Arms & Explosives

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CURRENT TOPICS.

A Mistaken Prosecution.—While in theory the journalistic ears are everywhere; as a matter of fact they are no more omnipotent than those of the ordinary individual. This must be our excuse for not having been present at the Hayward's Heath Petty Sessions on December 7th, when Mr. F. J. Agate was summoned for keeping on his premises 58 lbs. more of explosive than he was authorised to do. Continuing to quote from a report of the proceedings, which has appeared in the *Ironmonger*, we find that the inspector reported 30 lbs. of gunpowder on the premises and 558 lbs. of cartridges, which was 58 lbs. weight of cartridges in excess of the authorised quantity. Those who have followed the above context will note that the 58 lbs. excess of explosives turns out after all to be 58 lbs. excess of cartridges. This anomaly is not pointed out by our contemporary, who gives a bare version of the proceedings. The result of this ridiculous misinterpretation of the storage regulations was none the less serious for Mr. Agate, who was fined twenty shillings and costs for having committed the above offence under the Explosives Act, which, as a matter of fact, is not an offence at all. Had the purveyors of justice taken the slightest trouble to acquaint themselves with the provisions of the Act upon which they gave judgment, they would have found that the Act permits loaded cartridges to a number containing not more than 500 lbs. of powder. Considering that a loaded cartridge weighs roughly eighteen times as much as the powder it contains, it will be seen that Mr. Agate was fined for storing about 31 lbs. of powder under conditions allowing a maximum of 500 lbs. So frequent are the injustices done in the name of the Explosives Act by local authorities that we really think H.M. Inspectors should take some effective means of issuing to all local authorities a digest of those provisions of the Act which applies to registered premises where mixed explosives are stored. The Gunmakers' Association would no doubt be happy to supply the Home Office at a very nominal cost with as many of their varnished card abstracts of the rules as they could possibly want. At any rate, as things stand, H.M. Inspectors should take active measures of some sort to deal with the crass ignorance of the local authorities who are called upon to administer certain sections of the Act. In the present prosecution, at any rate, H.M. Inspectors should themselves initiate proceedings whereby the decision against Mr. Agate should be cancelled, and a handsome apology tendered for the inconvenience and trouble to which he has been subjected by the mistaken activity of some ill-informed inspector.

Veloxite.—The readers of *The Times* were lately treated to a lecture upon explosives in a letter by Colonel Hope, V.C. Altogether we must say that the gallant Colonel has chosen a most extraordinary method of introducing to public notice an explosive which he, at least, seems to consider is possessed of serviceable characteristics. We should think that very few inventors would be accorded the privilege of thus applying to their progeny a valuation laid down by themselves. However, by reason of their publication, Colonel Hope's views have become public property, so to speak, and as such, a fit subject for independent criticism. We are thus free to deal with what he has said. First of all he compares his new propellant with R.F.G. powder, much to the latter's disadvantage. This is misleading to the public, because we already know that Cordite stands exceedingly well on the same basis of comparison. Further, it is a very negative kind of advantage to an explosive to state the things that it does not contain. In fact to our way of thinking it would be equally enlightening to say that the explosive contains no iron filings or other machine shop refuse. The references to flash point, immunity from explosion when subjected to concussion and to general chemical qualifications go to suggest that the explosive, which is introduced with such a flourish of trumpets, is nothing

more than a mere laboratory sample, a view that is confirmed by the Colonel's statement that he has often not been outside his laboratory for weeks together. Such a material cannot, in the absence of comprehensive firing experiments, be treated as of higher merit than the hundreds of other laboratory samples of explosives which are filed on the shelves of most of the research departments of our leading companies. Hence we must express the belief that an explosive introduced by newspaper adulation, unconfirmed by any good opinions, except those of the inventor himself, cannot be taken seriously by experts. The last paragraph of the letter is as follows:—"With your permission I should like to add—though it is perhaps hardly necessary—that in the patient prosecution of my long labour I have received no assistance or encouragement from the War Office." This we consider a thoroughly unfair attack upon a much-abused body, and a regrettable aspersion on a department which is at the present time the subject of a good deal of public criticism. The War Office, as all must know who have any knowledge of its working, conducts a large number of researches into the quality and characteristics of explosive bodies, and public money is not stinted in securing the best technical assistance available. The implied inference that the War Office should associate itself with miscellaneous individuals who desire to reduce crude ideas into practical form is a very dubious proposition. The Explosives Committee is there to test things which promise to be of interest; but public policy is certainly against the promiscuous assistance and encouragement of occasional inventors who, as a class, are deficient in the technical qualifications which are possessed in so high a degree by the specialist experts who are responsible for the laboratory operations at Woolwich and elsewhere. Altogether we must regret the bad policy of an inventor who, thinking he has something useful to submit for military use, is of opinion that its introduction to the general public should be accompanied by unworthy sneers at a department which, whatever may be its faults of organisation, contains among its officials persons who take as high a view of their duties as did the gallant Colonel when on active service.

The St. Louis Exhibition.—On the 1st of May next, the St. Louis Exhibition will be open for the information and instruction of the vast crowds whose recognition of its special character is confidently expected. A proposal has been mooted by which the British gun trade should send samples of its workmanship by way of a joint exhibit. Hitherto the opinion has generally been held that our own Government has never taken the keen and personal interest in the welfare of commerce that is displayed by other nations. In the present instance a welcome exception seems to have arisen, since the Royal Commission, which has been appointed to organise the British exhibits, has gone so far as to offer to bear all incidental expenses connected with the collection, dispatch and display of guns and other weapons submitted jointly by the trade as a whole. Whatever may be the private views of gunmakers concerning the details involved in converting this offer into a practical scheme, there can be no two opinions as to the meritorious attitude adopted by the sub-committee for agriculture, horticulture, forest, fish, game and physical culture department. This comprises within its purview all that appertains to sporting fire-arms and ammunition. The fish and game section of the exhibition falls under department M, group 120 of which relates to hunting equipment. This embodies three classes, the middle one, class 721 comprising sportsmen's arms and accessories and sportsmen's ammunition. It is in the hope that this class may be truly representative of the best that British gun and rifle makers can turn out, that the Royal Commission has put forward a proposal which should on general grounds meet with the prompt and effective support of gunmakers whose collaboration is sought on such generous terms. While the time for arranging details is all too short it is still to be hoped that by prompt and effective action a set of weapons may be turned out which will adequately represent the characteristic merits of British workmanship. We, for our part, are not so very keen on seeing very highly and over-engraved fire-arms of the class which are as a rule specially prepared for exhibition purposes. We have before us at this moment a photograph of the King's own gun. It displays a studied reserve in the scheme of ornamentation. While highly artistic, the gun is much more practical that the gold encrusted weapons which His Majesty possesses in considerable numbers, few of which have ever received the testimonial of actual service. If, therefore, we send guns to the St. Louis exhibition, let them above all things be such as the sportsman could take down from the racks and use on game.

This Year's Miniature Bisley.—The National Rifle Association are showing a most praiseworthy amount of enterprise in the steps they are taking for the development of miniature rifle shooting on the club system. The Society of Working Men's Rifle Clubs showed that an indoor miniature Bisley could bring together large numbers of shooters from all parts of the country to take part in the competitions at 20 yards range. While the financial and other results of the meeting that was held last year at the Crystal Palace do not justify in their case a repetition of the programme, the National Rifle Association, on the other hand, with its splendid organisation and plentiful supply of funds, has decided to take over the task which was so successfully initiated by its junior contemporary. Last year the N.R.A. gave valuable assistance in the management of the nine day's meeting at the Crystal Palace, which was held in March. This year it proposes to go further and hold a fortnight's meeting at the Sports Exhibition, which will be located at Olympia, West Kensington, until Easter. While the gun trade may have been disappointed that the success of the Rifle Club movement has brought so little grist to their mill, the formal recognition of miniature indoor rifles, as distinguished from Service rifles using the Morris tube, will give them an additional chance. They should leave no stone unturned in their endeavours to ensure a thoroughly good show of miniature weapons in the hands of the competitors at the Olympia meeting. The cheap fifteen-shilling rifles which come from abroad may be all very well in their way; but it should not be a difficult task to outclass them in shooting capabilities by means of rifles specially designed for target work of this character. Hence all gunmakers who have interested themselves in the design and manufacture of miniature rifles would do well to acquaint themselves at the earliest possible date with the conditions of the contests that will be arranged, in order that they may have a sufficient supply of well-regulated ·22-bore rifles to place in the hands of competitors.

BELGIAN VIEWS ON THE MARKING QUESTION.

THE Belgian organ of the gun trade, *L'Armurerie Liègeoise*, has come out with an article which contains a number of outspoken comments on the question of the differential marking of foreign guns in English proof. Our contemporary the *Ironmonger*, devoted an article last month to a commonsense examination of the whole question. Naturally, in dealing with difficult and contentious ground, their remarks were open to reply. This our Belgian contemporary has done, following upon a full translation of the article which forms the text of its remarks. Altogether, we think that *L'Armurerie Liègeoise* has carried out its task in a level-headed and temperate fashion, and it is, therefore, the more interesting to examine the views put forward. In the first place as regards the relative status of the two gunmaking centres, comparisons to say the least are odious. For actual commercial size we cannot doubt that Liège has a considerably bigger turnover than Birmingham. Proof House statistics are an unsatisfactory method of computation, and we propose to leave them alone. In Birmingham the gun trade is one of many industries. In Liège it occupies a dominant position. The question for us to consider, is not the gross turnover of Belgian arms, but how best to safeguard and develop on legitimate lines the undoubtedly important gunmaking industry that occupies headquarters at London and Birmingham, with branches in every provincial centre, and in most of the Colonial markets. Touching the question of quality, no one who has seen the work of Francotte and Courally, can say that Belgium does not produce work of very high grade. Our Continental colleagues cater for both extremes just as we do. An expert examination of characteristic samples of work from both countries shows that each can substantiate claims to the possession of special merit. In fact the collaboration of Webley and Courally goes to show that among individuals this is frankly recognised, and that something very near perfection is attained when the two are judiciously blended.

In considering the issues that are raised as between the two countries, it is desirable to put aside all tendency to prejudice, which, however patriotic it may appear, cannot but obscure the principles of clear argument. On these grounds we must regret the statement of our Liège contemporary, that without Belgian arms to prove, the London Proof House would have nothing to do. The real question at issue is merely to ascertain the motive which underlies the custom by which large numbers of Belgian guns are yearly submitted for proof in this country, notwithstanding the fact that a perfectly efficient Proof House exists in Belgium. It seems to us that three reasons can be alleged: first, that the English proof may be supposed among buyers, to afford a more exacting test of the stability of a fire-arm; second, that the English proof permits English dealers to misname Belgium arms, as though they were of English make, without being given away by the foreign proof mark; and third, that the English proof mark would enable Belgian gunmakers to export Belgian arms to British Colonies and other centres with such added English names as their fancy or ingenuity may suggest. The first motive is an absolutely legitimate one, and if it accounts for the popularity of the English proof among Belgian gunmakers, well, we must accept the compliment as a sign of the estimation in which our proof is held. Reasons two and three naturally relate only to fraudulent misrepresentation; but we must not be reckoned to be making any accusations in quoting them as alternative motives to the first mentioned. Our Liège contemporary says most distinctly that it is not fair to permit Birmingham and London gunmakers to take credit for Belgian workmanship, and make their customers believe that the arms supplied are English. We think so too. Hence, there is no possibility of creating bad feeling with Belgium when we adopt an attitude that receives our neighbours' hearty concurrence. Those who may have an interest in the continuance of a form of trade which is abhored by respectable traders, will certainly not come forward publicly to lodge their objections. It, therefore, follows that on purely technical grounds we must all be on the side of honest trade methods. Even if our practice may not be as perfect as our precept, it must always be remembered that many things are done in self-defence which are contrary to one's notions of what is fit and proper.

Of the third reason, we have but little to say from information of a reliable character. We know that the registered trade marks of most of the leading Belgian firms are in English, and of a character that would lead the innocent purchaser to presume that guns so marked were of English origin. Also a large part of Belgium's foreign trade in guns is with English-speaking countries. If such arms are proved in England, well so much the better if the marking bears evidence of foreign origin. There can then at least be no mistake. In summing up the question, our contemporary states, that in its own opinion, the measures now approved will have an effect the exact reverse to what is intended. In taking our course we have endeavoured to benefit ourselves, so that if the opposite results, our rivals in Belgium will be the gainers. If they are, their attitude towards the new rules must be one of complaisant approval, and not of rancorous objection. They may withdraw the help they have extended to England, and redouble their efforts to get the trade direct. We on our side must do more than in the past of the work that bears English names, and endeavour by improved manufacturing processes, to give better quality and better value than ever before. This is competition as we like to see it, and we trust that no harsh words will be bandied about as the result of our attempt to enforce a stricter observance than has hitherto existed of the rule that each shall trade under the flag of his own nationality. Nothing in this attitude need detract from the respect that every one should feel for his rivals in business, be they British or foreign. No one appreciates more fully than we do, the enterprise and praiseworthy endeavours of such concerns as the *Fabrique Nationale*. We on our side are proud of such works as the Birmingham Small Arms Company, and those of Messrs. Webley & Scott. More than this, we recognise that the standard of Belgian workmanship is yearly improving, and that we on our side must be ever on the alert to leave no stone unturned that may conduce to the development of English trade. By pursuing scientific investigations to their utmost limit, and by throwing out old methods and installing new ones on approved lines in their place, we hope at least to find profitable employment for all whose call in life is to make guns.

THE NEW FIELD GUN-CARRIAGE.

EVIDENCE has not been wanting of late that the War Office is actively bestirring itself to improve the existing model of field gun-carriage. The South African war showed that our field artillery was frequently placed at a disadvantage by reason of the well-nigh obsolete form of carriage that was used. Whether it was truly obsolete at the commencement of the war may be open to argument, but now at any rate it is certain that the modern field gun-carriage must be such as to allow for the separate recoil of the gun, instead of gun and carriage going back as one piece.

As a general truth it may be stated that the gun recoils approximately 1½ inches during the time that elapses from the first movement of the shot inside the bore to its departure from the muzzle. As soon as the shot is gone the gases follow with great rapidity, so that the above distance of recoil may fairly be taken as covering the distance through which the gun moves while building up its maximum energy of recoil. This energy, whatever may be its value, is taken up by the action of the gun-carriage in cutting its way into the ground on which it stands. The necessary grip is mostly provided by a spade which is forced into the ground by the trail of the gun. The resistance necessary to bring the gun to rest may be calculated theoretically by dividing the number of foot-pounds energy of recoil by the distance which the gun covers in its backward travel. The trail should evidently be of sufficient strength to sustain the thrust that would occur in ground affording a maximum of grip, and, therefore, a minimum of travel before coming to a standstill.

The disadvantages of a solid mounting as between gun and carriage, are that the gun has to be relaid after the firing of every shot, so that a considerable amount of time must elapse between the rounds. The amount of displacement that the gun sustains by the firing of each shot is a variable quantity, since there is no certainty either as to the grip it will obtain, or even that it will recoil in a straight line. More than this the possibility that guns may be used on ground having a sandy or other unsuitable surface, places a limit on the strength of the ammunition that can be used. The recoil, be it understood, is in close relation to the power of the ammunition.

Where guns are attached to naval mountings the recoil is dealt with in a far more scientific fashion than occurs with field carriages. Sometimes pneumatic, but mostly hydraulic, buffers act as an elastic connection between the gun and its mounting, the recoil in such instances being taken up by a definite resistance which is applied over a considerable distance of backward travel. As the distance of recoil is increased, the actual thrust on the fixed mountings of the gun is considerably reduced, a condition which is essential to guns which are bolted to the deck of a ship. The French were among the first to apply the principle of the buffer to field gun-carriages, with the result that the rapidity of fire is greatly increased, the manipulation of the gun being proportionately simplified. The widely held view that the buffer system of recoil absorption would introduce complications of an objectionable character in the handling of field artillery has been found to be erroneous, the balance of advantage undoubtedly lying with the system that gives greatly enhanced efficiency at a comparatively small cost in the way of extra mechanical risks.

At any rate the experiences of the South African war afforded conclusive proof that the British pattern of field gun-carriage was in sore need of being brought up to date. It was clearly seen that the efficiency of artillery fire must be greatly enhanced, though of course experts will always disagree as to how far this should be done by increasing the velocity of existing shells, or whether the shells themselves should be increased in weight, thereby increasing their ranging power. Whatever may be the particular answer to this question, one thing at least is clear, viz., that the new carriages must be capable of absorbing a greater amount of recoil than the old type, and that the time lost in relaying the gun after firing must be materially reduced.

