Holborn, 1896–9.
J. B. HANQUET, 6, Love Lane, E.C., 1870–1; FERDINAND HANQUET, 1872–8.
A. P. HANS, Liége, 1886; A. P. HANS & Co., 1889.
CHARLES HANSON, 1, Eaton Lane South, Pimlico, 1857.
VICTOR HAROLD & Co., 9, Queen Street, Leicester Square, 1857–8.
HENRY J. HARRISS, 9, Carlton Street, S.W., 1899.
HARROD'S STORES, LD., 87 to 105, Brompton Road, 1898–1900.
G. HARSTON & Co., 12, Queen Victoria Street, 1875.
DANIEL B. HARVEY (Agent for W. W. Greener), 42, Ely Place, Holborn, 1856–9.
THOMAS R. HASDELL, 150, St. John Street Road, 1862–6.
FREDERICK E. D. HAST, 18, Aldermanbury, 1856–9.
HECHT & Co., 58, Finsbury Pavement, 1897–8.
FREDERICK W. HEINTZ (Agent), 102, London Wall, 1872–3.
CHARLES HELLIS, 21, Shrewsbury Road, N., 1894–6; 119, Edgware Road, W., 1897–1900.
ALEXANDER HENRY (Edwin H. Newby, Agent), 39a, King William Street, E.C., 1869–72.
ALEXANDER HENRY, 118, Pall Mall, 1877–1886; 31, Cockspur Street, S.W., 1887–93; 23, Pall Mall, 1894–6; ALEX. HENRY, LD., 1897; ALEX. HENRY & Co., 23, Pall Mall, 1898; 13a, Charles Street, Haymarket, 1899.
HENRY MILITARY RIFLE, 39a, King William Street, 1875; Chatham Buildings, New Bridge Street, E.C., 1876–7.
HENRY RIFLED BARREL Co., LD., Eagle Wharf Road, Hoxton, 1875; HENRY RIFLED BARREL, ENGINEERING AND SMALL ARMS Co., LD., Eagle Wharf Road, N. and 2, Chatham Buildings, New Bridge Street, E.C., 1876–80; Blenheim Works, 48, Eagle Wharf Road, N., 1881–1900.
DAN HENSER, 1, Fowkes Buildings, E.C., 1880–9.
WILLIAM HEPTINSTALL, 18, Swan Street, Minories, 1850–7; WILLIAM HEPTINSTALL & SON, 1858–68.
EDWIN HERMANN, 48, Marylebone Lane, 1890.
JOHN C. E. HEWITT, 84, Blackman Street, S.E., 1862–90; 24, Borough High Street, S.E., 1891–3.
H. HEYM, 42, Poland Street, W., 1890–3.
JOHN HILL, 76, Tooley Street, S.E., 1850–6.
W. J. HILL, 5, Bond Court, Walbrook, E.C., 1872.
WILLIAM J. HILL, 1 and 2, Fenchurch Street, 1878–9.
HILLSDON & STONES, 149, Oxford Street, 1897.
FREDERICK HOBSON & Co., 34, Basinghall Street, 1896.
EDWIN C. HODGES (Actioner), 8, Florence Street, Islington, 1860–78; 8, Florence Street, N. and 95, Mount Street, W., 1879–81; 8, Florence Street and 69, Ebury Street, S.W., 1882–4; 8, Florence Street, and 34, South Audley Street, 1885; 8, Florence Street, N. 1886–1900. [W.]
LIONEL HODGES, 249, Upper Street, N., 1899; 18, Charterhouse Buildings, E.C., 1900.
HODGES, PERRIN & Co., Belvedere Road, S., only 1861.
HARRIS JOHN HOLLAND, 9, King Street, Holborn, 1850–8; 98, New Bond Street, 1859–76; HOLLAND AND HOLLAND, 1877–1898; HOLLAND AND HOLLAND, LD., 1899–1900.

JAMES HOLLAND & SONS, 44, Great Prescot Street, 1850–4; 44, Great Prescot Street, and 44, Tenter Street South, E., 1855–56; JAMES HOLLAND & SON, 44, Tenter Street South, E., 1857–8.
EDWARD HOLLANDS, 180, High Holborn, 1864; 55, Rupert Street, Haymarket, S.W., 1870–5.
A. & E. HOLLER, 16, Gresham Street, E.C., 1858.
A. & E. HOLLER & Co., 39, Monkwell Street, E.C., 1868–70.
A. HOLLIS & Co., Dunster House, Mincing Lane, 1897.
ISAAC HOLLIS & SONS, 44a, Cannon Street, 1870–1; 83, Cheapside, 1872–5; ISAAC HOLLIS & SON, LD., 1876–8; 6, Great Winchester Street, E.C., 1879–91; 26, Billiter Buildings, E.C., 1892–9; 101, Leadenhall Street, 1900.
JOHN HOSKINS, 31, Frith Street, Soho, 1850–2.
MICHAEL J. HUBBARD, 163, Fenchurch Street, 1874.
ROBERT HUGHES (E. Manser, Agent), 16, Laurence Pountney Lane, E.C., 1869.
THOMAS HUNT, 32 and 33, Leman Street, E., and Tenter Street East, E., 1875–9; 66, Leman Street and Tenter Street East, 1880–1882.
H. J. HUSSEY, 81, New Bond Street, W., 1900.
JOHN HUTCHINS, 14, Bloomsbury Street, W.C., 1861–3; 44, Frith Street, Soho, 1864–5.
RICHARD HUZZEY, 39, Upper East Smithfield, 1881–2; 69, Upper East Smithfield, 1883–94; 17, Devonshire Square, E.C., 1895–7.

INTERNATIONAL (GIFFARD) GUN Co., Copthall House, Copthall Avenue, 1892–3.

RICHARD JACKSON, 30, Portman Place, Edgware Road, W., 1850–5; 185, Edgware Road, W., 1866–9; RICHARD AND ELIAS JACKSON, 416, Edgware Road, 1870–2; RICHARD JACKSON, 15, Edgware Road, 1873–94; 41, Upper Berkeley Street, W., 1895–7.
THOMAS JACKSON, 29, Edwards Street, Portman Square, 1850–69; 89, Wigmore Street, W., 1870–2; THOMAS JACKSON & SON, last address, 1873–9.
THOMAS JACKSON, JUNR., 4, Railway Place, Shoreditch, N.E., 1861–2.
ENOS JAMES & Co., 36 and 37, Loveday Street, Birmingham, 1880; 36 and 38, Loveday Street, 1887–8; 14, St. Mary's Row, 1889; Stamforth Street, 1899.
J. JANSSEN, 45 and 8a, Cross Street, Finsbury, 1876; 8 and 13, Cross Street, 1877–8; 36, Basinghall Street, 1880–1; St. Mary Chambers, St. Mary Axe, 1882–3; 3 and 6, Camomile Street, E.C., 1884–6; 4, Butler Street, E.C., 1887–91; JANSSEN FILS & Co., 1896.
HENRY J. JARRETT & Co., 15, Tower Hill East, and 15, King Street, Tower Hill, E., 1870; 15, King Street, E. only, 1871.
W. J. JEFFERY, 60, Queen Victoria Street, 1888–9; JEFFERY & DAVIES, 1890; W. J. JEFFERY & Co., 1891–7; 60, Queen Victoria Street, and 13, King Street, S.W., 1898–1900.
WILLIAM P. JONES, 75, Bath Street, Birmingham, 1887–9; 25, Whittall Street, 1897–8.
JOSELYN FIREARMS Co., (U.S.A.) (E. H. Newby, Agent), 39a, King William Street, 1867–8.
SOLOMON JOSEPH & Co., 77, Wood Street, E.C., 1870–6.