The War Office some time back invited various leading ordnance manufacturers to submit hydraulic field gun-carriages for the purposes of practical trial. This was with a view to the adoption of a satisfactory model to be sealed in due course as a service type. The arranged characteristics of the new design were that the gun should have a long recoil within its own mountings, and that elevation and traverse should be provided for as between the gun and its carriage, instead of by altering the position of the carriage itself relatively with the ground on which it stands. The invited firms accordingly lost no time in submitting models of carriages for the War Office experiments, and so far as information on such matters is available, there seems to be no reason to doubt that thoroughly satisfactory results have been attained. With French experience before us, it naturally follows that the designs separately arrived at by the competing firms must follow on very much the same lines. This facilitates the task of embodying in the new service gun-carriage the best features of all available systems. A characteristic of all recoil-absorbing field guns is that they have a very much more rakish appearance than those of the old pattern. This mainly arises from the fact that the spreading of the recoil over a prolonged thrust reduces the amount of strength required in the trail. The recoil mechanism itself is necessarily made as compact as possible, so that judging from the French and American models of gun, which work on the same general plan, very little mechanism lies outside the space enclosed by the wheels of the carriage.

One of the most important points of field gun-carriage construction, which has yet to be mentioned, relates to the sighting of the gun. In the French gun there is an independent movement between the sighting bar and the gun itself. In this way after laying the sights on the target, with an elevation appropriate to the estimated range, the sights remain fixed whatever may subsequently be done to the gun. Thus when it is found that the shot strikes either high or else short of the object aimed at, the gun may be raised or lowered in elevation without affecting the alignment of the sights. This represents a considerable saving of time as compared with the alternate process of first re-adjusting the elevation of the sights and then relaying the gun to accord with the new conditions.

The importance of this refinement in the sighting process may not at first be appreciated by persons who are not practical artillerists. Those who are used only to the handling of small arms will be unaware of any objection to the operation

of removing the gun from the shoulder and re-aligning it on the target after making any required alteration of the sights. Field guns on the other hand are not so readily manipulated. Hence the need for an independent movement of the sights of the gun. The sights being once aligned on the object of attack should so remain, the axis of the gun being thereafter subject to correction, according to the observed results of the shooting. This refinement of sighting would obviously be of no use in dealing with guns with fixed mountings on the carriage, because the disturbance of the gun's alignment after the firing of each shot in any case involves its complete relaying.

THE LATE MR. A. C. GOULD.

WE very much regret the news which has reached us from America to the effect that Mr. A. C. Gould died on the 15th ult. The late Mr. Gould was probably the best known rifle expert in the United States. In fact his individuality has become so much associated with American rifle doings that it is a natural attitude of mind to think of the two as mutually belonging to one another. Like many another journalist very little of his published work has been issued to the world signed with his own name, and although he has made such a complete study of the entire range of the American rifles and revolvers we have only two volumes from his pen, and a little handbook which was noticed in these pages in September, 1902. Most of Mr. Gould's time has been spent in editorial work connected with the paper *Shooting and Fishing*. Yet there is very little evidence in the issues of recent years of his having put pen to paper. The fact that his record of literary production hardly appears to be in accordance with his position and experience, suggests that a man of his enthusiasm must have been in great demand by those in need of his assistance in one way and another. An enormous amount of unofficial work can be done in this way which, while it displaces many legitimate activities elsewhere, does not secure for the person really responsible the full measure of credit that is his due. We know that Mr. Gould, by indefatigable labour and unremitting enthusiasm, was one of the chief instruments in the resuscitation of military match rifle shooting in America. To this aim alone a great part of his time during the recent years of his life was devoted, and we can only regret that he has not lived longer, so as to see the more complete developments of his schemes.

As regards his career Mr. Gould was born in Boston on the 8th August, 1850, but it was not until the early eighties that he became widely known as an expert rifleman who had specialised in the theoretical study of firearms. In 1885 he started a monthly periodical entitled *The Rifle*. In 1888 its name was altered to *Shooting and Fishing*, by which it has been known ever since. In the year 1894 the headquarters of the paper were removed to New York. The two publications, by which we prefer to judge the man, are entitled respectively *Modern American Rifles* (1892) and *Modern American Pistols and Revolvers* (1888 and 1894). This excludes the *Rifleman's Encyclopædia*, which struck us as unworthy of the author's earlier reputation. Each of the former works is recognised as an authoritative exposition of its subject.

PATTERN TESTING AT THE PLATE.

ONE of the reasons why the testing of patterns at the plate is not more systematically carried out seems to arise from the difficulties of fixing a reliable standard to work by. No one is in doubt as to the numerical value of the pellets that agree with the different grades of choke, but beyond this very few care to go. For instance, granting that a gun throws about the average pattern required what is the difference between good and bad behaviour? How many shots in ten may permissibly be allowed to show a wide divergence from the rest of the series without condemning the gun is a question we have frequently asked but seldom heard answered. No one really cares to admit how frequently the most perfectly bored gun and the most skillfully loaded cartridges will go back on previous records and throw really bad groups. The general allowance is about one in every ten rounds, but even then the bad shot may occur twice in one series and be absent in the next. However, accepting an all-round allowance of one shot in ten, then the next point to decide is what degree of conformity shall be asked for in the remaining nine rounds. Some days a gun will throw shot after shot with a variation of but a few pellets on either side of the average mark. On another the variations may be considerably greater, and for no apparent reason. There are in fact so many things that affect the distribution of the shot on the target as to make it very difficult to lay down any hard and fast rules. We all come across guns once in a way that seem to be free from most of these errors, but then the present remarks apply to guns as a whole and not to freak samples that combine in some unknown way the qualities that go to make for perfection.

Even if we arrive at some sort of notion of the consistency that should be recorded in the case of the ninety per cent. of selected patterns then the much more difficult question of analysing the regularity of distribution of the pellets comes in. Few patterns that are thrown from such a distance as to give a 30-inch killing circle will display such an absence of grouping and gaps as would ensure the killing of a bird anywhere within the circumference marked. According, therefore, to the frame of mind of the observer it is posssible to be satisfied or dissatisfied. One set of patterns may be condemmed for patchiness, whereas another equal in all respects may be praised by asking what one could want better. Although this part of the question may be held to be equally dominated by the personal factor of the experimentalist, we ourselves hold to the opinion that good patterns, which are good from all points of view, are those which give the most regular counts round by round. Whatever may be the distributing influence its affects is most certainly noticed in irregularity of the readings obtained. It may be impossible to locate the particular cause of the trouble, but when the patterns are regular the gun may be taken as all right, when on the other hand anomalies are constantly arising one may be sure that something is wrong somewhere. Do not expect mathematical regularity, because by so doing there is always the danger of attaining one's desire for perfection in pattern by means which destroy the whole value of the test. Weak cartridges or a gun that gives weak shooting with full power cartridges will always favour patterns, but even so a good pattern is only good if accompanied by a sufficiency of penetration.

THE NEW EXPLOSIVES CO., LD.

IN our issue of April, 1894, a short note appeared referring to the fact that the new board of directors of the New Explosives Company had issued their first report, which contained satisfactory evidences that the business of the Company was likely to show a considerable improvement. At the present time of writing such facts as these must necessarily rank as ancient history; but even so it is very interesting to mark the development of any industrial concern having a record which is a source of pride to those responsible for it. The Stowmarket factory of the New Explosives Company ranks as the oldest of its kind in this country, the late Sir Frederick Abel having there carried out his first venture in the way of guncotton manufacture on a commercial scale. This concern was known as the Explosives Company, Ld., and it was registered as such on November 18, 1881. Previous to that date the business was carried on as a private concern. An interesting relic of the Company's name should not be forgotten, in so far that the celebrated E.C. powder derives its title from the initials of this Company, in whose works it was first brought to light. In July, 1885, the business of the Explosives Co, Ld., was taken over by the New Explosives Co., Ld., and has since been carried on under the new designation.

It was, however, on March 31, 1893, that the turning point in the Company's modern career was reached. Prior to that date the business position of the Company had suffered from a variety of causes, chief among which was a tendency to favour the payment of large dividends at the expense of leaving an insufficient margin for safeguarding the strength of the Company. In due course the effects of this erroneous policy were felt. The works had not been kept up to the standard required for the class of work undertaken; and as a result the factory had been almost closed down, so that instead of presenting a scene of bustling activity, it bore a dejected appearance. Fortunately for the Company's future prospects the shareholders contained amongst their number a band of resolute enthusiasts who refused to permit a fine business to disappear for want of the necessary energy to effect its restoration. A committee was consequently appointed, and as the result of a systematic enquiry into its general financial condition they reported to their fellow shareholders that with active management there could be no reason why the Company should not witness a return to its former state of prosperity.

The new board of directors which was thereupon appointed consisted of the following gentlemen, viz., Mr. C. W. A. Goodfellow (Chairman), Capt. O. N. H. Barwell, Mr. F. Machell-Smith, Mr. Walter Stocken, Junr., Mr. W. W. De Buriatte. These directors issued their first report on March 21, 1894, the period covered comprising the year 1893, the last nine months of which represented their actual term of office. The balance sheet which they issued showed a share capital of £90,000, creditors £1,792, loan from bankers £2,500, and sundry small liabilities £149. This was covered on the other side of the account by £618 in cash, £4,154 for investments, £7,592 for stocks and stores, £76,983 for property purchase account, and £1,523 for other minor assets. The deficiency shown on this balance sheet amounted to £2,580 12s. 8d. It is not difficult even at this date to realise the task which the directors had undertaken in determining to convert this state of affairs into one denoting prosperity. Yet we find on looking over the last balance sheet issued (1902) that, while the capital has in the interval been increased by only £30,000, all that was unfavourable ten years ago has now been converted into a satisfactory asset. A reserve fund of £3,000, and creditors to the amount of £2,713, represent the total liabilities other than capital and undistributed dividends on the debit side of the account. The statement of assets shows that the property purchase account stands at £107,000, a figure which is arrived at after substantial depreciations have been written off. Debtors to the Company stand at £4.802, stocks and stores at £17,058, while the original £618 in the bank against a loan of about four times that amount had been converted into a credit balance of £15,028.

Of course it is impossible by a mere digest of the Company's statuary balance sheet to accentuate some of the points where progress has been most marked. A visit to the Stowmarket factory about the year 1893 would have given even a casual observer good reason for believing that old methods had been pursued far too long. Weather-worn buildings and out-of-date plant were everywhere in evidence. There was on nearly every side proof of the need for renewing the waste which is so serious a factor in such places as explosives factories, where acid and other strong chemicals exercise their deleterious effects. To go over the factory at the present time is to encounter a different experience. The days when guncotton alone was its staple manufacture have passed away, a new Cordite factory, which was erected under the direction of the Company's then Works Manager, Mr. R. B. Pollitt, being a model of perfection, both as regards the convenient location of the buildings, and the finish, of its appointments. The older part of the works has also been greatly re-modelled.

Although the making of Cordite, which carries with it the manufacture of nitro-glycerin, represents the most important expansion of the Company's scope, this by no means exhausts the new lines of business which have been cultivated. The demand of late years for coal mining explosives capable of being used with safety in fiery mines has called up an important group of what are commonly called safety explosives, in which the latest chemical knowledge has been exercised to produce the necessary power without the liability to ignite fire-damp or coal dust in the vicinity. "Stowite" is the very appropriate name which has been applied by the Company to a safety explosive for use in fiery mines. It has passed the severe Home Office tests for safety, as judged by the Woolwich trial gallery, and the success it has met with since the date of its introduction at least shows that it is accepted in the mining world as thoroughly effective for the work it is called upon to perform. The whole of the ingredients employed are uniformly incorporated, and the resulting mixture is of such a character and consistency as not to be liable to exudation. It is fired by means of a No. 6 detonator, and is capable of securing a large amount of coal in big pieces, with a minimum of slack. Another of the Company's safety explosives which is especially

MR. H. COMPTON.

MR. I. C. ODY, F.I.C.

MR. F. MACHELL-SMITH,
Chairman.

MR. E. H. HINDLEY.

MAJOR-GENERAL
SIR F. MAURICE, K.C.B.

MR. L. G. DUFF GRANT,
General Manager.

MR. W. W. DE BURIATTE

adapted for coal mines, is Pitite. It is of a different grade of strength from Stowite, so that between the two the miner is able to select a grade of explosive exactly suited to his needs. When to these is added the important group of nitroglycerin high explosives for rock blasting, which the Company commenced to make on the completion of their nitroglycerin plant, it will be evident that from turning out but one product they now manufacture practically every variety of modern explosives.

Another development, to which the New Explosives Company has paid a considerable amount of attention, consists in the building up of high explosive charges for shells and torpedoes in a single compressed piece. This takes the place of the older method, whereby the total charge is made up of a number of individual pieces or segments. While their compression in detail is much more easily performed than in dealing with the whole bulk, the old form of manipulation was performed at the cost of loss of space in the shell due to the interstices between the segments, and of a want of cohesiveness in the mass of explosive. The uniform density of the guncotton charges made by the new process assists detonation, as also does the certainty that the distribution of moisture throughout the mass is the same. In a similar way great advantage accrues from the possibility of repeating a given shape of charge time after time.

Of the personalty of the directors, who have been responsible for the Company's uninterrupted career of success since they took charge of its destinies, there is very little to say. Being men of business, they tackle the problems that present themselves for solution on ordinary common-sense principles. As time has gone on changes have naturally arisen, the most regrettable being the death of Mr. C. W. A. Goodfellow, on January 10, 1903. He had been chairman of the board of directors since the reconstruction of the Company, and to him in a great measure is due the success which it has achieved. Mr. Machell-Smith was elected his successor, and he now shares with Mr. W. W. DeBuriatte the honour of having been uninterruptedly on the Board of the Company since March 31, 1893. Of the new directors, Mr. E. H. Hindley has been in office for a number of years, having been also one of the original Board. Mr. H. Compton was appointed to one of the vacancies on the board since the issue of the 1901 balance sheet, his name appearing for the first time on the report for the year ending December 31 1902. The latest addition to the board is Major-General Sir F. Maurice, K.C.B., whose great military attainments will doubtless prove a very valuable asset to a firm whose manufactures are largely concerned with munitions of war.

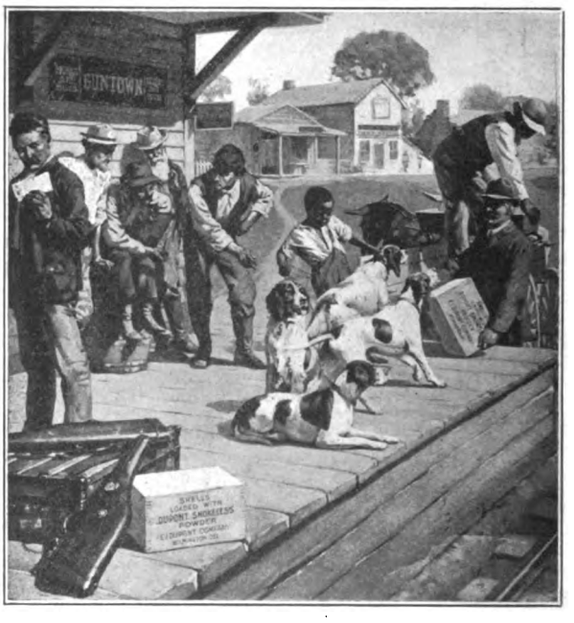
Of developments in the staff, there have of course been a certain number during the period under review. Mr. R. B. Pollitt, whose name has already been mentioned in this article, did good service for the Company during the establishment of the new Cordite works. Upon his leaving the Company's employment he was succeeded by Mr. J. C. Ody, F.I.C., who ably performs all the functions of works manager. Again, a very strong personalty among the officers of the Company was Mr. F. Marten Hale, till lately acting as general manager. To the post so vacated, Mr. L. G. Duff Grant, who is already well known to our readers, has been appointed. This gentleman has enjoyed some twelve years practical acquaintance with the explosive business, and throughout his connection with the trade he has shown himself to be possessed of an organising ability, whereby he has at all times been enabled to give undivided attention to various matters which are for ever turning up, and require for their settlement great concentration of mind. Speaking from a thoroughly comprehensive acquaintance of his past career, we feel safe in looking forward to a further continuation of the tide of prosperity which we have been at pains to review. His future is now intimately associated with the New Explosives Co., Ld., and we accordingly have great pleasure in including him in the accompanying group of officials and directors of the Company, of whom we cannot say more than that we trust that they will continue to progress in the future as they have done in the past.

EXPORT OF FIRE-ARMS AND GUN BARRELS IN LIÈGE.

ACCORDING to Sell's Commercial Intelligence the manufacture of fire-arms and gun barrels in Liège has steadily increased since 1880 and the export thereof has increased in like manner. The exports to all countries during recent years were as ollows: –

1898	600,000.
1899	660,000.
1900	720,000.
1901	760,000.

The United States is one of the principle markets for the fire-arms product of Liège, especially for guns costing under £1. Certain manufacturers turn out a large quantity of guns having imitation Damascus barrels attached. In the last ten years the production of Damascus and steel barrels has increased, the annual production being about 500,000, of which about 100,000 single and 160,000 double barrels were sent to the United States. The Damascus gun barrel is made principally at Nessonvaux, eight miles from Liege.



FROM THE LATEST DUPONT CALENDAR.

ROUND THE TRADE.

The affairs of Mr. Samuel Smallwood, gunmaker, of Shrewsbury, have been placed in bankruptcy.

A third and final dividend of 1s. 11d. has just been paid in respect to the affairs of F. T. Baker, making 16s. 11d. in all.

Mr. C. E. Greener has re-appeared in his old haunts, having completed a most instructive business trip in different parts of the world.

Those who have dealings as contractors with the War Office will have noticed the appointment of Mr. H. D. de la Bere to be director of contracts in place of Mr. Major.

The Mars Automatic Pistol Syn., Ld., is registered with a capital of £17,500 to do a fire-arms business. The first directors are Messrs. S. Sanders, A. Gray, J. R. Hutchinson and J. F. Fairley.

£10,000 debentures have lately been registered in the name of Messrs. F. Joyce & Co., Ld. They are charged upon the Company's undertaking and property, present and future, including uncalled capital.

An explosion occurred on the 18th ult. at the Greenwich factory of the Blenheim Engineering Company, better known as the Henry Barrel Company. The mishap appears to have occurred in the detonator filling room.

The 11th ult. was the date fixed for the adjourned examination in bankruptcy of Mr. H. W. Gabbett-Fairfax. The case will be dealt with summarily, and the estimated liabilities rank at £6,500, against estimated assets available for dividend £210.

We have received for notice a 107-page hand-book on gas engines, their advantages and application. The author is W. A. Tookey, the publishers Merritt & Hatcher, Ld. The scope of treatment displays throughout a thorough grasp of the subject.

We have received from Messrs. Ludw, Loewe & Co., Ld., of 30 and 32, Farringdon Road, a "week-at-a-glance" desk diary for 1904. The diary, which is in pad form, shows a whole week's engagements exposed to view by tearing off the slip for each day as it passes.

A Home Office report, signed by Major A. Cooper-Key, on the circumstances attending the nitroglycerin explosion, which occurred at the Cotton Powder Company's Factory in August last, has just been issued. No fresh light seems to be thrown upon the cause of the accident.

The South Wales Daily News recently published an appreciative paragraph concerning the Ross rifle, which it described as the invention of Mr. Charles Ross, himself a well-known Canadian. Considering that Sir Charles is the lineal chief of one of the oldest Highland clans, this is not bad.

The Peddie Small Arms Corporation, Ld., capital £100,000, has been registered for the object of taking over as a going concern the Harris Rifle Magazine, Ld. There is to be no initial issue, and the director's qualification is £50. The Mr. Peddie seems to be Mr. J. T. Peddie, of 15, Victoria Street, S.W.

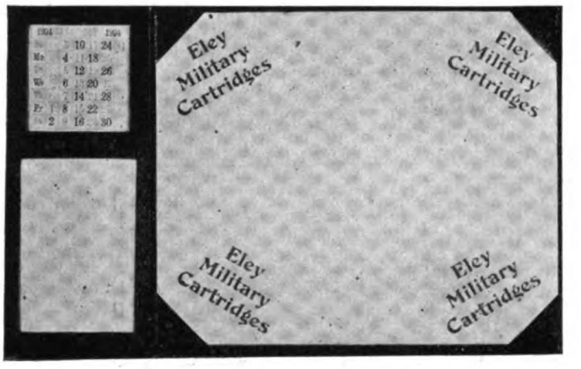
Mr. Dudley Wilson, acting on behalf of the South British Trading Co., Ld., direct representatives of the Stevens Arms Company, will pay a comprehensive round of visits to open up relations with dealers and others who handle these weapons in large quantities. The address is 13-15, Wilson Street, Finsbury, E.C.

The receipt of the latest edition of the Lyman catalogue of gun and rifle sights reminds us that so popular are this Company's specialities that gunmakers have the greatest difficulty in securing the delivery of their orders. It is a curious thing that no other firm in the world should be able to make sights up to the Lyman standard of excellence.

The annual general meeting of the Birmingham and Provincial Gunmakers' Association took place on the 7th ult., Mr. W. H. Hughes presiding. The chairman's speech was mainly a repetition of the matter we have already published in dealing with the annual report. The subsequent discussion was of a discursive character, and covered a number of subjects of topical interest.

Faithful readers of the *Field* advertisement matter will have noticed that one Johann Peterlongo, of the Mechanical Arms Factory, Austria, advertises for sale:—"Three and four-barrelled combined rifle and shot guns." *Land and Water* renders the same matter as follows:—"Shot guns, 3-barrelled guns, 4-barrelled guns, rifles, oval rifles, single-groove rifles, repeating rifles, guns with Paradox bore for shot." It would be interesting to know what really is meant.

Messrs. Eley Bros.' seasonable lines, to use ordinary commercial jargon, comprise the neat little calendar memo. pad and blotter which is here illustrated, and a wall calendar.



The chairman of the De Beers Consolidated Mines announced at the annual meeting held in Kimberley, on the 16th November last, that the Company's Explosive Works are now completed. It seems that the factory figures out at £929,659 in the balance-sheet. Continuing, he stated that the Company is supplying its own needs at Kimberley, and that it has entered into a contract with the most important groups of mines at the Rand for the supply of half their requirements.

That one may not sell an unproved gun without being liable to a penalty seems logical enough, but that a duly proved gun becomes an unproved gun by the fact of an English name being added thereto seems an absurd anomaly. This is sound law as applied to guns proved in Belgium and sold in this country. Daniel Leonard was fined 10s. and three guineas costs by the Birmingham magistrate on the 4th ult. because of his defective legal education in this connection.

The Critic, in its issue of November 8th last, writes a long article to the Colt Gun and Carriage Company. The general inference to be drawn therefrom is that while the market price of the £1 shares ranges somewhere about 2s., certain persons have got hold of the idea that they are worth more, because of a prospective payment from the Government in respect of the late war, and they are accordingly trying to buy up a supply at low prices in expectation of a rise. The general conclusion seems to be that the shareholders should at least be told as much as outsiders seem to know.

Land and Water came out on the 19th ult. with the first issue of a new series under the title of *Land and Water Illustrated*, this being the form in which the new proprietors have decided to run the paper. This adds another to the sporting papers which have abandoned the *Field* for a model, and adopted the *Country Life* style in its place. The probable explanation of this circumstance is that where papers cannot publish within twelve hours of receiving their latest news matter they do better to consider appearance, and abandon the attempt to rank as weekly newspapers.

The *Birmingham Magazine*, in an issue which does not appear to be dated, but which seems only recently to have come to hand, contains a long descriptive article of the Birmingham gun trade. It starts historically, criticises with a

certain amount of political bias, meanders through the fiscal question, and lands the reader muddled, but safe, at the end of the journey. The Birmingham and Provincial Gunmakers' Association, which is quoted in the first article, has the next all to itself. After recalling the long-forgotten strife in connection with the Payne-Gallwey dispute, it goes into more legitimate history. We are asked to review this magazine. It is amateur journalism, and attains about the same level as other unskilled effort, whether it relate to literature, drama or mechanics.

Among the latest catalogues that have reached us is that of A. B. Williams & Co., Weaman Street, Birmingham. Although issued as a trade catalogue, a notice of it is given in the *Gamekeeper*, which says that readers of that periodical may obtain copies on application. This being, therefore, a catalogue that may reach the consumer, we beg leave to criticise it as having too much purely gunmaking information, and too little of the description that will guide the lay buyer in the selection of a gun. Who cares, for instance, whether a gun has three-pin bridle locks? Certainly we should say not the sportsman. We should like to see a development of Messrs. Osborne's specialisation of graduated types, with descriptive matter comprehensible to the sportsman.

CORRESPONDENCE.

CARTRIDGE LOADING BY GUNMAKERS.

TO THE EDITOR OF *Arms and Explosives*.

SIR,—I have read with much interest the article in your December issue of *Arms and Explosives* under the heading "Lectures to Young Gunmakers," entitled "Cartridge Loading by Gunmakers." It is most satisfactory to note the care taken to show the importance of accuracy in loading sporting cartridges. Having regard to the fact that a gunmaker very seldom has any means of testing the pressures developed by his loads, it is wonderful that accidents are not more common. With cartridges which are wadded and rammed entirely by hand, a good powder can be safely used, providing ordinary care is taken, but when the ramming is done by a machine (such, for instance, as Dixon's rammer), which allows of a great pressure being put on the powder, by the exercise of very slight strength from the operator, it is surely essential that the very greatest care be taken, and the cartridges checked for pressure in a crusher gun before they are issued

I think one rule (No. 6) given in the article would cause trouble with most powders. Surely it is a mistake to advise so much as one-tenth inch compression of the powder. Such a compression upon most powders would cause pressures in the chamber of the gun much too high, especially in warm weather. I would recommend the following plan for machine-loaded cartridges, as being more serviceable to the gunmaker, bearing in mind always that it is much better to send a cartridge out a little on the weak side, rather than at all dangerous, viz.:—Place the powder wad so that it shall be clear of the powder, then put in the felt and over-felt wad, and seat them so that the powder card is well seated. Then adjust the rammers of the machine so that the wads will be seated to the same extent. This plan makes it certain that there shall be no air space between the powder wad and felt, and also allows a little give from the felt, in case either the charge of powder is on the high side in weight, or the felt wad too thick. For the same reason I believe a machine rammer fitted with comparatively light springs, the best to use for seating the felt and over-felt wads, although a stiffer rammer is useful for forcing the wads into the case.

A. C. L.

Dec. 22, 1903.

[The powder compression should average one-sixteenth of an inch, not one-tenth, as was erroneously stated in the rule our correspondent quotes. The system above recommended has always been advocated by us, except that we can see no reason why the over-powder wad should not be lightly seated on the powder, be it understood, to a distance short of what it will take up in the subsequent ramming. We further think the use of spring-operated rammers a mistake. ED.]

TO THE EDITOR OF *Arms and Explosives*.

SIR,—In going over your last "Lecture to Young Gunmakers" on the subject of cartridge-loading, a query comes into my mind which I wish to submit for consideration. It is that your advice is the advice of perfection, which a gunmaker situated as I am, and a great many more are, is very difficult to follow. Since prices have gone down so much the cartridge trade is not worth the trouble it used to be. In the good old days it paid us to work out loads for our customers' guns, and convince them by shots at the plate and at Pettitt's pads that what we advised was the best. In the order which followed there was usually compensation in full for the trouble taken, but now it often happens that after going to a lot of pains to convince a man of the merits of a particular load, he sends the order to one of the cheap firms, and as often as not he makes up a bigger lot than he wants, and divides it among his friends, all of them having the benefit of the low price. Our difficulty to-day is to show the cartridge account on the right side at the end of the year. What with the ammunition advertised by general store dealers and people of similar kind who know nothing about the business, and rely on the travellers to tell them how to sell the stuff, it is very difficult to see where the gunmaker comes in. He still gets a lot of orders for odd loads, which oftentimes gives more trouble than they are worth, but of orders in respectable quantities which can be put through on the best principles, he sees very few.

This is going a bit away from the subject I started to write about. The number of working hours in a day is limited, and if a gunmaker is in the loading-room superintending each cartridge order, he cannot at the same time be in the front shop talking to his customers, who, even if they have only called for a friendly chat, cannot be neglected. It is like this that the fitting in of odd loads often goes wrong. Highly paid assistants cannot be engaged for loading at the prices now given, and if they make an occasional error of judgment they cannot be too severely blamed. Among the gunmakers who still do a large loading business on their own premises, the quality of work must be fairly good, or they would soon know of it. Sportsmen are very fond of comparing cartridges when out shooting, and if any of them thinks something is wrong he loses no time in borrowing some from a friend to see if any difference can be noticed. So that you see cartridge loading, if not conducted on the highly scientific lines you advocate, is guided by the practical experience of those who have spent a lifetime at the business.

A COUNTRY GUNMAKER.

B.S.A. BARREL TUBE MAKING

A NEW INDUSTRY.

THE best piece of news that we have been privileged to convey to our readers for some time past is that the Birmingham Small Arms Company has taken up the subject of making gun barrel tubes for the trade. For months past it has been dinned into our ears that the existing barrel makers in Birmingham could deal with the home demand if it were placed in their way. Frankly we have received such statements with unqualified disbelief. Our attitude is not one of mere scepticism. It is based upon actual knowledge of trade conditions. Facts which have been brought to our notice have gone to show that the tubes which come from abroad are not only cheaper but better in quality than our own, with the further advantage of satisfactory rate of delivery and other business conveniences. We have never denied the possibility of remedying this state of affairs, but we could not see where the equipment and capital could be found which would enable us to compete on modern lines with the facilities which have been created by our continental purveyors. All these difficulties are set at rest now that there is a prospect of B.S.A. barrels becoming a feature of English gunmaking.

It will be interesting to review the circumstances that have led us in this connection to depart from our usually cautious attitude, and speak thus confidently of the future. Some ten or a dozen years ago the Birmingham Small Arms Company came to the conclusion that to drill military barrels from each end, and then roughly straighten the bar of steel so that the two holes lay more or less in line was, to say the least, obsolete in the light of what could be done with the Pratt and Whitney barrel-boring machine. They accordingly went more fully into the question, and ultimately possessed themselves of an outfit of Loewe machines of the kind illustrated in our issue of March, 1893. The general principle of this machine is that it can drill a hole from one end to the other of a bar of steel, that a supply of oil is delivered to the point of the drill through a hole in the drill itself, and that the pressure of oil is such that it carries the swarf or metal shavings back along the groove in the drill, so that there is no binding of its motion. More than this, each machine carries two spindles, and a single attendant can supervise the simultaneous drilling of six barrels. The satisfactory working of these machines was not mastered in a day, nor for that matter in a month. But at the present time of writing we can safely affirm that as the result of years of experience in the working out of details no set of machines in this well equipped small arms factory performs its work with greater certitude and efficiency than those under notice.

The specialisation of processes has carried things a lot further than most people are aware of. The B.S.A. system of barrel boring and straightening is now a comprehensive thing in itself, and much ahead of what we know to exist in other quarters. Systematic research has led to the determination of the causes that go to create untrueness in a barrel in the course of its various stages of manufacture, and remedies have been found for the troubles as soon as their operating causes have been located. At the present time of writing we are able to state as the result of personal inspection that the B.S.A. Company can now drill a steel bar straight from end to end, and by one single process finish the boring of the hole literally to within a mere fraction of its finished size. The degree of straightness and concentricity obtained, inside and out, is remarkable, and yet the straightening process is mechanically performed with exceptional trueness by unskilled lads who can qualify for the work in the course of a few weeks.

Here at least is proof positive that the B.S.A. Company have taken up shot gun tube making with an amount of preliminary knowledge that ensures them a front position in the market, whether viewed from the standpoint of price or efficiency. They are not dependent upon the Sheffielder for the forgings. They have their own power hammers, and can convert the rough bars of steel into a barrel forging in two minutes. More than this they can turn out the forging without a set in any direction, and they issue a straight barrel which has never been struck by a hammer since the forging. Their tubes are therefore, free from the local internal stresses which a hammer blow of necessity creates.

Finality has not yet been reached. The policy adopted has been to begin at the foot of the ladder, turning out for a start the cheapest class of tube that is called for by the trade. As experience increases, knowledge will be gained concerning the most desirable specification for the highest class of barrel tubes. Meanwhile, as the trade is naturally of a competitive character, it will be necessary to determine the most favourable dimensions for the barrel tubes to be sold in the trade, the idea being to carry their development to the utmost possible stage, so that the person or firm who buys B.S.A. tubes will derive the greatest possible benefit from the specialised appliances that are installed in the shops at Small Heath. For instance, we have seen barrel tubes from various sources delivered to the trade with a bore having a diameter of ·710 in. To fine bore and lap an already true hole of this size to the current ·729 in. diameter is to throw on the barrel borer an unnecessary amount of labour. The specialist who reduces the tube to its finished stage is wasting time if the same price will buy him a pair of tubes within a few thousandths of the finished size. The regulation of the choke, and other details of his work are no better performed by virtue of doing an unnecessary part of the tube-maker's work. Similarly, as regards the outside dimensions: these should be brought with equal exactitude to the point at which the barrel borer's expert operations may be said to commence.

It is, in fact, in supplying the trade with a more highly refined tube than they have previously been able to obtain, that the B.S.A. Company will be able to cater for the development of an industry which has far too long been left as a monopoly for the foreigner. The recent public admissions of our indebtedness to him have come as a surprise to many; and it behoves our English gunmakers to collaborate for the removal of a slur upon their independence. The question of price dominates the development of the new industry—that is, the relation of price to quality. If the same price that will produce a tube of a given quality and dimensions will produce one equally good, but with half the need for further expenditure of labour upon it, then the price of the tube must be considered in relation with the extent to which it has been carried towards its ultimate form as a barrel ready for jointing. For years past we have regretted that the inefficient boring of many otherwise excellent guns has detracted from their value. Want of concentricity between

inside and outside has made heavy barrels weaker than others several ounces lighter. Unnecessarily large variations from the standard bore for which ammunition of current manufacture is suited have been far too prevalent; and it is in the setting right of some of these difficulties that the B.S.A. Company will be doing a valuable service to the gun trade at large. While their self-allotted task is a big one, we can at least feel fairly certain that their highly efficient mechanical and business methods will at least provide the same stimulus to persistent endeavour that has been present in the welcome and satisfactory part they have taken in developing the cycle industry.