JOB KEEN, JUNR., 61, Glo'ster Street, Commercial Street, E., 1850–9; JOB KEEN & SON, 1860–6.
KEMP BROS., Iron Bridge Wharf, Barking Road, E., 1859; Iron Bridge Wharf and 20½ King Street, Tower Hill, E., 1860.
KEMP, LEDDALL & Co., 41, London Wall, E.C., 1860–2.
JAMES KERR & Co., (London Armoury and Armourers to the N.R.A.), 54, King William Street, 1870–83; 118, Queen Victoria Street, 1884–7; 114, Queen Victoria Street, 1888–94.
PAUL KRAUSS-KLEIN, 15, Tower Hill, E., and 15, King Street, Tower Hill, 1871–2; 15, Tower Hill, E., only 1873.

LACY & REYNOLDS, 21, Great St. Helen's, 1850–2; LACY & Co., 1853.
J. W. LAIRD & Co., 6, Bishopsgate Street Without, 1889–96.
L. LAMBLIN & Co. (Liége) (Henry Haschke, Agent), 60, Watling Street, E.C., 1868–71; 6, Love Lane, E.C., 1872–82; LAMBLIN & THEAK, 1883–7; 5, London Wall Avenue, 1880–91; 15, George Street, E.C., 1893.
ALFRED LANCASTER, 27, South Audley Street, W., 1862–85; 50, Green Street, Grosvenor Square, 1886–92; Business transferred to C. Lancaster, New Bond Street.
CHARLES WILLIAM LANCASTER, 151, New Bond Street, 1850–4; CHARLES WILLIAM & ALFRED LANCASTER, 151, New Bond Street, and 2, Little Bruton Street, W., 1855–60; CHARLES WILLIAM LANCASTER at both addresses, 1861–7; CHARLES LANCASTER, 1868–71; CHARLES WILLIAM LANCASTER, 1872–8;
CHARLES WILLIAM LANCASTER & Co., 1879; CHARLES LANCASTER, 1880; CHARLES LANCASTER & Co., 1881; CHARLES LANCASTER, 1882–1900.
CHARLES LANE, 60, Queen Victoria Street, 1889–91; LANE BROS., 45a., New Church St., Bermondsey, 1893-1900.
GEORGE J. LANE, 4, Duck Lane, Edward Street, Soho, W., 1879.
EDWARD LANG, 88, Wigmore Street, W., 1880; 89, Wigmore Street, W., 1881–9.
H. J. LANG (Solingen) (Heintzmann and Rochussen, Agents), 23, Abchurch Lane, 1867–9.
JAMES LANG, 33, New Bond Street, 1887; 18, Brook Street, W., 1888–90; J. LANG & Co., LD., 1891–3; 102, New Bond Street, 1894–5; LANG & HUSSEY, 1896; LANG & HUSSEY, LD., 1897–8; 102, New Bond Street, and Wells Mews, Wells Street, W., 1899–1900.
JOSEPH LANG, 7, Haymarket, 1850–2; 22, Cockspur Street, 1853–74; JOSEPH LANG & SON, 1875–89; 10, Pall Mall, 1890–8.
A. LAWTON, 27, Duke Street, Bloomsbury, 1861–6.
WILLIAM R. LEESON, 29, Maddox Street, 1899–1900.
JOHN LEIGH, 1, Duncan Street, Whitechapel, 1850–6; JOHN LEIGH & SON, 1857–63; JOHN LEIGH & SON (Executors of), 1864.
JAMES LEITCH, 29, Great Portland Street, 1860.
D. LEONARD & SON, 15 and 18, Bishopsgate Street Without (and at Birmingham), 1880; at 90b, Aston Street, Birmingham, 1891.
L. LE PERSONNE & Co., 24, Great Winchester Street, E.C., 1894; 99, Cannon Street, 1895–1900.
MOSES L. LEVIN, 1, Bevis Marks, E.C., 1885–8.
LIEGE FIREARMS MFG. Co., LD., 8, Coleman Street, 1882–4
LIEGE SMALL ARMS FACTORY (Heintzmann & Rochussen, Agents), 23, Abchurch Lane, 1867–80.
WILLIAM LING, 61, Jermyn Street, 1850–62.
G. LITTLE & Co., 63, Haymarket, 1889–96.
W. LOCKE, WATTS & Co., 391, Strand, 1882–92.
LUDW. LOEWE & Co., 145, Cannon Street, 1892–8.
LOHMEYER TAIT & Co., 3, Wilson Street, E.C., 1889.
LONDON ARMOURY Co., LD., Railway Arches, Henry Street, Bermondsey Street, 1857–63; 36, King William Street and Victoria Park Mills, Old Ford Road, E., 1864–7; 36, King William Street and 27, Leman Street, E., 1868; LONDON ARMOURY Co., 54, King William Street, 1875–83; 118, Queen Victoria Street, 1884–6; 114, Queen Victoria Street, 1888–93; LONDON ARMOURY Co., LD., 1895–1900.
LONDON, BIRMINGHAM AND FOREIGN ARMOUR AGENCY, 38, Lime Street, 1864–8.
LONDON BREECHLOADING FIREARMS Co., 447, West Strand, 1882–4.
EDWARD LONDON, 51, London Wall, E.C., 1850–72; in 1867 Exors. of formed part of the entry in directory.
LONDON FIREARMS Co., 431, Strand, 1886–7.
LONDON GUN Co., 42, Wool Exchange, E.C., 1888–1900.
LONDON SMALL ARMS Co., LD., Old Ford Road, E., 1867–1900.
ANDRE AND CHARLES DE LONEUX, (Liége) (Heintzmann & Rochussen, Agents), 9, Friday Street, 1865–6.
RICHARD LONG & Co., (Agents for A. Bourchez, Liége), 31, Threadneedle Street, 1867.
JOHN D. LÜNESCHLOSS, 90, Newgate Street, 1867–8.

JOHN MACGUIRE, 7, Chambers Street, E., 1865–87.
MACKENZIE BROS., 84, Mark Lane, E.C., 1881–92; 132, Queen Victoria Street, E.C., 1893–4.
JAMES MACKIE, 42, Cambridge Street, Pimlico, 1879–83.
CHARLES H. MALEHAM, 20, Regent Street, W., 1878–82 and 1884–1900.
PHILIP JOSEPH MALHERBE & Co. (Liége) (Frederick L. Homer, Agent), 23, Crutched Friars, 1854.

ROUND THE TRADE.

THE following extracts are taken from the announcement, referred to elsewhere, issued by Messrs. F. Joyce & Co. Ld. from Kingsway House :—" We beg to inform you that our business will be transferred as from January 1st next to Messrs. Nobel's Explosives Co. Ld. of Glasgow, who will carry it on in conjunction with their sporting powder and ammunition trades at the above address. An entirely new and modern factory has been erected at Waltham Abbey, with an enormously increased capacity, and this factory has been equipped with the most up-to-date machinery available."