TRADE MARKS.

ADVERTISED DECEMBER 2-23, 1903.

257,530. A device representing a "cock of the woods" standing upon a branch. To apply to explosive substances. Lindener Zündhütchen-und-Thonwaaren Fabrik, Germany, October 1, 1903.

259,010. The word "POWDERITE." To apply to explosive substances. Kynoch, Ld., Birmingham, November 30, 1903.

No Trade Marks of interest to our readers were registered between November 19 and December 16, 1903.

APPLICATIONS FOR PATENTS.

NOVEMBER 23—DECEMBER 19, 1903.

22,821A. Flying Targets. W. Bailey. (Date applied for under Rule 9, October 22, 1903).
25,517. Sporting Guns. F. Nusch (Agent for *R. Schrader*).
25,523. Wind Gauge Sight for Small-arms. T. Ledward.
25,082. Range Finder. Sir H. Grubb.
25,737. Lance Bayonet. J. Forbes.
26,142. Telescopic Sights. J. Stuart and J. W. Hasselkus.
26,215. Ordnance Target Practice. A. J. B. Légé.
26,239 Wind Gauge Rifle Sights. J. B. Thorneycroft and M. G. Farquhar.
26,291. Detonators. W. H. Edwards.
26,439. Small-arms. T. Perkes.
26,503. Torpedoes. A. Racic.
26,572. Gun Sights. W. E. Corrigall.
26,609. Targets. F. Dorsett.
26,626 Laying Gear for Ordnance. F. Wigley and H. H. Mulliner.
26,660. Cartridges and Caps. P. Brighenti.
26,868.* Guns. C. A. T. Sjögren. (Date applied for in Norway December 13, 1902).
26,978. Explosives. M. S. Talbot.
26,980. Revolvers. W. Meischke-Smith.
27,076. Telescopic Sights. T. R. Dallmeyer.
27,081. Armour-piercing Projectiles. A. T. Dawson and J. L. S. Benthall
27,090.* Ordnance Mountings. V. J. Pontet. (Date applied for in France December 15, 1902).
27,093. Recoil Brakes for Ordnance. C. D. Abel (Agent for *Rheinische Metallwaaren und M/*).
27,234. Targets. H. W. Bull.
27,237. Targets. C. E. Luard.
27,264. Gun Sights. L. G. P. Thring.
27,470. Torpedo Discharge. G. P. Spooner.
27,515. Explosives. H. H. Lake (Agent for *The Cyanid Gesellschaft mit beschränkter Haftung*).
27,519. Single-trigger Mechanism. J. Ross and F. H. Banister.
27,609,* Percussion Time Fuses. C Puff.
27,725. Ordnance Sighting. A. T. Dawson and L. Silverman.
27,728. Explosives. W. Hope.
27,768. Targets. W. M Campbell.

* These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

NOVEMBER 26th—DECEMBER 17th, 1903.

COMPILED BY HENRY TARRANT.

456 (1903). **Manufacture of Explosives.** Kynoch, Ld., Witton, and T. J. Ashley, Stanford-le-Hope. A method of reducing the risk of ignition of explosives by friction of machinery during manufacture, consisting in supplying an inert ingredient such as acetone or vaseline into the machine by way of the bearings so that other components of the explosives being kneaded are excluded therefrom. Accepted November 12, 1903.

457* (1903). **Manufacture of Explosives.** Kynoch, Ld., and A. T. Cocking.

1,138 (1903). **Automatic Guns.** A. T. Dawson, and L. Silverman, London. In another patent fully described in this issue a system of blank cartridge is dealt with. The present patent covers the provision to automatic guns of a muzzle device adapted to enable the requisite amount of energy to be obtained from such ammunition for working the gun without any adjustment of the recoil spring. The guiding of the shorter blank ammunition through the feed block into the gun is also provided for. Accepted November 19, 1903.

1,149* (1903). **Blank Ammunition.** A. T. Dawson, and L. Silverman.

1,323 (1903). **Projectile Fuses.** Maj. H. W. W. Barlow, and W. Charlesworth, Woolwich. A fuse for projectiles which is controlled by a rod passing through the shell. The arrangement is such that the explosion in the gun impels the rod forward and so determines the firing of the time detonator, the arming of the percussion action, and the opening of communication between the powder magazine of the fuse and the bursting charge of the shell. Accepted November 19, 1903.

2,333 (1903). **Ordnance Mountings and Sights.** W. Beardmore, G. A. Kohler, and A. Bremberg, Glasgow. A method of improving and simplifying the construction of training and operating gear. The gun and its cradle with the top carriage are trained horizontally about a vertical pivot through the medium of a screwed shaft working in the front part of the trail. Friction is minimized by the provision of roller bearings; and the sight is worked by a pinion actuated through a handwheel and clutch. Accepted Nov. 26, 1903.

2,460 (1903). **Sighting of Heavy Ordnance.** Capt. H. H. Grenfell, late R.N., Alverstoke. Sighting gear for heavy power-actuated ordnance, by means of which the sight setter is enabled to adjust the gun for range without interfering with the sights, while the firer controls both gun and sights when bringing the gun to bear upon the target. The gear consists of two independently operated hydraulic cylinders arranged one inside the other, or side by side. Accepted November 12, 1903.

2,786 (1903). **Ordnance Sighting.** Sir W. G. Armstrong, Whitworth & Co., Ld., Newcastle-on-Tyne, and Ann Common, Ealing. A method of sighting a heavy naval gun by means of a telescope which can be kept constantly on the target whilst allowing the gun to be moved for re-loading. The telescope is mounted on a pivot attached to the gun slide so that it may be moved in a vertical plane to follow or keep on the object although the ship should roll. A pointer indicates the moment when the gun is in the correct firing position. Accepted November 19, 1903.

3,624 (1903). **Ordnance Mountings.** A. T. Dawson and W. Burton, London. A method of so mounting guns of the Maxim R. C. type as to ensure rigidity whilst allowing for rapid and easy dismounting. The cross-head is formed with radially slotted bearings. A rotary joint-pin is carried by the gun, and, through the medium of inclined surfaces, an angular movement of the joint-pin locks the gun to its mounting. Accepted November 19, 1903.

4,061 (1903). **Firing Mechanism of Ordnance.** J. A. Palmborg, Sweden. A method of rendering premature ignition impossible, consisting in arranging a rotatable firing pin-carrying core in the centre of the breech block. When the breech is opened the firing pin is, on account of the

eccentric arrangement of the core, displaced to the side of the percussion cap Only when the block is right home and securely locked, is the pin allowed to register with the cap. Accepted November 12, 1903.

5,501 (1903). **Improvements in Gunnery.** Lt.-Col. L. K. Scott, Farnborough. The mechanical embodiment of the principle of assimilating, automatically or otherwise, the shooting of guns of different calibres, is covered by this patent. A gun of large calibre is combined with a gun of small calibre in such a manner that the gun range can be found for the big gun by the little gun, without any necessity of firing a shot from the former. The invention is intended to improve the shooting of coast and naval guns, and to reduce the expense of training gun layers. Accepted November 19, 1903.

6,148 (1903). **Gun Carriages.** A. Reichwald, London (Agent for *Fried. Krupp, Germany*). A gun carriage having a rocking barrel carrier, wherein the carrier is divided transversely of its length. The parts so formed are pivotally connected, and are held by a collapsible coupling in such a manner that the gun barrel may be brought to a lower level from the firing position without its being necessary to overcome the resistance which the returning device and the recoil brake offer to the withdrawal of the barrel. Accepted November 26, 1903.

9,425 (1903). **Combination Fuse for Projectiles.** G. M. and C. F. Hathaway, U.S.A. A combination time and percussion fuse so designed as to be simple and effective. The projectile with which it is combined may be handled safely. Detonation is insured either at a predetermined moment or upon impact The rotation of the shell down the bore brings the hammer and firing pin into alignment with the detonator. The time ring is set by hand. Accepted November 12, 1903.

5,306 (1903). **Breech Mechanism for Ordnance.** J. B. Moore, U.S.A. Breech mechanism for ordnance in which the threads between the block and the breech of the gun are uninterrupted and are cylindrical in form and multiple The block is provided externally with right and left-handed screw threads, one set being adapted to screw into the breech and the other to receive a locking ring for operating the block. Accepted November 12, 1903.

16,991* (1903). **Bolt Rifle Safety Device.** J. Tambour.

17,191 (1903) **Breech Mechanism of Ordnance.** M. Mondragon, France. Breech mechanism for ordnance in which the block turns in a threaded crown segment eccentric to the bore The mechanism may be operated either automatically or by hand, and the weight of the block when swung out ejects the empty case. Accepted November 26, 1903.

20,773 (1903). **Locking Mechanism for Automatic Pistols.** B. Müller, Switzerland. Automatic pistol mechanism, in which a self-locking sliding breech block is particularly dealt with. An upper locking part carried by the barrel, and a lower locking device contained in the casing in which the barrel slides, work conjointly to lock the barrel and breech bolt securely when in the firing position. Accepted Nov. 5, 1903.

21,365 (1903). **Explosive.** Nelly Schnebelin, France. An explosive powder adapted either for sporting or military uses, or for blasting operations One kilo of powdered chlorate of potash is dissolved in a litre and a half of boiling water. To this is added half a litre of boiling water holding in suspension 250 grains of starch. The mixture is stirred well, and 250 grains of solid paraffin are added. The complete explosive is then coloured and granulated. Accepted November 5, 1903.

21,518 (1903). **Explosive Charges.** P. du Buit, France. A modified form of the explosive charge set out in former Patents, Nos. 17,863, 1,899 and 12,536, 1900, is dealt with in the present Specification. The charge is formed of sheets of explosive cut with teeth to facilitate ignition and to regulate combustion. The invention consists in so protecting the teeth that they shall not be buckled and cause the combustion to be irregular. Accepted November 12, 1903.

21,944 (1903). **Percussion Fuse for Projectiles.** J. B. Semple, U.S.A. A percussion fuse for shell in which the firing pin and the detonator are held out of alignment one with the other until the moment when the initial shock imparted to the projectile starts it down the bore of the gun. When forced by this shock into operative relation with the detonator the firing pin is automatically locked. Accepted November 26, 1903.

22,160 (1903). **Ordnance and Mountings.** A. T. Dawson and G. T. Buckham, London. A method of providing for the ready detachment of the gun and carriage wheels from the trail in order to create convenient loads for conveyance over difficult country by mules. When the gun is of the kind that recoils in a cradle having buffer cylinders, means are provided whereby the gun may quickly be disconnected from the rods of the buffer pistons and removed from the cradle. Accepted November 19, 1903.

23,061 (1903). **Sighting and Firing Ordnance.** P. M. Justice, London (Agent for *H. E. Curtis, U.S.A.*). In order to obviate personal errors in firing heavy ordnance mounted on platforms, automatic firing is accomplished directly the gun bears the desired relation to the collimation axis of the sighting telescope, by the completion of an electric circuit. Little skill and less judgment are required by this method than that in which the "pointer" had to give the order to fire. Accepted November 26, 1903.

*These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

MANUFACTURE OF EXPLOSIVES.

457 (1903). Kynoch Ld., Witton, and A. T. Cocking, Stanford-le-Hope. In the manufacture of explosives such as cordite containing nitroglycerin and guncotton, considerable difficulty is experienced when it is desired to increase the proportion of guncotton to nitroglycerin, owing to fact that the amount of the latter becomes insufficient to moisten the whole of the former during the mixing operation. At present the two ingredients are first roughly mixed by hand before being transferred to the incorporating machines, where they worked up into cordite with added acetone as a solvent. When large proportions of guncotton are used, there is a tendency for particles of dry guncotton to fly about during the hand mixing operation, and these particles become a source of great danger. Then when the mixture is transferred to the machines, the same difficulty arises, through parts of the guncotton being insufficiently moistened. The danger exists only when the machine is first started, since the acetone quickly renders the mixture safe.

In order to overcome this danger the inventors use an additional volatile liquid ingredient to any one or more of the components of an explosive containing guncotton. The liquid, which may be either alcohol, benzine or naphtha, is added before mechanical treatment so that the guncotton shall be thoroughly wetted, detonation by friction being thus obviated. The nitroglycerin is also mixed with a liquid such as alcohol, which dissolves nitroglycerin but does not dissolve or gelatinize guncotton. The volume of the nitroglycerin is in this way increased until it carries sufficient moisture thoroughly to wet the guncotton.

In the manufacture of an explosive such as cordite consisting of about 65 per cent. of guncotton, 30 per cent. of nitroglycerin and 5 per cent. of vaseline, the nitroglycerin is dissolved first in about its own volume of methylated spirits. About half this amount may be sufficient in some cases. The solution of nitroglycerin is then mixed by hand with the guncotton preparatory to the introduction of the mass to the incorporating machines. The required quantity of acetone and vaseline is added in the machines the use of a smaller quantity of acetone than usual being necessary on account of the presence of the alcohol. The nitroglycerin solvent used must not have any chemical action upon the other ingredients of the explosive, or interfere with their proper gelatinization afterwards, and it must be sufficiently volatile to be driven off afterwards in the drying stoves. Accepted November 12, 1903.

BLANK AMMUNITION FOR RIFLED GUNS.

1,149 (1903). A. T. Dawson and L. Silverman, London. A blank cartridge for use in rifled guns, either with loose or fixed ammunition, is described in this Specification. Hitherto the firing of blank cartridge, has, say the patentees, been a source of some danger to persons standing in the line of fire. This danger

Fig. 1

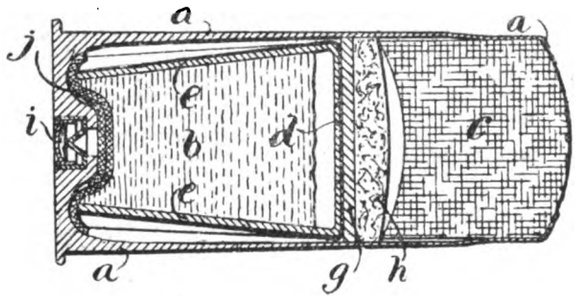
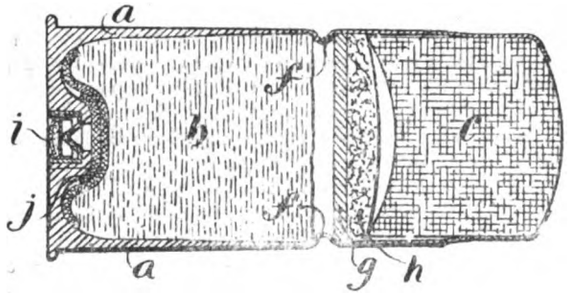


Fig. 2



arises from the fact that the charge, when of the smokeless type, must necessarily be confined in order that it may properly explode and create sufficient pressure for working the gun. Thus the cartridge has been plugged with a thick wad, or with some hard substance which constitutes a dangerous missile when the gun is fired. This danger is prevented by forming the wad of a sufficiently hard substance to take the rifling and to acquire a high rotative speed great enough to break it up by centrifugal force into small harmless pieces when it is no longer supported by the barrel.

The blank cartridge illustrated is one intended for the 37 m/m gun. The cartridge case *a* is filled with a charge of cordite *b* over which is placed the wad *c*. The wad is preferably constructed of very small flakes of paper which are subjected to heavy hydraulic pressure to compress them into a cylindrical block. No adhesive material is used. One of these blocks is inserted in the mouth of the case where it is held by turning in the metal. The wad is of sufficient hardness to enable it to open out the inturned mouth without any alteration of shape.

A sort of bridge piece *d* consisting of a transverse strip having limbs *e* extending from its ends, is provided to prevent the space intended for the charge being encroached upon when the wad is inserted. An alternative method consists in crimping the case at *f* as is illustrated in Fig. 2. Between the bridge piece and the wad is inserted a layer of cardboard *g* and a layer of felt *h*. The cartridge is fired in the usual manner through the detonator *i*, the flash of which is communicated to the igniter *j*. The wad *c* may be made larger than the bore of the gun in order to obtain sufficient resistance to the explosion of the charge; or an annular rib, adapted to act as a copper driving band, may be provided. Accepted November 19, 1903.

BOLT RIFLE SAFETY DEVICE.

16,991 (1903). J. Tambour, Austria. A safety appliance for rifles of the bolt type is described in this patent. A part which is pressed by the hand in grasping the grip of the stock shifts a limb which releases the sear holding the cocked bolt. The disengagement of the sear can be effected by a double trigger mechanism.

The lever *a* shown in Fig 1, is locked by the arm *b* of the elbow lever *c* (illustrated in detail). The elbow lever is pivoted to the trigger-plate, and its arm *d* is engaged by the forward end of the part *e* projecting from the underside of the grip of the stock. The spring *f* holds the elbow lever in the position illustrated in Fig. 1.

When the stock is grasped for the purpose of firing, the pad *e* is forced inwards. The lever *c* is turned and is so caused to unlock

Fig. 1

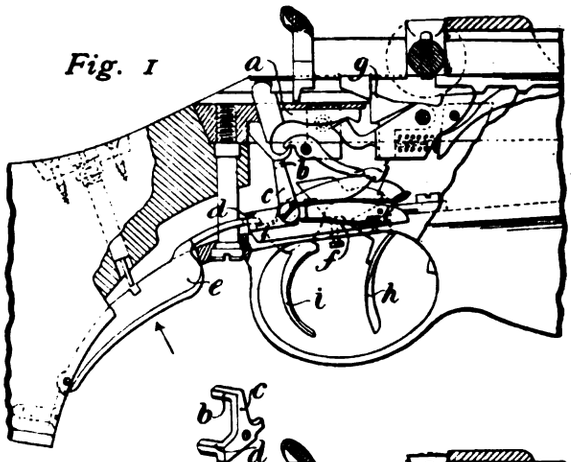
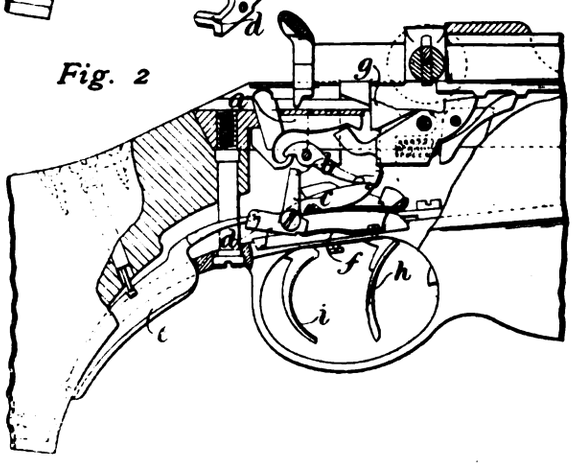


Fig. 2



the lever *a* and the sear *g*. The sear may be disengaged from the firing bolt by either of the triggers *h* or *i*. It may be disengaged directly by the trigger *h*, or if the detent on the trigger *h* holds the end of the blade of the trigger *i* and the trigger *h* is slightly pulled to disengage one from the other, the trigger *i* will be caused by its spring to act upon the lever *j*, so as to release the bolt. Two modified forms of the mechanism are illustrated in the patent specification. In one of these the pressing part *e* is situated upon the top of the grip instead of underneath; whilst in the other the elbow lever is actuated by another lever instead of being turned directly by the pressing piece *e*. Accepted November 5, 1903.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

A Kynoch Director on the Tariff Question.—Mr. J. S. Nettlefold recently gave public expression to his views on the tariff proposals with special reference to the firm of Kynoch, and he condemned the entire programme as likely to injure his firm, which he appears to regard as a typical commercial enterprise. His chief complaint is that any alteration of the kind mooted would tend to increase the cost of production without enabling enhanced prices to be obtained for exported manufactures. Mr. Nettlefold specifies the very extensive range of goods produced by his firm, and he points out that the Company's export trade in such articles would diminish in the presence of an increase of productive cost. In this connection it may seem reasonable to call attention to certain features of the Kynoch position which may be considered exceptional. By far the greatest part of this Company's work is for the Government, and their position has been built up by its aid. The foreign producer is barred from doing trade with the British Government, so that the firm of Kynoch, in common with other contractors to the War Office, has exactly that protection in its home market which other manufacturers appear desirous of obtaining. The remarkable enterprise and highly modernised equipment of our large Government contractors accentuate the benefits of a properly protected home market. We should doubt for instance whether the Birmingham Small-Arms Co., Ld., would have achieved its present position had it been forced to build up its extensive productive facilities by means of contracts obtained from customers other than the British Government. The Vickers-Maxim Company would equally have been in a very different position had it been deprived of the same important nucleus of trade, by the help of which its organisation is maintained on an efficient and profitable basis. We are, therefore, of opinion that if Mr. Nettlefold desires to apply his business experience to the discussion of tariff problems he should remember that circumstances alter cases. From an outsider's point of view the illustration he quotes appears to have no application to the condition of manufacturers who are not highly protected in the way that Government contractors are.

The Pistols Act.—A facetious gunmaker recently supplied the *Westminster Gazette* with an outline of his experiences in the operation of the Pistols Act. While the incidents he recorded were treated from the humourous aspect they none the less reflect very seriously upon the failure of this Act to regulate the sale of pistols without unjustly interfering with the legitimate acquisition of pistols by responsible persons. So far as can be seen, those who want pistols for illegitimate purposes are perfectly well able to obtain them at a slight extra expenditure, either of money or of time. On the other hand those who have genuine need of them find many difficulties placed in their way which cannot by any stretch of imagination be regarded as for the benefit of the community. It is easy enough to be wise after the event. Hence we make no apology for propounding the opinion that it would have been much better for everyone concerned if the trade, recognising that a bill of some sort must be passed, had agitated

for a simple enabling Act, giving the Home Office power to make such regulations as might seem suitable for dealing with the sale of pistols. Such an Act relating to the use of explosives in fiery mines was passed, and the Home Office have made wise use of the power thus placed in their hands. Had they been similarly free to deal with the framing of the pistols regulations, they would have drafted a code of rules such as would have caused a minimum of inconvenience to the retailer, at the same time safeguarding the public as far as is possible from the evils incidental to the promiscuous ownership of pocket weapons. Their regulations would have been subject to alteration when the need arose. Consequently as fresh experience would have been gained concerning the practical effect of the regulations these could have been modified or adjusted, so as to carry out the wishes of Parliament with the least possible inconvenience and vexation.

The Late Herr von Mannlicher.—It is a recognised axiom that inventors as a body seldom receive a fitting reward for their genius and the benefits they confer on humanity. The late Herr von Mannlicher is hardly an exception to this rule, for reasons, however, which have nothing to do with the commercial success of his patents. By persistent and self-denying endeavour he attained a degree of success far beyond ordinary experience, and yet having achieved all that an inventor can hope for in this world he dies at the comparatively early age of 56. The Mannlicher rifle is known the world over, not only for its ingenuity of principle, but mainly for the fact that it reproduces the essential requirements of magazine rifle construction with a minimum complication in the parts and a directness of purpose, so to speak, which at once stamp it as an ideal weapon to place in the hands of the soldier. This result was not attained without a painstaking process of examination of all available systems and ideas. Herr Mannlicher's plan at the outset of his work was to acquaint himself with everything that had ever been proposed or carried out in the region of rifle construction. Having thus laid the foundations for his future work he was able to start where others had left off. Consequently at a single step he registered a degree of progress that placed him at the very front, a position from which he has never receded. The nation is to be envied which includes such men amongst its subjects, and Austria has gained a great deal by the enterprise of the Austrian Small-Arms Factory at Steyr, with Mannlicher ever at its head proposing fresh ideas, and taking large orders from nearly every nation in the world.

Automatic Rifles.—The National Rifle Association has taken a bold step in offering a prize of one hundred guineas for the best automatic military rifle submitted for competition at the coming Bisley Meeting. It is very difficult fully to understand the position adopted by this enterprising Association. The conditions for the test which are printed in another part of this issue remind one more of Government trials, with a view to service adoption, than mere target competition practice, which the N.R.A. is chiefly interested in promoting. In fact it is not certain that the National Rifle Association is not unofficially acting on behalf of the War Office in giving facilities for a test of automatic weapons. The N R.A. sub-committee of three charged with the conduct of this competition will no doubt include one or more members of the late Small-Arms Committee. The specification of necessary and desirable conditions points rather to expert examination than to a test of efficiency as judged by accuracy and rapidity of firing. Admittedly tests of this kind will take place with all the rifles submitted, but even so these occupy about the same position in the programme as they would in any tests that would be laid down by a War Office committee. The rounds fired for accuracy and rapidity involve the getting off as many shots as can be fired in one minute at a target 200 yards distant. Assuming that some 50 rounds can be fired in this time, it is fairly evident that the test will be a destruction test, in so far that the wood-work of the rifle will probably be on fire before the series is completed. A hundred-guinea first prize is a by no means tempting offer to the mere shooter considering the expenses that he will be forced to incur in complying with the conditions necessary to qualify for a place in the competition. Even supposing the contest is supported by automatic rifle syndicates it still seems severe on the rifle to expect it to shoot at top speed for one minute a day for four days, bearing in mind that directly after firing each series the competitors must clean their rifles and hand them to the Committee for safe keeping. Time, however, will show how far our criticisms are justified. With the general intentions of the N.R.A. we are in every sympathy, but we fear they have gone a little too far at the first outset.

N.R.A. Annual Report.—The annual report of the National Rifle Association, which has just been issued, shows that this body continues in a thoroughly prosperous condition. A moderate surplus is shown on the year's transactions, and the assets are further increased by numerous presentations of valuable trophies and other permanent property of one kind and another. The records of rifle club development show that this latest feature of the Association's activity is progressing with all the virility that might be expected from its popular character. Rifle clubs as such need but little stimulation to launch out on a successful career. The difficulties encountered are not connected with any want of keenness among the civilian population to become marksmen. They relate more especially to the obstacles that have to be overcome in securing proper range accommodation. Rifle shooting is acknowledged to be a most wholesome form of recreation for all classes of town and country workers, the movement to promote its further extension receiving an amount of support and patronage which it could hardly expect were it not as desirable from a patriotic point of view as from that of recreation pure and simple. A more general knowledge of firearms among civilian population must of necessity be of great value in the long run to all classes of gunmakers, though it is likely that the benefits will be of less immediate consequence than was at first anticipated. However, the report of the National Rifle Association goes to show that the rifle club movement is well supported on all sides, there being at the present moment no less than 440 affiliated clubs, with a collective membership of 30,000, the number of clubs having increased by one hundred during the past year, with excellent prospects of a further increase in the current year. In speaking of the Palma contest at the last Bisley meeting the report states that the N.R.A, of America has been asked to give particulars of the date of adoption by the American army of the special type of barrel which was used by the American team in this match.

THE ENGLISH SHOT GUN INDUSTRY.

A spirit of inquiry has been aroused by recent discussions on trade policy, and as a result many persons, who would otherwise be inclined to take matters as they find them, are actively considering future possibilities and how they shall be met. We have recently been greatly interested in hearing the views on the future prospects of shot gun manufacture of one who by training and association is well qualified to form sound opinions. He inclines to the belief that our methods of distribution are more to blame than our manufacturing organisation for any lack of enterprise that may be shown to exist. The specious advertisements of the pushing tradesman tell us to deal direct with the manufacturer, and so save all middlemen's profits. Business experience seems to point to an opposite conclusion. In fact, so far from manufacturing success being attained by dealing directly with the public, some of the better organised manufacturing establishments prefer to leave the retailer altogether alone, and do business exclusively with factors or agents. A manufacterer who does a retail business finds it necessary to make a large assortment of different patterns, each of which could be produced at a more economical rate by a single maker, who might concentrate his whole energies upon supplying the total demand for that thing only. In the gun business practically all the retailers rank as manufacturers before the public, although but a small proportion carry out even a moderate part of this programme, while fewer still make all they sell bearing their name. General dealers who aim at running a gun department follow out a very similar policy, and the result is that the public lack guidance as to where value can be obtained, except in the case of a certain number of London houses and a smaller number of provincial firms who are able to advertise their wares in appropriate fashion. The result, in our friend's opinion, is that the firms who command the market are hampered in extending their business by big prices, whereas the firms who can manufacture are unknown to the sporting world. When a trade is thus split up, the manufacturer loses all touch with the actual user of his goods, and the retailer whose sole aim as a business man is to show a good profit at the end of the year, is not concerned as to whether the goods which his customers appreciate are of English or foreign make. They all come alike to him so long as he can give his clients what they ask for and so long as the quality is appropriate to the price charged.

Now the manufacturer who caters for this class of business is frequently placed in a very embarrassing position. His trade customers are not so well versed in the details of manufacture as the man must be who daily settles the questions that are referred to him by his employees and managers. If, for instance, he makes a certain grade of gun in which the cost of production has been fairly divided over what meets the eye and what tends to promote efficiency in use, he may be asked to combine A quality of finish with B quality of workmanship at some intermediate price. These things he must do, knowing all the while that five minutes' chat with the user would show that a disproportionately highly finished gun would be a bad speculation in the long run. Anyone who takes a cheap quality gun to pieces and thoroughly examines it will find many minor defects of construction which could have been remedied for the spending of a few extra shillings in the making. The maker and the consumer would both like to have these things adjusted, but they are kept apart by the retailer who lays down the law in such things. The typical retailer is more often than not a general dealer, who knows that such goods are mostly sold according to their appearance, and they have not the stake of a local gunmaker in seeing that the goods give satisfaction after they are out of his hands. The competing gunmaker must, however, take such conditions into account, so that he in his turn is forced to sell goods which his better judgment tells him would give greater satisfaction were they differently made up. We have ourselves frequently enquired from manufacturers why they do not lay themselves out to make a settled model of gun and systematise its manufacture, so as to eliminate certain faults which are easily dealt with in the factory and yet which cause so much trouble when the gun is in use. Their reply invariably lays the blame at the door of the retailer. One man will have one pattern, another will insist on something else, and none of them will countenance a few extra shillings to be expended on things that do not meet the eye. Why, for instance, says the manufacturer, should any attempt be made to bore the barrels to the correct size so long as the retailer never troubles his head about such matters? This is the difficulty. And yet, we have seen many Winchester shot-guns sold simply because the buyer knows for an actual certainty that these weapons are uniformly bored to the sizes that experience goes to show give the best results.

The success of the London gun trade arises in our opinion solely from the fact that among the masters are some of the finest judges of a gun in the world. In spite of the constant reminders that the sporting world receives that the guns sold are not of genuine London make, sportsmen continue to patronise the men whose judgment they would back before all others, the name on the top rib being an all-important guarantee for the excellence of the workmanship that is concealed within. Now, if a name will sell a gun in London, why should it not equally sell a gun in the country? The reply is that there is not the same certainty about a country gun that there is about one sold in London. There are, we admit, many worthy exceptions, but regarding the question from the manufacturer's standpoint, we must say that in taking an all-round average of the variety of dealers who offer guns for sale in our country towns, there is not one in ten whose name on a gun is any guarantee of worth. Such dealers can sell Colt, Winchester, Marlin, Stevens and Harrington & Richardson firearms, because these are all standard goods, but they cannot sell a ten pound hammerless gun made in Birmingham, because the maker of it hides his light under a bushel, and the seller has no light to hide. If the maker did put his name on a gun, the friends of the satisfied owner would insist on having an identically similar thing, and the maker would be encouraged to lavish extra pains at minimized cost on a grade of weapon in such extensive demand. Country dealers would not suffer by the extensive naming of guns sold outside London. Guns with fictitious names sold well till the practice was stopped, because the sportsman thought he was getting something of standard quality. When the London

gunmaker offers to supply "Bonax" cartridges he is met with the rejoinder that the purchaser can equally well get them from his own village. Thus the naming of cheap guns with the true maker's designation will be of assistance to the country trade. London it cannot hurt, because their trade is a special kind which circumstances of such a kind cannot alter. Meanwhile if something is not soon done, the manufacturing centres will suffer, and they will involve in their decline the whole of the distributing firms who rely on them for supplies. We have seen one line after another become the perquisite of a specialising firm. The double shot-gun still remains with us. It works sweeter than its American prototype, and is sounder all through than the Belgian equivalent. Our rivals are not, however, inclined to sit still. They must be up and doing. So must we. Our course is clearly marked out. It is to limit the number of patterns issued, to improve the methods of their manufacture, and to mark them so that the sportsman will know where to go when he wants more.

THE PISTOLS ACT AT WORK.

HOW TRADE IS HAMPERED.

A gentleman who is in the gun trade has written to the *Westminster Gazette* giving the following amusing account of how the Pistols Bill operates:

No doubt Parliament meant well when they passed the Pistols Bill in August. We believe they often mean well, oftener perhaps than one would imagine, judging merely from results.

The Pistols Bill was, of course, intended to keep pistols out of the hands of boys, drunken men, and other undesirables. It enacts, as perhaps about ·01 per cent. of your readers may know, that a pistol must not be sold retail unless the customer either: Produces a gun licence. Shows that he can carry a gun without a licence (men in his Majesty's forces). Is a householder, and only intends using the pistol in his house or the "curtilage thereof;" or is going abroad for not less than six months, and brings a statement to that effect, signed by a "J.P." or a police-inspector. And in no case can a lad be served under the age of eighteen.