The committee, which has been appointed to deal with the question of automatic rifles submitted to the Government under the conditions published in the October issue, is a special body chosen for that purpose only, and, therefore, does not include the Small Arms Committee as such. Brig.-Gen. Wilson is president of the committee, and the members are Col. W. N. Congreve (Hythe), Col. J. D. Hopton, Lieut.-Col. Hon. T. F. Fremantle, Major W. H. Greenly, Major W. B. Wallace (Chief Inspector of Small Arms) with Capt. Scott for Secretary. Col. Congreve and Major Wallace are both members of the Small Arms Committee, also Col. Fremantle, and Capt. Scott is its Secretary.

A circular has been received from the London Small Arms Co. Ld. describing a new pattern of L.S.A. aperture sight for use on Lee-Enfield rifles fitted with ·22 barrels. The arrangement has been achieved by an ingenious combination of the Company's aperture disc with an overhanging arm which extends over the bolt-way, the sight being attached to the rifle by means of the service aperture sight spring and screw.

An Order in Council dated the fourteenth of October last gives notice that " Swalite " has been added to the list of explosives scheduled for use in fiery coal mines. The makers are the Cotton Powder Co. Ld., and the composition is as follows :—nitroglycerine sixty per cent. ; nitrocotton four ; nitrate of potassium seventeen, woodmeal 5·5, and oxalate of ammonium 13·5. These proportions are the mean of the limits specified in the order. There is the further proviso that moisture shall not exceed one per cent.

The following are the terms of the official memorandum on the subject of the relationship between bullseye shooting and military marksmanship :—" A Conference has recently been held between representatives of the War Office and the National Rifle Association to discuss various matters in connection with Rifle Shooting. The War Office representatives fully realised the important work which has been and is being done by the National Rifle Association and recognised the difficulties which would have to be encountered by the Association in guiding rifle shooting more in the direction of training for war. At the same time the Association were fully aware of the fact that progress should, where possible, be made towards practical conditions for the benefit of the country. It was mutually agreed that any change in the form of rifle practice and competitions, which might now or in the future become desirable, should be effected slowly and after careful consideration. As a step towards mutual co-operation it was agreed that the conditions of the King's Prize should next year be slightly modified. Assurance was given by the War Office that every support would continue to be afforded to the annual meeting at Bisley and it was arranged that opportunities would be offered to Territorial soldiers to qualify for marksman and in the standard test during that meeting. It was unanimously agreed that the result of this Conference would have a beneficial influence on rifle shooting generally."

In a recent issue of *The Times* the announcement is made that Rear-Admiral Reginald H. S. Bacon is retiring from active service to take up the position of Managing Director of the Coventry Ordnance Works, Ld. As Director of Naval Ordnance Admiral Bacon brings a specialist's knowledge to his new field of work.

A copy of the latest Marlin Catalogue, dated October 1909, has been received at this office. So far as can be seen from a casual inspection it differs very little from its predecessors. In a business of this kind changes, if any, are restricted to details which are apt to pass unnoticed unless a special search is made.

According to the German Customs return, the import of blasting powder, dynamite, and other explosives for 1907 was 357 tons, and the exports, Japan 613 tons, Australia 722 tons, other countries 3,676 tons, whilst in 1908 the imports were 333 tons, and the exports : Japan 304 tons, Australia 1,198 tons, other countries 4,085 tons.

The Bisley Meeting, which has hitherto been held during the second and third weeks of July, will next year commence on Tuesday the 5th, the Monday being reserved for arriving and generally settling down. The alteration is to avoid clashing with the annual camp training of the territorials. It has further been decided that the closing of the ranges during the week preceding the meeting shall give place to the opposite practice, viz., that as many targets as possible shall be available. The Council is prepared to inspect designs of aperture sights adapted for fixing to military miniature rifles. This means that the converted Martini will be sanctioned for use with aperture sights.

The Field recently devoted nearly a whole page to the question of number six shot as made by the firm of Eley Bros. for use in experiments. One of the chief items of interest was a new design of shot trowel in which each row consists of seventeen holes, which is exactly the sixteenth part of two hundred and seventy two, the number of pellets in an ounce of the new count of this size of shot. As has before been explained the change from the hitherto recognised count is purely nominal, and has only been introduced to facilitate exact division in sixteenth-ounce units. The new trowel is of handsome design, and has been calibrated up to the limit charge of one and a half ounces. The setting is accomplished without the aid of screws, and the trowel is accompanied by a special design of box to hold the shot. An ordinary square hopper is attached to the latter. The whole outfit is sold practically at cost price for use by gunmakers, powder makers and others who are in the habit of loading special cartridges for testing purposes. In order that a supply of shot of the standard size shall be available for use, Messrs. Eley Bros. have specially prepared a one-ton lot of exceptional evenness. Samples were promiscuously drawn from all parts of this mass and a careful weighing test showed that the greatest deviation out of sixteen counted charges was three grains by weight surplus. The average of the series was 1·5 grains surplus, so that, bearing in mind that a pellet of number six shot weighs 1·62 grains, it will be seen that the average of the sample is just the odd pellet that ensures a full measure of weight with a greatest additional error of another pellet. The error is thus a mere fraction of one per cent., which means that counted charges of this shot, whilst as accurate as weighed charges, can be drawn off a good deal quicker. The article already referred to contains a table for reducing shot gun patterns with every possible charge of number six shot to a percentage basis, the idea being to enable the degree of choke in the gun to be defined according to the shooting results, the rule for which is forty per cent. equals true cylinder, fifty per cent. equals improved cylinder, sixty per cent. equals half choke, and seventy per cent. equals full choke.

ABEL ON HEATING GUNCOTTON TO 100°C (1867).

BY GEORGE W. MACDONALD, M.Sc., F.C.S.

Pelouze and Maury in their accounts of the effects of heat upon guncotton, describe several kinds of stages of decomposition as occurring, or producible at will, by its exposure to a temperature of 100°C., and state that in every instance they found a few minutes' exposure to that temperature sufficient to produce a disengagement of nitrous vapours. A large number of experiments have been instituted with guncotton prepared at Waltham Abbey and Stowmarket according to Von Lenk's direction, and also with some specimens of Austrian guncotton, with the view of ascertaining the effect upon them of exposure to 100°C. The guncotton was exposed to heat in sealed tubes and in open vessels arranged in different ways. The quantities operated upon and other conditions in the experiments were varied, as will be presently particularized, the objects contemplated being, in the first instance, to examine into the effects of exposure of guncotton to heat, and afterwards to ascertain if possible by what circumstances those effects might be subject to modification.

EXPERIMENTS IN SEALED TUBES.

Air-dry guncotton (coarse yarn, manufactured in 1863), enclosed in a stout glass tube hermetically sealed, was maintained at 100°C. in a water-bath. The tube was filled with deep orange vapours in about three hours. The vapours gradually diminished in intensity, after a time, until the guncotton was converted into a gum-like mass, the transformation occurring most rapidly at the upper end of the tube, where the water produced during the change condensed and returned, charged with acid, upon the guncotton. When the sealed tube was opened, after continuation of the heat for three or four days (seven hours daily), nitric oxide escaped under considerable pressure. Upon closing the tube again, after the escape of gas, and continuing the application of heat, the guncotton was gradually converted into a black pitch-like mass. This experiment, several times repeated, always furnished closely similar results.