The promoters of the Bill no doubt thought it would work like this:

No. 1. Enter a boy. Wants a cheap revolver. Is asked his age, and then told that the new Act forbids us to sell to anyone under eighteen. Exit boy.

No. 2. A roughish-looking customer. "Good mornin', Guv'nor; got any secon'-an' revolvers?" We have not. "Well, what's the price of the noo uns?" We mention the necessity of a licence; some vague feeling keeps us from mentioning the "J.P." or the police-inspector. He says his mate will buy the licence while he buys the revolver. But we must *see* the licence—and he departs to get one, and, of course, does not return.

No. 3. Young, fresh provincial. He is a young farmer going to Canada, lives in a village about 100 miles away, and has come to London to buy various things, including a revolver. He knows all about the new Act (naturally), and has his going-away-for-over-six-months-paper duly signed by a "J.P." Quite so; that would be all right if only it were true, but it is not true, not a little bit of it. Of the first seven customers—would-be customers, that is—who came in for revolvers after the passing of the Act, we refused four, and yet not one was an undesirable, as far as could be seen.

We have given the imaginary; now for the actual.

No. 1. Stout gentleman, well-dressed, foreign, wants a "good small revolvah." He gives name, and we recognise it, also City address, and we find he is going on business to—to *Armenia*! But he has no licence, and will not buy one. We prattle of "J.P.'s" and inspectors, but he will have none of it, and gets peppery. "I could get all these things done, oh yes, but why trouble? I can get him quite easily in Paris as I pass through." He says "Good day." He expresses no opinion about us; but from his manner we fear we have not impressed him favourably.

No. 2. An American returning home. Wants to buy a revolver on this side. He has no licence, is not a householder, knows no J.P. or Inspector, and he begins to grin. "Well," after a few more futilities on our part, "I reckon you are a funny people; tell you what—if I were a Britisher I should shut up shop." He goes out grinning and much pleased with the interview. On the whole, that is worse to bear than when they go out angry.

No. 3. Elderly gentleman in clerical dress. Head of ——. Going abroad, but for *less* than six months, and did not see why he should buy a licence. Here was a situation: a Bill to prevent boys, drunkards and murderers from obtaining revolvers stood in the way of this high-placed cleric buying what he thought he had need of! However, in this case we managed, and effected a sale; though the way we managed—well, never mind.

No. 4. Sea-faring man. Captain of small vessel trading in various foreign ports. Wanted a revolver as called at queer places, and sometimes the crew pretty queer, too. Liked them to know that he *had* such a thing. We trot out dismal procession of licence, J.P., and Inspector, but he has no licence, and the nearest police officer and J.P. he knows are at his home at Bideford, in Devon. Why should not this old captain have a revolver? Why should he not buy it in London instead of abroad? He did buy one in London. If a ship is not exactly a house, nor a foreign harbour "the curtilage thereof," we thought they were near enough. We considered we were keeping the spirit of the Act, if not quite the letter.

No. 5. Young gentleman with a foreign accent, and a letter. "I have a letter from my brother in ——; he wants a revolver, a Webley, or Smith and Wesson, have you?" We have. He chooses one, and then we have the pleasure of introducing the "Act," with the licence, the J.P., the householder (for drawing-room use only), Army and Navy, and policeman. We try them all—but cannot get hold of him anywhere. At last he says he must tell his brother the tradesmen of London do not want to sell their goods for export, but prefer Liège or Paris to do the business. We agree; only request that he may say "Government" and not "tradesmen."

No. 6. Customer well known to us. He has a licence, and, wonderful to relate, knows about the Act, and has brought it with him. Thankfulness, relief. We sell a revolver.

No. 7. Smart young fellow; says going to —— in the employ of the London and —— Bank. All right enough, no doubt; and as he is going to —— it is extremely desirable he should have a revolver. A brother of ours going there should take one, Act or no Act. But he was not our brother, and we refused to supply unless— Then we trotted out before him, like a small pantomime procession, the "J.P." and the Policeman, the Soldier, the Sailor, and the Householder. He was neither, and he had to go sadly away; while we, also sadly—and with certain thoughts about our Rulers—replaced the revolvers in the case.

So we lost four of the first seven, and possibly we ought strictly to have supplied *one* only—namely, to No. 6. But, as it stands, to lose four out of seven is a big percentage. If our loss was for national good we would grin and bear it; but what additional security for his Majesty's subjects is secured by making the gentleman going to Armenia, for instance, buy his revolver in Paris instead of in London?

But there! No doubt the Government *meant well*, and they no doubt mean well with the new fiscal policy. On a small trade matter they have gone wrong, but on a big one—well, we do not quite know, except that they doubtless *mean* well.

CALCULATIONS OF CORDITE RIFLE BALLISTICS.

By F. W. JONES.

About thirteen months ago the writer had occasion to make experiments covering a wide range of rifles with one sample of Cordite. In these experiments the weight of bullet and charge of powder were varied, and some of the cartridges were fired at abnormal temperatures. A comparison of the results obtained proved that Cordite behaves similarly in bores as widely separated as ·256 and ·620. This being so, an attempt was made to establish mathematical relations whereby the variations in ballistics following an alteration in loading could be deduced.

The formulæ obtained have since proved useful in calculating the alteration in ballistics consequent on a change in bullet, load or temperature of firing, and also in estimating the ballistics of new cartridges. The results predicted for the new cartridges were almost identical with those obtained on firing, and it is in the hope that they may be useful to others that the formulæ used are now published.

Empirical formulæ—that is to say, formulæ containing factors arrived at from actual experiments—are ridiculed by some experts, because they lack the discipline contained in purely theoretical ones. It can, however, be affirmed that what the former lose in academical qualities they gain in accuracy, although restricted in application. All empirical formulæ should, however, contain the usual variables present in similar formulæ derived from theoretic considerations.

PRESSURE.

Now in the experiments referred to above, it was observed that if:—

p = the percentage increase of pressure due to
l = a percentage increase of load,

Then $p = l^{1.35}$ ... ... (1)

This relation gives to the exponent of the charge, in a pressure formula, the value of 1·35. Making this a condition in Sarrau's expression for pressure, and then giving a suitable value for the constants from the results of actual experiments, the following formula for pressure was obtained.

$$P = \frac{\Delta c^{0.35} w^{0.5}}{20d^2} \quad \ldots \quad \ldots \quad (2)$$

Where P = Pressure in tons per square inch.
Δ = Density of loading.
c = Charge of powder in grains.
w = Weight of bullet in grains.
d = Diameter in inches of a circle related to the sectional area of the bore, taking the rifling grooves into account.

VELOCITY.

The expression for velocity was not so easily obtained. First it was observed that for bores differing very little, the energy per grain of cordite (as shown by the velocity of the bullet) was a constant at the same pressure; but that as the bore or pressure materially increased this constant became greater. Now the actual energy given out by the powder consists of more than that due to the acceleration of the bullet. The other most important variable energies are due to the resistance of the bullet in the bore, and its velocity of rotation, both of which act at the circumference of the bullet, and would for a given weight of bullet be greatest with the smallest bores. It was, therefore, thought that if account could be taken of the energies lost in friction and in spinning the bullet, the constant might be equal for all bores. This was found to be the case, namely, that the energy per grain of cordite is the same in all rifle bores when pressures are equal and the bullet is taken as equal to $(w + 400d)$ grains.

As, however, the energy per grain increases with the pressure, we have:

$$\text{Constant} = P^x \frac{Energy}{C} = P^x \frac{(w + 400d)\, v^2}{2gC}$$

$$v = \text{Constant}\ P^x \sqrt{\frac{C}{w + 400d}}$$

To obtain x, the exponent of the pressure, it was observed that in a given bore the velocity was directly proportional to the charge, thus:—

$$\frac{v}{v_1} = \frac{C}{C_1} = \left(\frac{P}{P_1}\right)^x \left(\frac{C}{C_1}\right)^{0.5}$$

replacing the ratio of the pressures in terms of the charges from (2) gives a value $x = 0.37$. Placing this in the expression for velocity, and finding the value of the constants from actual firing results, we have finally, in feet:—

$$v = 2380\ P^{0.37} \sqrt{\frac{C}{w + 400d}} \quad \ldots \quad (3)$$

TEMPERATURE.

To explain the manner in which the temperature effects were obtained, would carry us too far into interior ballistics. Let it suffice, therefore to say that if t_1 and t_2 are temperatures on the Fahrenheit scale at which firing takes place, then:—

$$p_{t_2} = p_{t_1} \left(\frac{t_2}{t_1}\right)^{0.3} \quad \ldots \quad \ldots \quad (4)$$

$$v_{t_2} = v_{t_1} \left(\frac{t_2}{t_1}\right)^{0.1} \quad \ldots \quad \ldots \quad (5)$$

where p_{t_2} p_{t_1} v_{t_2} and v_{t_1} refer to pressures and velocities at t_1 and t_2.

WEIGHT OF BULLET.

The effects due to changes in weight of bullet follow from (3) and (2). More particularly we have from (2), when the powder chamber and charge is the same:—

$$p_2 = p_1 \left(\frac{w_2}{w_1}\right)^{0.5} \quad \ldots \quad \ldots \quad (6)$$

All these formulæ relate to metal-covered bullets of the military pattern, pressures in side proof barrels, and velocities in rifles of about 30 inches long.

The first table was calculated by means of (2) and (3), and the agreement with practice is remarkable. It ought however to be pointed out that the ·600 and ·577 are rather low in pressure and velocity, and the ·375 rather high in pressure and velocity.

The formulæ (2) and (3) should be used only to calculate the ballistics of standard charges. For variation from standard known results due to changes in temperature, charge

or bullet (1), (4), (5) and (6) should be employed. In the experiments referred to above, the results obtained by variations from standard were checked by these formulæ and the agreement was very good. Moreover, where it has been possible to test the formulæ by published results, the measured and calculated were as close as could be expected. As an illustration the second table, relating to values, taken from Kynoch's catalogue of 1903, indicates how accurate are the calculations by means of (1), (4), (5) and (6).

The pressures at ordinary temperatures are stated by Kynoch's as being fired between the limits of 60° F. and 70° F. and the high temperature cartridges at 150° F. and 160° F., the mean has been assumed in the calculations. Under these conditions the calculated and observed are as near as could well be expected. In estimating the pressures due to increase of powder and weight of bullet the effect due to powder alone was first obtained by (1) and then the increase of this pressure due to bullet by (6).

VALUES CALCULATED FROM FORMULÆ (2) AND (3), SHOWING THE AVERAGE BEHAVIOUR OF CORDITE.

Cartridge.	Diameter related to Section of Bore.	Powder Charge.	Weight of Bullet.	Loading Density.	Calculated.	
					Pressure.	Velocity.
·600/3 in.	·627	120 grains	900 grains	0·708	14·4 tons	2,063 ft.
·577/3 in.	·581	100 ,,	750 ,,	0·680	13·8 ,,	2,006 ,,
·577/·500	·507	90 ,,	570 ,,	0·621	13·9 ,,	2,150 ,,
·500/3¼ in.	·507	80 ,,	570 ,,	0·655	14·1 ,,	2,038 ,,
·500/3 in.	·507	80 ,,	570 ,,	0·734	15·8 ,,	2,126 ,,
·500/·450	·455	70 ,,	480 ,,	0·584	13·7 ,,	2,038 ,,
·450 No. 2 nitro	·455	80 ,,	480 ,,	0·575	14·1 ,,	2,202 ,,
·450/3¼ in.	·455	70 ,,	480 ,,	0·714	16·7 ,,	2,193 ,,
·450/·400/3¼ in.	·407	60 ,,	400 ,,	0·631	16·0 ,,	2,167 ,,
·450/·400/3 in.	·407	60 ,,	400 ,,	0·618	15·6 ,,	2,147 ,,
·450/·400/2⅜ in.	·407	42 ,,	400 ,,	0·591	13·2 ,,	1,689 ,,
·375	·372	40 ,,	270 ,,	0·740	16·0 ,,	2,074 ,,
·400/·360	·365	40 ,,	300 ,,	0·625	14·8 ,,	1,932 ,,
·360 No. 2 nitro	·365	55 ,,	300 ,,	0·529	14·0 ,,	2,244 ,,
·360/2¼ in.	·365	30 ,,	300 ,,	0·666	14·2 ,,	1,650 ,,
·303	·307	31 ,,	215 ,,	0·659	17·0 ,,	2,056 ,,
·30 U.S.A.	·304	31 ,,	220 ,,	0·603	16·0 ,,	2,023 ,,
8 m/m	·319	33 ,,	244 ,,	0·600	15·6 ,,	1,962 ,,
7 m/m	·280	32 ,,	175 ,,	0·615	17·4 ,,	2,290 ,,
6·5 m/m	·260	30½ ,,	157 ,,	0·649	19·9 ,,	2,462 ,,
·236 U.S.A.	·240	30 ,,	112 ,,	0·647	19·5 ,,	2,715 ,,

VALUES CALCULATED FROM FORMULÆ (1), (4), (5) AND (6), FOR COMPARISON WITH KYNOCH CATALOGUE FIGURES.

Cartridge.	Powder Charge.	Weight of Bullet.	Pressure of Standard loads at 65° F.	PRESSURES.			
				Standard loads at 155° F.		With ⅛ more Cordite and ⅛ heavier bullet at 65° F.	
				Measured.	Calculated.	Measured.	Calculated.
·600	100 grains	900 grains	13·5 tons	— tons	17·5 tons	— tons	24·5 tons
·577/3 in. ...	100 ,,	750 ,,	15·0 ,,	20·0 ,,	19·5 ,,	26·0 ,,	27·1 ,,
·500/3 in. ...	80 ,,	570 ,,	16·0 ,,	20·5 ,,	20·7 ,,	28·0 ,,	29·0 ,,
·500/·450 ...	70 ,,	480 ,,	13·0 ,,	17·5 ,,	17·0 ,,	24·5 ,,	23·5 ,,
·450/3¼ in. ...	70 ,,	480 ,,	17·0 ,,	21·5 ,,	22·0 ,,	31·0 ,,	30·8 ,,
·450/·400/3¼ in....	60 ,,	400 ,,	17·5 ,,	22·5 ,,	22·7 ,,	30·5 ,,	31·6 ,,
·450/·400/3 in. ...	60 ,,	400 ,,	16·5 ,,	21·5 ,,	21·4 ,,	29·0 ,,	29·9 ,,
·375	40 ,,	270 ,,	14·5 ,,	20·0 ,,	18·8 ,,	26·0 ,,	26·2 ,,
·375	40 ,,	320 ,,	16·0 ,,	21·0 ,,	20·7 ,,	30·0 ,,	29·0 ,,
·400/·360 ...	41 ,,	314 ,,	14·0 ,,	19·0 ,,	18·2 ,,	25·5 ,,	25·4 ,,
·350 Rigby ...	43 ,,	310 ,,	16·0 ,,	21·0 ,,	20·7 ,,	28·0 ,,	29·0 ,,
·360/2¼ in. ...	30 ,,	300 ,,	13·5 ,,	18·0 ,,	17·5 ,,	25·0 ,,	24·5 ,,
·303	30 ,,	215 ,,	16·0 ,,	21·0 ,,	20·7 ,,	30·0 ,,	29·0 ,,

Tropical Cordite Cartridges.	·500/·450 (75 grains and 480-grain bullet).			·450 (70 grains and 480-grain bullet).		
	At 75° F.	At 145° F.		At 75° F.	At 145° F.	
		Measured.	Calculated.		Measured.	Calculated.
Velocity (ft.) ...	2,103	2,258	2,246	2,094	2,235	2,236
Pressure (tons) ...	13·48	16·94	16·43	14·84	17·48	18·08

ROUND THE TRADE.

Mr. W. P. Markle, of the Tatham Shot Company, U.S.A., is at present visiting this country.

We are informed that Mr. Ernest Rigby has been admitted a member of the Livery of the Gunmakers' Company.

The death is reported of Mr. H. Dorris, head of the firm, H. E. Dorris & Co., well known as gunpowder carriers.

The trustees of the Astor Rifle Club Fund have settled the amount of the yearly grants to rifle clubs at the rate of £600 per annum.

Ample stocks are now available of the new Winchester automatic ·22-bore rim-fire rifle. It has a pleasing exterior and is easily dismounted.

New rules for the regulation of proof have lately been published in Belgium. They include as a special feature a supplementary nitro-proof.

The International Machinery and Ammunition Factories Trust, Ld. is the name of a company registered in Guernsey with a capital of £1,000,000.

From press comments it appears that cartridges marked "Maxim" have got mixed with the ·303 ammunition issued to soldiers. Hence they are enjoined to examine all cartridges before use.

Some interesting particulars are given in our article on cordite rifle ballistics of Eley's No. 2 nitro ·360 cartridge. The ·450 No. 2 nitro is an assured success, and Messrs. Kynoch are making it.

The County challenge cups for rifle clubs have been ordered from Messrs. Elkington. They take the form of a large tankard with single handle and lid. In private life, cups of this design make excellent biscuit boxes.

In our reference to calendars which have been sent to this office, we omitted to mention one framed in rich red leather, which was forwarded by Messrs. Bennett, Sons & Co., of the Roskear Fuse Works, Camborne, Cornwall.

We very much regret that the first week of the new year was marked by a serious explosion at the works of the National Explosives, Co., Ld. at Hayle, involving a number of deaths. Our sincerest sympathy goes out to the Company in their trouble.

Messrs. Lightwood & Son, Ld. have sent out a circular notifying the trade that their business has been registered under the Companies' Acts for family reasons, and that the management will remain as in the past, no shares having been offered to the public.

The employees of Messrs. Westley Richards & Co., Ld., held their 92nd annual dinner in Birmingham on the 30th ult. About 120 were present, and what with a good dinner and a musical programme, to say nothing of the speeches, the company voted the evening a thorough success.

The Tariff Committee is evidently losing no time in getting to work. They have already issued a preliminary circular to manufacturers, and they have just applied for monthly copies of this, among other periodicals, in order that they may take note of any references to the subject which may appear in the trade and technical press of Great Britain.

As a result of a press demonstration the newspapers have lately been filled with notices of a rifle carrying sling which has been christened the Laing-Hebbert equipment. The rifle is by its aid slung across the back in a position which enables it to hang nice and free. We have not any information as to the features of its design which are considered to be exclusive property.

The Ironmonger continues in its issue of the 23rd ult., its playful little war of words with its Belgian contemporary, *L'Armurerie Liégeoise*. It is justifiably astonished at the latter's declaration that without Belgian guns the London Proof House would have nothing to do. Considering that the Belgian paper is run by the Liège proofmaster, one would have expected a little more dignity than this.

Recent articles which have appeared in *The Field* concerning the advantages of the three-inch length of case for firing pigeon loads have been taken to heart by most of the trade, who are anxious to put the thing to a practical test. The idea is that the extra space so allowed for wadding will improve the shooting of the cartridge. This compares with the attempt made a year ago to get the length of the nominal 2½-inch cartridge reduced to this length net.

An interesting souvenir Xmas card which arrived too late for mention in our last issue, came from the officers of the Explosives and Analytical Department, Perth, Western Australia. The card includes a photograph of Mr. E. A. Mann and a group of the laboratory staff, the hot sun blazing on the verandah, reminding us of our infrequent visions of that reserved luminary. The interior and exterior views of the "lab" are most suggestive of the work there carried on.

The Daily Graphic lately contained a very interesting series of drawings, depicting the doings of the Midland Railway Rifle Club at Derby, the Company having placed a disused carriage shed at the club's disposal for use as a range, the targets being placed at 25 and 50 yards respectively from the firing point. Miniature cartridges are sold at six a penny, and the club's armament includes 25 service rifles, 9 Morris tubes, 5 Greener club rifles, 4 cadet Martinis, and finally, 2 Winchester and 2 Colt repeaters. The club has 250 members, and they have fired 19,973 rounds of ammunition in six weeks.

The new N.R.A. definition for match rifles has been altered to the following for the purpose of granting greater latitude than heretofore for the improvement of military rifles:— "when of British make to bear proof marks, both on barrel and breech; weight of barrel, not including removable appliances, not to exceed 3¼ lbs.; pull of trigger, minimum 6 lbs.; maximum calibre ·350 in.; telescopic sights to be allowed in match rifle unlimited competitions; the cartridge generally must be a serviceable one from a military point of view, and having regard to the weight to be carried by the soldier"—any question under this head to be decided by the council of the Bisley committee.

The N.R.A. evidently intend by their new match rifle specification to stop the carrying out of a proposal made last year to the effect that special match rifles should be constructed with barrels of the greatest possible weight consistent with the maximum allowable weight of rifle. The Lee-Enfield barrel weighs 3 lbs., and this with a small margin is the new maximum weight for match rifle barrels. They evidently disapprove of the latitude in this respect of the old rules which permitted a total weight for the rifle of 10 lbs., which would have allowed 5 lbs. for the barrel and an equal amount for the stock and action. The only surprise to us is that no competitor made use of a heavy falling-block rifle, which could not very well have been disqualified during the progress of the meeting.

The latest trade marks registrations include the following:— A device representing a catfish ornament used by African natives, beneath which are the letters J. H. The ornament and the letters are surmounted by a border composed of two tusks. To apply to arms, ammunition, and explosive substances. John Hall & Co., Ld., Liverpool. November 23, 1903. The word "Vigourite." To apply to explosive substances. R. J. Harmer, trading as J. R. Watson & Co., London. November 28, 1903. Upon a black ground of peculiar pattern, the Yoruba words, "Súrú Logúm Aiye," are written in native characters. These words mean, "Patience conquers (the world) everything." To apply to arms and ammunition. The Lagos Stores, Ld, Liverpool. December 14, 1903. Upon a black ground of fork-like pattern, in native Yoruba characters is written the word "Súrú" (Patience). To apply to arms and ammunition. The Lagos Stores, Ld., Liverpool. December 14, 1903. Device representing a hedgehog around the top of which is the word Hedgehog. To apply to arms and ammunition. The Lagos Stores, Ld., Liverpool. December 14, 1903. No trade marks of interest to our readers were registered between December 17, 1903, and January 20, 1904.

AUTOMATIC RIFLE COMPETITION.

THE N.R.A. announce a competition for automatic rifles for a first prize of one hundred guineas. The following is an abstract of the conditions laid down :—

The calibre to be between ·255 and ·303.

Minimum weight of bullet to be 24grs. per millimetre of bore.

Weight must not exceed 9¾lb.

The rifle must be capable of alternative use as a hand-operated arm. The bolt supporting the base of the cartridge must, at the moment of firing, be positively locked. The magazine must contain not less than five cartridges, and must be loaded from clips or their equivalent. The rifle must, in the opinion of the special committee, be generally serviceable as a military weapon. The committee may require any further tests which they think necessary to enable them to form a judgment upon this or any other point.

The "desirable requirements" are laid down as follows:

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. All parts that may require to be cleaned or oiled by the soldier should be accessible without the use of tools. The rifle should fire rimless cartridges for preference. 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. The direction in which the fired cases are ejected should not be such as to incommode the firer or men at his side. The rifle should handle and balance well, and the recoil should be moderate. An efficient safety device should be carried by the rifle, but the absence of such will not be held to disqualify.

The following rules are also laid down :

No component will be allowed to be repaired or replaced during the competition. A competitor may enter two rifles of a similar type if he so wishes. Competitors are to bring their own ammunition and bayonets for their rifles. Each rifle will be tested by the committee as a hand-operated magazine rifle.

The following tests for accuracy and rapidity will be repeated on four days during the Bisley meeting (July 11 to 23, 1904), the rifles being fired by the exhibitors or their representatives. The rifles will be fired as automatic rifles for accuracy, ten shots at 200 yards, the same to be repeated with the bayonet fixed. They will also be fired as automatic rifles for accuracy and rapidity at 200 yards, as many shots as possible in one minute; the score only will be counted, and not the number of shots fired.

Each day directly after firing, the competitors will clean their rifles, and hand them to the committee for safe keeping. A rifle failing on any two occasion to work correctly automatically during the four days test for accuracy or rapidity will be disqualified, except when in the opinion of the committee the failure is due to a misfire caused by a defective cap. The rifles which have passed the above tests will be stripped by the exhibitors after the conclusion of the tests on the fourth day, and the parts will be examined for wear or clogging by the committee. On the fifth day each rifle with the magazine charged will be placed in a box, and half a pint of mixed sand, varying from medium to very fine, will be blown into the box; after which the rifle will be taken out, and as much sand as possible will be shaken off and wiped away with the hand. Fifty rounds will then be fired automatically from each rifle at 200 yards range.

The judging will be carried out by a special committee of three members, appointed by the National Rifle Association, from whose decision no appeal will be allowed.

Rifles will be disqualified if, when used as a magazine rifle, they require excessive force to operate the bolt by hand, or if they otherwise fail to satisfy the tests laid down. Those which have not been disqualified will be placed in order of merit. If, in the opinion of the committee, none of the rifles or ammunition are considered to be "of sufficient merit," the prize will be retained until another year. Should two rifles be of equal merit, the committee may divide the award.

LECTURES TO YOUNG GUNMAKERS.

XXV.—THE PHYSICAL PROPERTIES OF SMOKELESS POWDERS.

Several of the preceding lectures to young gunmakers have dealt incidentally with smokeless powders, but in no single one of the series have smokeless powders been dealt with in anything approaching a comprehensive system of treatment. In referring to the physical properties of smokeless powders the idea is to exclude everything that relates to their ballistic performances. That is to say smokeless powders will here be considered in reference to their action and characteristics prior to the time of their ignition by the cap.

Smokeless powders may be considered from the standpoint laid down in regard to :—

(1) The form and texture of the grain,
(2) their capacity to load regularly,
(3) their hardness of grain, and
(4) their moisture.

While the above classifications specify the four leading physical characteristics of smokeless powders it will not be convenient to deal with them under the separate headings, since the examination of smokeless powders with reference to their satisfactory loading necessitates the simultaneous consideration of their properties as a whole.

As regards the general texture and formation of the grains which comprise the various samples of smokeless powders, it will be found that very material differences are encountered. The first classification in the granulation of smokeless powders must apply to whether the separate pieces are formed of grains or pellets or of mechanically produced leaflets. The former characteristic is more often met with in English smokeless powders; first, because it adapts itself more readily to the loading machines that are commonly in use, and second, it is by this system of granulation alone that the bulk of the powder can conveniently be regulated to that of corresponding charges of black powder. We will, however, deal first of all with what are known as leaflet powders.

These are formed of thoroughly gelatinised nitro compounds which are rolled into sheets of suitable thickness, the latter being cut into squares of appropriate dimensions. The best known type of leaflet powder on the English market at the

present time is Ballistite. By reason of the size of the leaflets this powder cannot be loaded in ordinary machines, this being due to the liability of the leaflets to become so interlocked with one another in the hopper as to cause the effect known as bridging. The only leaflet powder that could be used in ordinary loading machines was that known as Shot Gun Rifleite, the grains of which were cut so small and were so thoroughly smoothed at the edges by prolonged shaking up in barrels, that they slid easily over one another and would uniformly pass through the small orifice which leads from the hopper to the measuring chamber of ordinary loading machines.

The only means by which coarsely granulated leaflets can be loaded is by sweeping the powder over trays containing cavities of the required dimensions. This apparatus is associated with the name of Erskine, and the principle of loading it embodies, while universally recognised, has nevertheless given way in most instances to that which is performed by means of hopper-fed telescopic tubes, whose capacity can be screw-adjusted. In the case of the Erskine machine on the other hand the thickness of the wooden or metal tray, and the dimensions of the holes, are a fixed quantity, and there is no convenient means by which small adjustments of the loads thrown can be effected. Cooppal No. 2 is another representative of the leaflet type of powder. Past issues of this nitro compound have equally required the use of special Erskine trays adapted for the throwing of standard charges, and when it is desired to load odd charges of powder into cartridges there has been no alternative, in the absence of a proper Erskine tray, but to measure the charges by individual weighing. It may, however be interesting to mention that on the Continent at any rate a more refined granulation of this powder has been issued, whereby it is said to be possible to load it by means of any suitable hopper machine.

The final characteristic of leaflet powders which may here be mentioned is that they occupy as a rule a bulk far less than that of ordinary granulated powders. More than this, certain leaflet powders must not be compressed in the loading, as they are incapable of sustaining the ordinary ramming pressure applied to the wads. The effect, therefore, of amming such powders of the leaflet type is to reduce the amount of space they occupy in the cartridge. This necessitates the use of extra wadding, and in any case raises the pressures by reason of the diminished space available for the combustion of the powder. Most leaflet powders are, however, uncompressable, and when used in combination with special cone-base cases, which provide a cone to occupy part of the powder chamber, can be loaded with practically the same wadding as is used with Bulk Powders.

Cooppal powder does not require the use of special cone-base cases, but on the other hand the loader must be exceedingly careful not to go beyond the amount of wadding recommended by the agent. As the powder does not support the wads with anything like the firmness of a powder of ordinary granulation. it is necessary to see that the wad-seating plungers do not enter the case beyond the distance necessary for allowing the appropriate space for the shot charge and turnover which must be accommodated. In turning such cartridges over, further care must be exercised n the avoidance of any undue pressure, such as might force the contents of the cartridge too far into the case, so increasing the size of the turnover at the expense of the capacity of the powder chamber. In fact, we know of an instance where a shooter, who regularly uses the powder under consideration, is in the habit of seating the wadding to a distance that barely allows space for the insertion of the shot charge and top wad, the further seating of the wads being accomplished by the turnover process which is provided with a stop that limits its action at the point when an appropriate length of case has been turned over.

The great popularity of the granular system adopted in smokeless powders must be mainly attributed to the simplicity and ease with which the processes of measuring the charges and filling into cartridge cases can be accomplished. If a sample of a well granulated smokeless powder is placed in the hopper of a glass funnel with a comparatively small bore of tube, it will be found that the contents run out with an even flow, such as affords evidence that the grains of powder slide smoothly over one another without any tendency to stick and so form a stoppage. This particular smoothness of grain is produced in the manufacture of the powder by rolling it continuously in large hoppers or drums, such rotation causing a prolonged friction and rubbing between powder grain and powder grain, so that all the rough corners are gradually got rid of. Subsequent sifting has the effect of separating the grains which are of correct size and formation from the large and unduly small grains which would interfere with the proper working of the powder. Hence it becomes a test of a smokeless powder to see whether it contains an undue proportion of small grains. Irregularity in the charges thrown necessarily follows from exceptional unevenness in this respect, the small grains tending to settle at the bottom of any receptacle in which the powder is shaken up, the large grains passing to the top. As the density of a mass of closely packed small grains of powder is greater than that of the larger ones it would follow in extreme cases that there would always be present a tendency for the smaller grains to throw heavier charges than those of larger size. Assuming, however, that a sample of powder has been properly manufactured in this respect, the chief test that may be applied to it in examination of its characteristics must relate mainly to its density of loading.

For the purpose of making this test nothing can be more satisfactory than an ordinary Accuratus loading machine. This should be set up on a bracket firmly fixed to the wall of the loading room, with a bench beneath suitable for the handling and preliminary examination of batches of powder that are sent to the loading room. The hopper of the Accuratus machine should be filled with the powder which it is intended to examine, and the first couple of charges should be placed on one side without examination as a precaution against the possibility that the powder may not at that stage have settled down into a regular formation in the hopper. The next charge taken should then be carefully weighed, and the machine should be adjusted until the correct three-dram bulk is registered as judged by the throwing of standard weights of charge, whether 42 or 33 grains, according to the class of powder under inspection. The loading apparatus will thus be adjusted to the particular sample of powder under consideration. It may, however, be found during the examination of subsequent samples that the first adjustment of the machine does not hit off a fair average of existing powders. However, in course of time a setting of the machine will be arrived at which may be regarded as a correct average of the

standard three-dram charge. When this has once been attained the machine should never again be re-adjusted, the fixed setting being treated as a standard by which the density of all subsequent deliveries of powder should be examined. Assuming that a machine adjusted in the manner indicated is in regular use it becomes a very simple matter to examine various systems of wadding such as are commonly used for powders of standard bulk.

A sample of powder having been obtained which throws a correct 42 grains, that is with a variation not exceeding half a grain either way, charges may be passed into a number of test cartridges. These should then be wadded in the customary way, and care should be taken to note the amount of pressure requisite to seat the over-felt wad so as to allow a distance of 1·05 inches to the mouth of the case for the standard charge of 1⅛ oz. of No. 6 shot. Having duly inserted the top wad and turned over the end of the cartridge, the time has arrived for ascertaining the suitability of the loading adopted. By holding the cartridge in the left hand, and pressing the top wad with the forefinger of the right hand, it will soon be apparent whether or not the powder is sufficiently solid in the grain to support the pressure so exerted upon it. If the top wad gives way it is evident either that the wadding used is not sufficiently solid, or else that the powder charge is unduly soft, the question of its bulk having been settled by the Accuratus test.

It will be found by this and other similar tests that some powders are softer in grain than others, and as the public demands a cartridge with a well-supported top wad it will be necessary, either to reject the sample of powder delivered, or else to use an extra sixteenth inch of felt. Such a test as this is exceedingly useful as a means of determining the suitability of a powder for various forms of loading. In fact it is the absence of this preliminary experiment which leads to the bad loading of the many exceptional charges which sportsmen are in the habit of specifying. Large sizes of shot occupy more space than smaller sizes, while again the highly chilled varieties occupy nearly a thirty-second of an inch more space in the cartridge than when the charge consists of pure lead shot. The greater or less compression of the powder is the obvious way by which these differences may be adjusted, provided they lie within a sufficiently small margin, but the amount of latitude so dealt with must be very small, and the wads must be altered for all variations beyond the thickness of a thin card wad. Such adjustments should not in any case be met by altering the depth of case utilised for turnover. This not only gives a bad appearance to the cartridge, but it is liable to create an undue amount of resistance during the initial stages of combustion.