A tube containing fine guncotton thread, manufactured in 1863, was exhausted and sealed. After four hours exposure to 100°C., it exploded with great violence, tearing open the stout copper water-bath in which it was heated. Portions of unburned guncotton were scattered about.

Another tube, containing some of the same guncotton, was opened after seven hours' heating, to allow the gas to escape, and again sealed. On the second day, after heating for three or four hours, it exploded violently. Several experiments were made with perfectly dry guncotton, and furnished results quite similar to those obtained with the air-dry material. Fine guncotton thread was introduced into a tube sealed at one end; the other extremity of the tube was constricted, then exhausted and filled with nitrogen, these operations being repeated three times; the tube was afterwards filled and heated to 100°C. in a water-bath. After forty-five minutes faint red vapours were observed. In another quarter of an hour the colour of the vapours was very deep; in a short time nitrous acid began to condense in the cool part of the tube. After continuing the heat for 1¼ hours longer, the coloured vapours had entirely disappeared. The guncotton had become highly bleached, and in the upper extremity of the tube it was partially converted into a gummy substance. Nitric oxide escaped when the tube was opened.

A sample of guncotton impregnated with about 0·4 per cent. of alkaline carbonate, was exposed to 100° in an exhausted sealed tube, for the purpose of collecting the gases evolved. When the tube had been heated six hours daily for five days, it was opened under mercury, and the gas, which escaped under considerable pressure, collected. The tube was again closed and heated for two days, when gas was once more collected from it. The experiment was interrupted, after the guncotton had been further heated for two days, the tube being fractured by the effects of an explosion in its vicinity. The collected gases were found to consist of 50·2 per cent. of carbonic acid, 4·7 per cent. of nitric oxide, and 45 per cent. of nitrogen. These experiments, in which the guncotton was submitted to the influence of 100°C. under the most severe conditions, appear to indicate that nitric peroxide or nitrous acid is liberated by the first decomposition of the guncotton, and at once establishes a further destructive action upon the substance, becoming reduced to nitric oxide, nitrogen being eventually liberated by complete reduction of the latter. The extent of surface of guncotton presented to the action of heat, and of the liberated acid, appears to exert, as might be anticipated, an important influence upon the change. Exposure of fine guncotton thread to heat under the same conditions as those which were safe with coarse yarn gave rise to explosions, due possibly to the increased pressure of gas in the tubes, but more probably, judging from their great violence, to the sudden decomposition of the guncotton at a particular period. The characters exhibited by the products of decomposition of guncotton obtained in these experiments were similar to those already described by other chemists, and have been referred to in the preceding parts of this paper.

EXPERIMENTS IN VESSELS OPEN TO THE AIR.

The following experiments, conducted with considerably larger quantities of guncotton than before employed, were made with the view of obtaining, at one time, several distinct data regarding the decomposition of guncotton at 100°C. Direct evidence was sought of the development of heat in guncotton upon continued exposure to that temperature. The period was carefully noted when decomposition was first indicated by the disengagement of nitrous acid, after commencement of the experiment. In some instances, the loss of weight sustained by the guncotton was determined at intervals (*e.g.* at the close of six hours, or one day's exposure to heat), the nitrous acid contained in the vessel being first displaced. The vessels employed in these experiments were globe-flasks fitted by means of perforated corks, with long narrow glass tubes, and in most instances with thermometers graduated from 100°C. upwards. The flasks were of a size to receive the guncotton

in a compact condition, and the thermometer-bulbs were inserted into the centre of the mass. Continuous observations were made in safety during the experiments, through a small glass let into a wooden screen, which was placed in front of the water-bath containing the heated flask. The results indicated :—(1) That sufficiently protracted exposure to 100°C. under conditions unfavourable to the rapid expulsion of the nitrous acid developed by the first action of the heat upon the guncotton, ensures the complete destruction of the original properties of this substance, and its conversion into a variety of volatile and fixed products. (2) That the rapidity and violence of the decomposition resulting from the combined action of heat and of the acid generated, is regulated by the quantity of guncotton operated upon. (3) That, as shown by experiments conducted with coarse and fine yarn manufactured in precisely the same manner, the mechanical condition of the guncotton exerts an important influence over the rapidity of decomposition at 100° (a point also indicated by the results of experiments in sealed tubes). (4) That a very important difference may exist between the behaviour of different samples of guncotton, even if operated upon in precisely the same manner, quantities, and mechanical conditions.

This is illustrated by comparing experiments (conducted with Austrian guncotton) with precisely similar experiments instituted with different samples of Waltham Abbey guncotton, in not one of which was an explosion brought about by long continued exposure of equal quantities (6·5 grms.) to 100°C. The two specimens of Austrian guncotton differed very greatly in composition from all the products of manufacture prepared at Waltham, according to Von Lenk's system ; and it will be shown presently that this circumstance may serve to account for the exceptional proneness of these specimens to very violent decomposition under the particular conditions of the above experiments.

It need perhaps scarcely be stated that the temperature-observations in these experiments(and others still to be described) were instituted more with the view to afford a good means of registering the comparative rapidity of decomposition of different specimens of guncotton operated upon under equal conditions, than with the idea of attempting to ascertain the actual moment of development of heat and progressive rise of temperature in a mass of guncotton. Such observations could only be correctly made with much larger quantities of guncotton, so confined as to prevent the escape of heat from the interior, and are therefore impracticable on the score of danger. A considerable number of these thermometric observations, which unquestionably recorded close approximations of the actual rise in temperature of the interior of the mass of badly conducted guncotton showed that when the temperature passes 110° to 112°C., the development of heat proceeds with great rapidity, so that very speedily the rise of the thermometer does not keep pace with the heating of the portions of the guncotton in close proximity to it, and therefore the explosion of the mass appears to occur at a temperature considerably lower than the actual exploding point of guncotton.

In continuation of the heat-experiments, several samples of guncotton from Waltham Abbey and Stowmarket, weighing 3 grms. each in an air-dry condition were exposed to 100°C. in conical assay flasks, into which long quill-fubes were fitted. Eight experiments conducted precisely alike pointed to a very important difference in the powers of different specimens of guncotton to resist destruction by exposure to 100°C. Of five samples manufactured at Waltham Abbey, only one exhibited the effects of such exposure described by Pelouze and Maury as invariable, namely, the disengagement of nitrous vapours within a few minutes. One specimen did not exhibit this sign of change until after five hours' exposure, and then only to a very slight extent. Of two specimens of guncotton from Stowmarket, one decomposed with very considerable rapidity at 100°C., and the other did not, in one experiment, evolve any visible amount of nitrous acid during forty-five hours' exposure, in nine days, and exhibited very slight signs of change at the expiration of this severe treatment ; while in a second experiment, with a portion of the same sample, slight decomposition became apparent at the close of the third day's exposure of five hours. The cause of the latter difference in the behaviour of one and the same sample, upon different occasions, was traced to the circumstance that the specimen, in the condition in which it was first employed, contained a somewhat larger proportion of moisture than when the experiment was repeated with it, in consequence of its having been in a damp locality for a short time before the first portion was operated upon. Thus one possible reason for the different behaviour of several samples of guncotton prepared by one and the same process was indicated. In confirmation of the influence exerted by moisture in retarding the decomposition of guncotton exposed to a high temperature, the results of a preliminary experiment may be here recorded, which was instituted with a sample of guncotton found to be very readily affected by exposure to heat. Three specimens, each of one grm., were exposed side by side in small long-necked flasks to 100°C., in three different conditions. The one was air-dry (and contained therefore about 2 per cent. of water), the second was dried immediately before the experiment by sufficient exposure to 50°C., and the third was saturated with water and pressed between bibulous paper. The dry sample shewed signs of decomposition in ten minutes, the air-dry sample began to decompose in forty-five minutes, and the moistened specimen exhibited no acidity after exposure to 100°C. five hours daily for three days (further experiments on the protective power of water will be presently described). In all subsequent experiments upon the comparative effects of exposure of different samples to elevated temperatures, the guncotton was employed in a dry condition.

(To be continued.)

The Winchester Repeating Arms Company have introduced a telescope sight, to the design and mounting of which exceptional pains have been devoted. Samples have just been received by the London Armoury Co. Ld., and from an inspection of the same there can be no doubt that

the optical design is of the best. The mechanical mountings are also very good. The rear support comprises a substantial frame with vertical and horizontal micrometer adjustments. So thoroughly have all the details been worked out that each telescope is accompanied by a drill and taps to ensure that the screws supplied for fixing it shall fit into truly tapped holes.

APPLICATIONS FOR PATENTS.

OCTOBER 18—NOVEMBER 20, 1909.

23,951.* Projectiles. Fried Krupp.
24,036. Ordnance Sighting Device. W. Beardmore & Co. Ld. and A. Bremberg.
24,056.* Rifle Backsight. H. McKenzie.
24,266.* Detonators. J. Harlé.
24,329. Targets. B. W. Bates and A. E. Southam.
24,742. Preventing Ignition of Coal Dust. J. Brightmore.
24,826.* Recoil Mechanism. E. C. Rothe.
25,184. Adjusting Range Finders. A. Barr and W. Stroud.
25,253.* Firearm Sight. Waffenfabrik Mauser, A.-G.
25,276.* Projectiles. J. T. S. Schouboe.
25,308. Drop-down Guns. A. Rosling and J. Ross.
25,356. Ordnance. A. T. Dawson and G. T. Buckham.
25,486. Ordnance. W. Beardmore & Co. Ld. and A. Bremberg.
25,538. Firearms Sighting. H. J. Blanch and G. J. Stevens.
25,720. Ordnance Sighting. A. Barr and W. Stroud.
25,874.* Removing the Burr from Cartridge Shells. Nobel's Explosives Co. Ld. and H. D. Hodge.
26,141.* Time Fuse for Artillery. J. D. B. Fulton.
26,214.* Gun Carriages. Fried Krupp.
26,239. Explosives. Nobel's Explosives Co. Ld., J. Sayers, W. A. Wilson and J. Thorburn.
26,359.* Explosives. C. G. Demetriade, C. Jonescu and J. Coanda.
26,362. Explosives. W. Rintoul and F. Baker.
26,377.* Projectiles. H. E. McDonald.
26,430.* Trigger Device. Fried Krupp.
26,445.* Safety Device for Guns. J. B. Ward, and A. B. Ward.
26,450.* Cartridge Magazine. P. Mauser.
26,454. Report Silencer. T. R. R. Ashton.
26,628. Shot Gun Cartridges. F. Greener.
26,650. Rifle Barrel Cleaner. A. W. Foster.
26,659. Single-trigger Mechanism. L. B. Taylor.
26,766. Adjusting Rifle for Aiming. S. M. Collins.
26,786. Wheeled Gun Carriages. Fried Krupp.
26,796. Time Fuses for Artillery. J. D. B. Fulton.
26,841. Automatic Rifles. T. R. R. Ashton.
26,943. Breech Loading Cartridges. F. Greener.
26,946. Directing Rifle Fire. H. W. L. Steward.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

OCT. 28—NOV. 18, 1909.

COMPILED BY HENRY TARRANT.

20,872 (1908). **Protective Shell for Small-arms.** J. Singer, Austria. An oblique plate is attached to the top of a rifle by a clip surrounding the barrel and fore-end. The plate is resiliently mounted on a spring, whilst just below it is a pillar adapted to help the spring absorb the shock of a bullet when it strikes. Accepted Oct. 4, 1909.

21,030 (1908). **Under Lever Bolt Action Rifle.** P. T. Clift, Usk, and A. E. Morton, Abersychan. In this action the bolt is locked in the closed position by a " recoil block " which is thrown up at the rear of it by the under lever. The bolt is reciprocated by a connecting rod between an extension of the forward part of the lever and the rear of the bolt. The action is adapted for single or magazine loading. Accepted Oct. 28, 1909.

21,038 (1908). **Target Apparatus.** H. T. Dumbleton, Birmingham. A metal target plate of the kind used by air rifle clubs has the usual " bullseye " aperture in the centre. When a pellet passes through this hole it knocks a lever over which falls and makes an electrical contact. A bell continues to ring until the lever by means of a cord is pulled up again. Accepted Oct. 6, 1909.

21,922 (1908). **Ordnance Firing Mechanism.** Lieut. A. T. Dawson and G. T. Buckham, London. In electric and percussion firing mechanism, arrangements are made to avoid misfires with certainty. The needle is dropped electrically and the percussion device is almost simultaneously actuated so that the primer is " doubly " fired. Patent No. 6,654, 1908 is quoted in the Specification. Accepted Oct. 14, 1909.

21,930 (1908). **Ejecting Mechanism for Ordnance.** A simpler form of extracting and ejecting mechanism than that set out in patent No. 15,672, 1901 is described. The extractor and two ejecting arms are mounted independently of each other on a spindle actuated by a cam on the carrier hinge pin. The cam first brings about a strong wedging primary extracting movement through the extractor arm. The ejecting arms afterwards give the case a sharp blow. Accepted Oct. 14, 1909.

22,102 (1908). **Range Finders.** Sir W. H. M. Christie, Royal Observatory, Greenwich. Improved means are described for effecting easily and with accuracy the infinity adjustment of range finders without the necessity for the use of a known range or of a star. A separate bar or tube is employed for the purpose. Accepted Oct. 14, 1909.

22,703 (1908). **Ordnance Sighting Gear.** Lieut. A. T. Dawson and G. T. Buckham, London. Gun sighting gear has interposed between the range dial and the elevating gear mechanism such that when the sighting apparatus is adjusted for increasing ranges the movement of the dial is augmented at short ranges and diminished at long ranges and *vice versa*. Patents Nos. 24,703, 1903 and 23,727, 1907 are mentioned. The invention is applicable to sights of present pattern. Accepted Oct. 7, 1909.

22,843 (1908). **Ordnance Breech Mechanism.** Lieut. A. T. Dawson and G. T. Buckham, London. Combined in ordnance breech mechanism of the swinging carrier type are means for angularly displacing the breech screw as set out in patent No. 15,975, 1902, firing gear of the kind dealt with in patent No. 6,648, 1908, an electric and percussion lock as described in patent No. 21,922, 1908 and extracting and ejecting mechanism of the nature of that forming the subject of patent No. 21,930, 1908. The last two patents are digested in this issue. Accepted Oct. 21, 1909.

23,187 (1908). **Automatic Small Arm Mechanism.** R. H. Kjellman, Sweden. Cartridge feeding mechanism is dealt with in this patent. A " transporter," provided with a slot adapted to receive the cartridge, works in conjunction with extracting hooks which draw the cartridge from the magazine. A lever enters an opening in the transporter and helps in the reloading operation. Ejection of the empty case is also facilitated by other details forming part of this invention. Accepted Oct. 28, 1909.

23,764 (1908). **Target Apparatus.** Dr. F. R. S. Milton, Llanberis. Two targets are cross connected by wires or ropes with two firing points. The apparatus is adapted for snap shooting. When the shot of one of two shooters strikes the central disc of his target, a screen is automatically pulled up at the firing point on front of the other shooter. Accepted Oct. 7, 1909.

24,953 (1908). **Aperture Sight Mounting for L.-E. Rifle.** L. R. and J. Tippins, Mistley. To a side plate, held on the rifle by the usual long range stem fixing means a platform is hinged. The latter carries the aperture sight and is held in a horizontal position over the rear end of the Lee-Enfield action body by a spring. When the rifle bolt has to be removed the platform is turned up on its hinge against the pressure of the spring. Accepted Oct. 7, 1909.

25,966 (1908). **Target Apparatus.** C. B. Winder, U.S.A. In order to adapt short range targets for teaching how to adjust sights, etc. to suit outdoor long range conditions, an aiming target is provided and above this (behind a wind and elevation chart) a recording target. The shooter is instructed to set his sights for a certain range and wind and if he does this correctly and his aim is right the shot

strikes the bull of the recording target which has by means of the chart been adjusted. Accepted Oct. 28, 1909

27,577 (1908). **Fuse Setting Machine.** F. Wigley, R. Redpath and T. A. Petrie, (Coventry Ordnance Co. Ld.), London. In a machine for setting fuses having dials graduated for time and range mounted concentrically, the time dial in which the seconds of time do not subtend equal angles is connected to one of the rotatable members of the machine engaging with the fuse in order that a constant zero correction may be converted into a variant factor at different ranges. Accepted Oct. 21, 1909.

28,012 (1908). **Perchlorate of Potassium Explosives.** E. H. Harris, London. (*See Selected Patents*).

28,534 (1908). **Loading Apparatus for Ordnance.** La Société Schneider and Cie, France. Loading apparatus for turret guns or those on pivoted carriages is dealt with in this patent. The movements for effacing the loading cradle and for bringing it into line with the gun are effected by the opening and closing movements of the breech. Appropriate mechanism is employed consisting mainly of an arm, one end of which is pivoted to the loading cradle and the other to the gun. Accepted Oct. 7, 1909.

180 (1909). **Detachable Side Locks for Small Arms.** H. White (Jos. Lang & Son, Ld.), London. (*See Selected Patents*).

865 (1909). **Bringing Ordnance to Loading Position.** Sir W. G. Armstrong, Whitworth & Co. Ld., E. W. Lloyd and F. G. D. Johnston, Newcastle-on-Tyne. To enable a gun to be brought to a fixed loading position by a single movement of a lever a hydraulic piston is adapted to operate the loading stop of a valve actuated by the movement of the piston and to put the main elevating cylinder to pressure or exhaust so as to elevate or depress the breech of the gun. Accepted Oct. 28, 1909.

2,569 (1909). **Automatic Pistol Safety Grip.** W. J. Whiting, Birmingham. The hammer and sear of an automatic pistol are mounted in a spring influenced housing. When the pressure on the grip is removed this housing shifts the sear away from the tripping bar of the trigger mechanism. When the grip is taken hold of firmly to fire the pistol these parts are made to resume normal " cocked " acquaintance. Accepted Oct. 12, 1909.

3,937 (1909). **Plastic Ammoniacal Saltpetre Explosives.** H. W. Lake, London (Agent for *Vereinigte Köln Rottweiler Pulverfabriken, A.-G., Germany*). A " nitro-semi-cellulose," see patent No. 5,126, 1904, is employed in solution with aromatic nitro hydrocarbons instead of nitroglycerine heretofore used. A paste of this substance is formed and 17·20% is mixed with 83–80% of nitrotoluol. If about 15% of this paste is kneaded with 85% of finely ground ammoniacal saltpetre an explosive is formed which it is claimed has good detonating properties and storage capacity. Varying proportions and minor additions are dealt with in the patent in which specifications Nos. 11,645, 1893 and 2,509, 1908 are also mentioned. Accepted Oct. 28, 1909.

8,564 (1909). **Detachable Small Arm Locks.** H. White (Jos. Lang & Son, Ld), London. In patent No. 680, 1909 (fully described on page 166 of this issue) an automatic latch for detachable locks is described. The present patent is concerned with a non-automatic fastening consisting of a cam, eccentric, hook or other device manipulated by hand. Accepted Oct. 28, 1909.

9,466 (1909). **Ordnance Mountings.** Rheinische Metallwaaren und Mf., Germany. A device for eliminating the effect of oscillation of the fixed carriage comprises a spherical bearing interposed between barrel and gun carriage in which the cradle is mounted on trunnions. The bearing rests with relatively free movement in all directions, about a centre on the carriage. Accepted Oct. 28, 1909.

9,478 (1909). **Automatic Pistol Safety Device.** P. Mauser, Germany. To lock the firing mechanism a lever on the side of the pistol is turned down against the influence of a spring. It is held on the locking position by a resilient snap device. When it is necessary to fire the pistol quickly the resilient snap piece is pressed down by the thumb of the firing hand. This allows the locking lever to be returned by its spring to the inoperative position. Accepted Oct. 21, 1909.

9,663 (1909). **Projectiles for Bombarding Air Ships.** Fried. Krupp, A.-G., Germany. In the front of this shell a bursting charge is situated and in a larger chamber at the back a " tracer " smoke charge. The latter ignites when the shell leaves the gun and the former bursts the projectile when it strikes. Accepted Oct. 14, 1909.

10,166 (1909). **Differential Recoil Guns.** K. Haussner, Germany. In the case of guns of this kind which have a tendency to sink at the muzzle at every shot the patentee employs a device which prevents impermissibly great sinking and does not present any difficulty in the changing of traverse in regular shooting. Accepted Oct. 28, 1909.

11,458 (1909). **" Tracer " Shells.** J. B. Sample, U.S.A. A chamber situated at the rear of the shell contains smoke generating material intended to show the path the projectile follows. This material is ignited by a cap. When the shell is fired a striker is forced up to this cap and fires it. Normally, cap and striker are held apart. Accepted Oct. 14th, 1909.

14,223 (1909). **Automatic Small-arm Mechanism.** Aktiebolaget Svenska, Vapen-Oct., Af., Sweden. In Swedish patent No. 21,421 a recoil loading gun is described in which a weight is moved relatively forward against a spring and then back again to operate the breech. Constructional improvements are made in the breech mechanism. Accepted Oct. 14, 1909.

14,926 (1909). **Fixing Bayonets to Automatic Rifles.** C. A. T. Sjörgren, Sweden. In recoil operated arms the mass of the bayonet makes a difference to the automatic action. The patentee, therefore, arranges that it shall be fixed so that it does not participate in the recoil movement. A spring returns it to its proper position after each shot. Accepted October 21, 1909.

18,410 (1909). **Bullet Catcher.** A. P. Maxim, U.S.A. A portable box has on one end a target. Behind the target is a compartment containing some loose fibrous material and behind that a sand box. The fibrous material prevents the escape of sand. Accepted Oct. 21, 1909.

SELECTED PATENTS.

POTASSIUM PERCHLORATE EXPLOSIVES.

28,012 (1908). E. H. Harris, London. The perchlorate of potassium explosive forming the subject of this patent is claimed to possess qualities of stability and power both in manufacture and application. It is suitable for blasting or for shells. The sole oxidising agent is the substance already mentioned, $KClO_4$ which must not contain more than one *per cent* of impurities. In conjunction with it are used (1) a substance of medium density, insoluble in water, one which will give out a large quantity of heat and gas—preferably charcoal, soot, coke or one of the forms of carbon ; (2) a substance containing both hydrogen and carbon —preferably napthalene $C_{10}H_8$, benzol C_6H_6, or other hydrocarbon ; (3) a substance containing nitrogen and oxygen as well as hydrogen and carbon—preferably one or more of the nitro-derivatives of the above mentioned hydrocarbons, say mononitrobenzol $C_6H_5NO_2$, or mononitronapthalene $C_{10}H_7NO_2$.

The members of these three groups are mixed with potassium perchlorate in the following proportions. Potassium perchlorate 66–86%, Carbon 2·8–12·8%, Hydrocarbon 2·0–7·0%, Nitroderivative 4·0–15·0%.

The perchlorate of potash is first dried and ground to powder, the carbon is treated separately in the same way and the two are added together with the other constituents. The whole is then thoroughly mixed and ground together in a machine. As a lubricant 5% or more of paraffin oil is added with or without not more than one *per cent.* of castor oil. When finished the mixture is pressed into cartridges and the excess of paraffin and moisture is removed by a current of warm air. A residue of paraffin of not more than one *per cent* may be left if the best results are to be secured.

In its final state the compound contains sufficient oxygen to combine with the hydrogen and form steam and also to oxidise the carbon present to form carbon monoxide (CO) or carbon

dioxide (CO_2) or a mixture of these gases. Various proportions of the constituents mentioned above to adapt the explosive for different mining purposes are set out in the patent. Accepted Oct. 28, 1909.

DETACHABLE SIDE LOCKS FOR SMALLARMS.

680 (1909). H. White, London. To enable the side locks of break-down sporting guns and rifles to be easily and quickly removed for cleaning or other purpose the patentee proposes to fit them with a pivoted thumb piece to which is secured a fastener adapted to engage with a slot in the stock, to hold the lock in position. The thumb piece or other similar device lies flush with the face of the plate when not in use. When in the position for detaching the lock it serves as a means for facilitating the lifting of the lock out of position.

The illustrations appended clearly illustrate this device.

The lock plate *a* is provided at its forward end with the usual lip *b* which engages that portion of the action or plate seating provided for the purpose. The lock plate as is shown in Figs. 1, 2, and 3 is furnished with a sliding latch *c*, normally spring-pressed outwardly. The latch *c* is arranged to slide upon a guide *d* supported in a bracket *e* mounted on the rear or inner face of the plate *a*. Between the latch *c* and the end of the bracket *e* and mounted on the guide *d* is a coiled spring *f* serving to press the latch outwardly. In the position shown in Figures 1 and 2 the latch is thus represented adapted to engage the " bite " or grip *g*, which is sunk in the stock of the gun or rifle or other suitable portion of the small arm and retained by an ordinary screw.

The latch is adapted to be indrawn against the action of the spring *f* by means of a complementary member such as a pivoted thumb piece *h*. The fastener is in this way released and the lock plate may then be removed from its seating. The thumb piece *h* is hinged or pivoted in the lock plate by means of a transverse

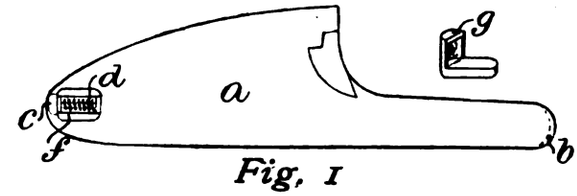


Fig. 1

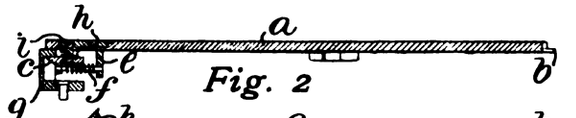


Fig. 2

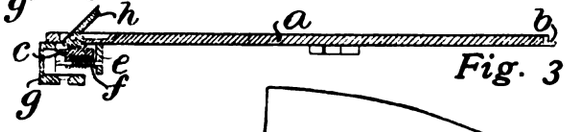


Fig. 3

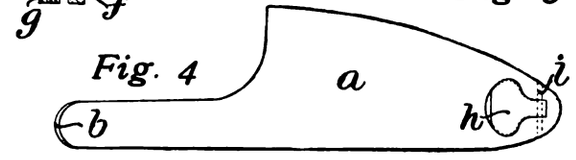


Fig. 4

pin *i* and it is connected with the latch in such a manner that raising the thumb piece withdraws the latch from its bite. The raised thumb piece provides a handle whereby the lock plate may be lifted out of its seating. The thumb piece is serrated or provided with part of a pinion engaging a short rack on the latch, and this arrangement limits the extent of the movement of the latch. When not in use, the thumb piece *h* automatically folds down under the action of the spring *f*, into the lock plate (see Figures 2 and 4) flush with the surface of the plate. It can be lifted by the insertion of the thumb nail under the free extremity, as shown in Figure 4.

This improved method of securing the lock plate dispenses with screws, pins, etc., and also with projections of any kind. The lip *b* having been inserted in place it is necessary only to press the lock plate home. The latch rides over the bite, and the automatic fastener secures the plate in position. Instead of the pivoted thumb piece the patentee proposes as a modification to use a separate key. Accepted Oct. 28, 1909.

BREECH-LOCKING MECHANISM FOR RECOIL OPERATED SMALLARMS.

20,658 (1908). P. Mauser, Germany. In Patent No. 3,496, 1906 this inventor has dealt with breech-locking devices for recoil operated arms. These devices he has now modified. Whereas they were in the first instance arranged to work in conjunction with a sliding barrel and moved with a sliding socket, they are now designed for a rifle with a fixed barrel and are themselves fixed permanently in the lock casing. A part, normally held up by a compressed spring, travels forward under the influence of recoil. Studs on the locking levers slide through slots of irregular shape on this part and the levers are in this way removed from locking engagement with the breech block.

Fig. 1

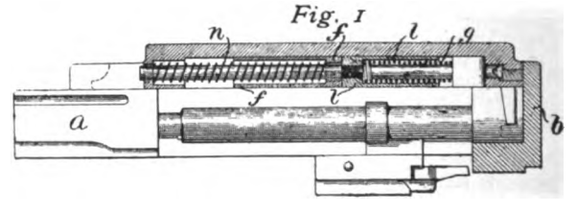


Fig. 2

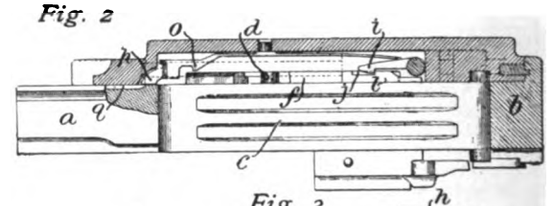
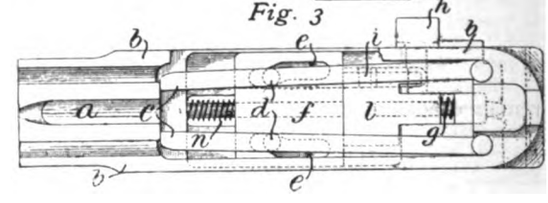


Fig. 3



In the illustrations here reproduced, *a* is the breech block which slides in the casing *b*. The locking levers *c* lie along each side of the breech casing and are pivoted at their rear ends so that their noses may be moved towards each other behind the closed breech bolt *a*. As will readily be seen their arrangement is such they support the breech block symmetrically.

The displacement of the levers *c* from the position illustrated in Fig. 3 is effected through the studs *d* which project downward from the undersides of the levers *c* into the slots *c*. These are so shaped that when the sliding plate *f* is in its forward position the lever noses are turned inwards so that they stop any rearward movement of the breech bolt *a*. The reciprocating movement of the plate *f* is effected one way through the spring *g* and the other through the recoiling breech block. Immediately a cartridge is fired the weight *h* is caused to swing forward. A lever to which the weight *h* is attached communicates with the catch *i*. This catch holds the plate in the rearward position when the parts are in the firing position. When therefore, the weight moves forwards the catch is disengaged from the notch *j* in the " presser " part *l* which, under the influence of the spring *g*, is pushed forward and it carries the sliding part *a* towards the breech. This movement, through the engagement of the projections *d* in the slot *e* carries the lever noses *c* outwards away from each other so leaving the breech block *a* an open path for backward travel.

The presser part *l* is carried back by the recoiling breech block, the spring *g* is once again compressed, and the catch *i* enters the notch *j*. A counter spring *n* is provided for returning the plate *f* when the breech block has travelled forward again and thus for turning the levers *c* into the locking position. The plate *f* is held in the forward position meantime by the catch *o* which is released from the plate by the forward travelling breech block. The curved shoulder *p* is struck by the inclined surface *q* of the block. The counter spring is of course compressed by the stronger spring *g* when the latter pushes the presser part *l* forward. The details of arrangement of the springs, etc., their bearing points and so forth are clearly set out in detail in the patent. Accepted Sept. 23, 1909.

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No. 195.—Vol. XVI. DECEMBER 1, 1908. MONTHLY, PRICE 6d.

ANSWERS TO CORRESPONDENTS.

"CUPIDITY."—Lord Bacon wrote "Read not to believe nor take for granted but to weigh well and consider." What he meant by this was, that all the power of advertisement cannot make good shooting with bad ammunition, and that the individual value of the Marksman must also be taken into account. (See reply to "Bullseye.")

"SIMPLE SIMON."—No! K.N.S. is a solvent and it chemically dissolves the nickel fouling without injury to the rifle barrel, just as easily as water dissolves sugar without injuring the tea cup.

"FLY STALKER."—The best ·22 cartridges in the market are the "Cayenite" Brands. Sorry you do not like them, but at the time you mention, the makers had only commenced manufacture. You should try them again, as that firm are always improving the quality of their cartridges. You seem to have discrimination, so they will certainly please you. Write to the Miniature Ammunition Co., Ld., 48 Dover Street, London, W.

"BULLSEYE."—What is the matter with the "Long Palma" Ammunition? It has never yet been beaten at any distance, and last year it made three World's Records. The *Times* suggested that the bullseye should be reduced to vary the monotony of the scores when shooting with "Long Palma."

"HERCULES."—No doubt bath brick or turkey stone and fat will remove your lead fouling from the tops of the lands if you rub hard enough, so will a gauze pull-through but you are wrong to speak of "Leadene" as an "abrasive." You simply smear the bore with the paste and it chemically softens the lead so that you can wipe it out like oil, not only from the lands, but from the corners of the grooves as well.

"MATCH RIFLEMAN."—Yes, you can get the ·280 cartridge with Nitro Powder or M.D. Cordite from the same Makers as the celebrated "Palma" Ammunition, but you should first find out what Messrs. Rigby & Co. are doing with the ·303 bore.

"PALM OFF."—It is the right size but the wrong Brand. The one you should use is spelt "Palma."

"TERRITORIAL."—The answer is obvious. You cannot expect to learn how to shoot unless you use reliable ·303 Ball Ammunition. Once you know that the shots are going exactly where you aim, you can correct your faults and soon become a first class Englishman capable of defending your home.

"Q.U.I.P."—Thanks for the amusing enclosure. Of course you do not want a Chemical Laboratory for using K.N.S. any more than for making a cup of tea. You simply dissolve the solid in the liquid, and pour it into the rifle barrel. You then run the solution away, and wash out the barrel with water. Be sure and wipe out with Fluor Oil before and after shooting. What could be more simple? (See answer to "Simple Simon.").

"TYRO."—Yes, it is quite true that Mr. George Gibbs of Bristol made 57 consecutive bullseyes at 900 yards with "Long Palma" Ammunition. The rifle was his own design. With this combination you only need to "hold" and you can do as well yourself. Write and ask him.

"AUTOMATIC."—We quite understand your position and sympathise with your irritation at your chance being ruined by unsuitable or unreliable ammunition. The 6·5 mm. with the big case will give you the highest velocity without undue pressure, and they will weigh less. Of course you can have 7 mm., 7·6 mm. Mauser type with either M.D. Cordite or Nitro Powder as well as the ·303. For the best people to consult, see reply to "Constant Reader."

"PULVO."—Quite so. It is understood that "X" stands for "the unknown quantity." There is nothing of this in M.D. Cordite or Nitrokol.

"CONSTANT READER."—I am quite inclined to agree with you that these paragraphs look very much like an advertisement for the King's Norton Metal Co., Ld., of Birmingham and Abbey Wood, Kent, as they are undoubtedly the best manufacturers of everything that is suggested or mentioned above. (ADVT.)

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THE following figures show the effect on Bisley Match Rifle Scores produced by King's Norton Cartridges. The comparison is taken with reference to the ten years preceding 1904, when their 225-grain bullet was first permitted:

ALBERT.

15 Shots at 800, 900 and 1,000 yards.

Highest Possible Score, 175

Average score previous to 1904.	Dropped Points,	18
Best performance previous to 1904.	,, ,,	7
Best performance by King's Norton.	,, ,,	2

ELCHO. (Teams of Eight.)

15 Shots at 800, 900 and 1,000 yards.

Without Sighters. Highest Possible Score, 1800

Average score previous to 1904.	Dropped Points,	216
Best performance previous to 1904.	,, ,,	173
Best performance by King's Norton.	,, ,,	83

(The eighth man with lowest score not using K.N. Ammunition.)

This is a world's record, beating the American record in 1907 by 3 points.

HALFORD MEMORIAL.

15 Shots at 900 and 1,000 yards. Highest Possible Score, 150

Average score previous to 1904.	Dropped Points,	15
Best performance previous to 1904.	,, ,,	6
Best performance by King's Norton.	,, ,,	2

HUMPHRY CUP. (Teams of Four.)

(OXFORD AND CAMBRIDGE.)

15 Shots at 800, 900 and 1,000 yards.

Highest Possible Score, 900

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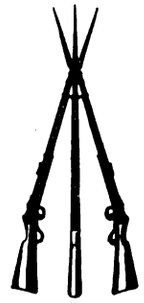

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