The question of density of powders thus becomes one of the most important points to be considered by the conscientious cartridge loader. Not only must the powder occupy a suitable bulk in relation to weight when in the loading machine, but the grains must be of such hardness that a compression of about sixteenth of an inch after loading into the cartridge will solidify the powder sufficiently to enable it effectively to support the contents of the cartridge. The compression sustained by the powder should be applied to the face of the over-felt wad. By the skilful manipulation of a hand rammer it is easy to determine the point at which the felt wad comes into contact with the over-powder wad, also the amount of force necessary to seat the over-felt card in its final position in the cartridge. If the powder offers an effective resistance to the seating of the over-felt wad there need be no danger of a loose cartridge.

When the powder, as delivered, is incorrectly regulated for density, the charge thrown by the standard adjustment of the Accuratus will be either too light or too heavy. When the former it means that the powder will occupy too much space in the cartridge, and the wads must be regulated accordingly if the difference is considerable. More than this, the setting of the ordinary loading machine must be re-adjusted so that the correct charge by weight shall be thrown. Conversely, when too heavy a charge is delivered the powder will occupy too small a space in the cartridge, and the extra space available must be filled in by means of extra wadding. As a general rule it may be laid down that 50 grains of Schultze in a suitably compressed state occupies ·8 of an inch in an ordinary 12-bore cartridge. Thus a quantity of five grains represents ·08 or rather under one-tenth of an inch, and two grains occupy one-thirty-second of an inch as nearly as possible. Consequently a 42-grain powder, which is erroneously bulked to the extent of two grains in the standard three-dram charge, has an error equal to one thirty-second of an inch, which cannot be ignored in the making up of a satisfactory cartridge. The error so arising must be corrected, either by the alteration of the wadding, or else by returning the delivery of powder, so giving the manufacturer an opportunity to send something closer to standard.

The systematic study of the physical properties of smokeless powders is of considerable importance in dealing with exceptional loads. The total thickness of the wadding must be such as will allow for the due filling of the cartridge when it contains the specified charges of powder and shot. If the turnover, shot, wads and powder do not agree in total measurement with the length of the cartridge, some correction must of necessity be made if satisfactory ammunition is to be the outcome. For such purposes a special Accuratus loading machine will be found of great advantage. This can be adjusted with the required nicety to load a small number of special charges, though for the loading of sample cartridges it is sufficient to weigh the charges singly by means of the chemical balance. The shot should in the same way be inserted by weighing, though of course it is equally suitable to use the shot counter provided a sample correct to the normal size is reserved for such purposes. At any rate, the successful execution of an order for special loading must depend entirely on the care which is taken in examining the charge specified with reference to the other contents of the cartridge. The day has certainly gone by when it is good enough to load divers combinations of powder, charge and shot with a set range of waddings without reference to their suitability or otherwise. Present-day requirements undoubtedly demand that the contents of every cartridge issued shall be firmly held in place by a turnover of suitable form and consistency, and a reliable turnover cannot be guaranteed unless the top wad is properly supported by reason of the appropriate adjustment of the materials inserted into the case.

The moisture present in a sample of smokeless powder is very closely related to its ballistic capabilities. Consequently, this particular characteristic only falls incidentally within the scope of the present lecture. All powders have their appropriate percentage of moisture, which under normal

conditions should lie midway between the extremes of variation that are due to the climate of Great Britain. It is hardly likely that many cartridge loaders will set themselves to study this aspect of smokeless powders, though it is highly essential to do so if an opinion is to be passed upon their condition after prolonged storage. At any rate, the process of testing the moisture of a sample of smokeless powder is a laboratory operation which can be conducted only by the aid of certain simple appliances. These comprise an accurate chemical balance and set of weights, a weighing bottle and a water-jacketted oven. A sample of powder, say one hundred grains roughly in weight, may be inserted in a weighing-bottle. The bottle and powder should then be placed on the balance and their weight correctly taken to the hundredth part of a grain. The powder should then be placed in a watch-glass or other flat tray, after which it should be inserted in the oven, which should be maintained at an equable temperature of 70° C. by means of a Bunsen burner. After two hours of such treatment the sample of powder should be carefully returned to the bottle, when a re-weighing will show the loss of moisture due to evaporation, the purpose of the bottle being to prevent the re-absorption of moisture during the second weighing. A little sum in arithmetic will then show the percentage of water so established in the powder.

By careful comparison of results obtained at different times, skilful manipulation and the power to interpret the figures obtained will soon result, and in the end a very interesting side-light will be thrown on the condition of smokeless powders which are supplied for loading purposes. In the case of powders containing nitroglycerin the drying should not be conducted in a hot-water oven, the alternative being to use what is known as a dessicator, that is, a stoppered glass vessel containing in its lower receptacle a quantity of well-dried chloride of calcium. This has the power of withdrawing the whole of the moisture from the powder in the course of say three days. This method of drying is equally applicable to all classes of powder, and the apparatus has the advantage of being kept more easily in working order than the water-jacket oven; but on the other hand time is lost in obtaining the required particulars. The relation of moisture to powder ballistics must be dealt with on a future occasion.

CORRESPONDENCE.

VELOXITE.

To the Editor of *Arms and Explosives*.

Sir,—I am sorry that you should find me guilty of "bad policy," or think that I have done "a most extraordinary" thing in writing to *The Times* to announce an important discovery of interest to both the Navy and the Army, as well as taxpayers. A short letter to *The Times* seemed to me the most natural and proper mode of making such an announcement, and I still think so. You call my short letter "a lecture on explosives" which it most certainly was not. If it had been, I fear it would have caused a still greater flutter in the dovecote for which you appear to hold a brief. You are, as you say, perfectly "free to deal with what" I have said, and I claim the same freedom as regards what you have said.

I compared Veloxite with black powder and not with Cordite, for three reasons: 1st, because black is the standard of comparison in use by all artilleries; 2ndly, because I had fired it against black, but not against Cordite; and 3rdly, because you cannot always compare Cordite even with itself. It is so capricious and uncertain—witness Ladysmith. I stated what Veloxite does *not* contain; because it is the only smokeless powder which contains no nitro, or other dangerous compound. My letter repudiating all nitro compounds was immediately and tragically echoed by the Hayle nitroglycerin explosion. An explosion is the very last thing which an artillery officer, or a sportsman, if sane, wishes to set up inside his gun, and I hope that within the next two years no such dangerous compounds, unsuitable for ballistic purposes, will be used. But though I hope to kill all such, I have told all powder makers and gunmakers who have written to me, that I do not desire to injure any one but will give them all licences, so you see your clients need not have been so perturbed. But you and they must know, just as well as I do, that not only are there not "hundreds," but not *one* "laboratory sample" of any explosive on any one's "shelf" which has the special qualities of Veloxite. *Hinc illæ lacrimæ.*

You describe my short statement of fact about the War Office as "a thoroughly unfair attack." Knowing nothing whatever about it you accuse an old soldier of "conduct" which would certainly be "unbecoming an officer and a gentleman," and you then read into my short statement of fact, an "inference" which is ludicrously remote from any words in my letter, and you then call me, by *direct* inference, a "miscellaneous individual" with "crude ideas" desiring "promiscuous assistance" for my "deficient technical qualifications." Calling names is generally the last sign of defeat, and you have begun early; but next time perhaps you will kindly criticise what I do say, and not read into it what I do not say. Meantime I will try and set myself right with your readers, to whose sense of "fair play" I confidently appeal.

When in December, 1856, I took the shrapnel shell for rifled guns to the Ordnance Select Committee, it was condemned as useless, because "rifled guns will never be introduced into the British Service." When I reported from Washington, on the 19th December, 1857, on the first metallic cartridge cases ever seen in the world, and on the Morse sliding breechloader for firing them, I was ordered to buy a Morse rifle and 1,000 rounds of his ammunition and send them home, which I did in March, 1858. Both rifle and ammunition were condemned for the three following reasons:—

1. The rifle fired too quickly (12 rounds a minute).
2. The cartridge cases were metallic.
3. They contained the principle of their own ignition (being central fire and containing a countersunk cap and anvil).

My Report had ended with a prophecy which was fulfilled by the Zundnadelgewehr in the Sadowa campaign. Thereupon came out in October, 1866, the celebrated War Office advertisement inviting competition for the British breechloading small-arm of the future, leaving as much as possible to inventors, but stating that no rifle would be admitted to the competition, unless it complied with the three following *sine quâ non* conditions:—

1. The rifle must fire not less than 12 rounds a minute.
2. The cartridge cases must be metallic.
3. They must contain the principle of their own ignition.

In 1861 I reported against the original heavy Armstrong

guns, five of which blew out their breech pieces on board H.M.S. *Cambridge* (gunnery ship) in one day. But I will not go through the long record of my protests and prophecies about our never ending failures, and I will not stir up still more stinking dirt inside the War Office, for such things are better kept quiet until the day of reparation comes; but I will ask you to remember in future, that I was one of the earliest of modern experts in artillery and war material, as I am now one of the oldest, and further that I am a Scot, and that *nemo me impune lacessit.*

To refute your personal charge of unfairness in my statement of fact about your clients the War Office, I now charge them with gross incapacity, or gross neglect of duty—whichever you prefer—inasmuch as in 1896, before I had succeeded in abolishing smoke, I had produced a very fine powder with a great diminution in the volume of smoke, and a great lightening in its texture, so that it rose rapidly and cleared away. Knowing that my name was to the "old gang" of officials like a red rag to a bull, I got a firm in the City to sign a letter which I dictated, offering in their own name a trial of the powder free of expense, guaranteeing that it would increase the velocity of all our old guns by 20 per cent., while not increasing maximum pressure, and therefore that it would increase their penetration by 50 per cent. That offer, free of expense, was promptly refused by the War Office. Now, Sir, what defence have you for your clients? You, Sir, of all people, should be for the "Noble Army of Inventors," not for the obstructionist Jacks-in-office. Your Journal, and all modern technical publications, owe their very existence to the inventors, whose battle I have always fought.

14, Crowdace Road, Fulham. W. HOPE,
January 16, 1904. Colonel.

APPLICATIONS FOR PATENTS.

DECEMBER 21, 1903—JANUARY 23, 1904.

27,958. Frogs for Side-arms. P. A. Martin.
28,066.* Automatic Rifle. T. A. and O. A. Fidjeland.
28,171. Cartridge Belt. A. J. Boult (Agent for *W. Lindsey*).
28,265.* Submarine Mine Torpedo. A. Elgar.
28,489. Motion of Rifle Breeches. D. Petriccione and A. Carbone.
28,490. Breech Mechanism of Ordnance. Sir W. G. Armstrong, Whitworth & Co., Ld., and Sir A. Noble.
28,495. Ordnance Loading. A. T. Dawson and T. Horne.
28,588. Air Torpedo Propelling Charge. W. T. Unge.
28,710. Blasting Explosives. J. Russell.
28,718. Ammunition. C. Merson-Davies (Agent for *L. Merson-Davies*).
28,774. Ordnance. A. T. Dawson and J. Horne.
28,785. Ordnance. A. T. Dawson and J. Horne.

1904.

26. Blasting Fuses. Curtis's and Harvey, Ld. and J. Malson.
95. Automatic Scoring Target. S. T. Woodhouse.
116.* Nitrocellulose Gunpowder. O. Schmidt.
118. Machine Guns. Kaid Sir H. Maclean and E. J. Hill.
406. Sporting Cartridges. J. W. Smallman.
751. Projectile Cap. W. W. Motteram.
826.* Barrel Locking Device. B. Behr.
834.* Single-trigger Mechanism. E. D. Fulford.
843. Rifle. W. G. H. Salmond.
882. Practice Cartridge Adapter. G. Hookham and Kynoch, Ld.
898. Automatic Machine Gun. B. W. Murray.
900. Targets. E. Salaman (Agent for *C. Birch*).
924. Torpedo Propulsion. T. J. Crocker.
1,105. Shells for Ordnance. E. von Reichenau. (Date applied for in U.S.A., May 25, 1903.)
1,370. Small-arms. F. E Cowin and J. W. Allen.
1,475. Gun Sights. Sir W. G. Armstrong, Whitworth & Co., Ld. and R. T. Brankston.
1,507. Cartridge Wad. H. Bodin.
1,650. Range Finding Attachment. T. R. R. Ashton.
1,669.* Projectiles. R. H. Quisling. (Date applied for in Norway January 26, 1903).
1,685. Percussion Fuses. King's Norton Metal Co., Ld., T. A. Bayliss and C W. Hill.
1,686. Percussion Base Fuses. King's Norton Metal Co., Ld., T. A. Bayliss and C. W. Hill.
1,802. Ordnance. C. D. Abel (Agent for *Rheinische Metallwaren- und Mf.*).

* These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

DECEMBER 24th, 1903—JANUARY 21st, 1904.

COMPILED BY HENRY TARRANT.

27,016 (1902). **Range Finder**. C. A. Allison, London (Agent for *Sarah M. Keen, U.S.A.*). Upon a base, two telescopes, one movable and the other fixed, are arranged. The pivoted telescope is brought to a focus upon the distant object which has already been brought within the focus of the fixed telescope. The movement of the telescope on its pivot is communicated through the medium of a micrometer screw to a pointer working upon a distance-indicating dial. Accepted December 8, 1903.

27,246 (1902). **Projectile Construction**. A. Hooper, J. M'Cormick and H. Kernaghan, Belfast. The longer axis of a projectile is from end to end surrounded by a space of a diameter about one fifth of that of the projectile. The rear end of the tube so formed is closed by a disc which falls away when the bullet leaves the barrel. The air passing through the boring is said to cause the projectile to travel in a straight line for some considerable distance. Accepted December 10, 1903.

28,268* (1902). **Back Sights for Rifles** T. J. Britt, C. W. Abbott and C. F. Kelly, South Africa.

28,520 (1902). **Movable Targets**. A. F. Spooner, London (Agent for *P. Lange, Germany*). Two targets, suspended from pulley blocks running upon rails forming part of the target framing, are so arranged that a pull upon the chain attached to one set of pulleys causes them both to move in a horizontal direction. One of the targets is, by means of this motion, brought into the view of the shooter, and the other is carried behind a bullet shelter. A pull upon a chain at the other side of the target framing reverses their positions. Accepted December 24, 1903

28,708 (1902). **Time Fuse for Projectiles**. C. Bäker, Germany. A time fuse, in which a firing spring after the lapse of a certain variable period from the time of discharge of the shell, is released by a clockwork mechanism, and is caused to fire a percussion cap through the medium of a firing pin which it carries. A safety device is attached to prevent premature release of the firing spring or injury to the clockwork mechanism at discharge. Accepted December 3, 1903

1,639 (1903). **Detonating Fog Signal.** F. A. Ludlow, Birmingham. A modified form of fixing the lead strips to fog signal is dealt with in this Specification. The patentee's method is intended to save expense and time in performing this operation. Accepted December 17, 1903.

2,557 (1903). **Breech Adapter for Minature Ammunition**. W. H. Track, London. A case of ordinary service dimensions is provided with a removable cap chamber. A lighter bullet is inserted into its mouth and a solid powder charge is dropped into the case through the cap hole. The cap chamber has to be renewed after each shot. Accepted December 10, 1903.

3,064 (1903). **Ammunition Waggons.** A. T. Dawson and G. T. Buckham, London. A detachable contrivance is so constructed that it can be applied to the base of a cartridge lying in its receptacle in the ammunition limber of a field gun. The cap is protected by this device, and the cartridge is locked securely in its place in the limber. Accepted December 10, 1903.

3,408 (1903). **Vanishing Targets.** E. Holloway, Reading. A combined running man and vanishing target arrangement in which four targets are fixed to a revolving bar, and are adapted to appear only at predetermined intervals. The running man target is attached to a chain working around two pulleys. Accepted December 31, 1903.

4,729 (1903). **Spiral Spring Manufacture.** R. and T. Eyre, Sheffield. A method of regulating the pitch of spiral springs, more especially those of the heavy class used in ordnance. The rolled bar of steel whilst hot is placed upon a lathe-like machine, and a mandril carrying a "nib" is entered inside the spring. The mandril and nib are turned, and the nib running the coils of the spring is adapted to regulate the pitch of the spiral. Accepted December 31, 1903.

5,791* (1903). **Safety Explosives.** C. E. Bechel, Germany.

6,689 (1903). **Ignitors for Blasting Fuse.** A. Engl, Austria. Attached to a blasting fuse is a frictional ignition head adapted to be fired by means of a separate rubbing surface. This head is in direct communication with a firing composition whereby the ignition of the filler and the fuse is secured. The ignition head is composed of 100 parts by weight of chlorate of potash, 50 parts by weight of sulphide of antimony, and 20 parts by weight of pulverised glass and the rubbing surface of 10 parts by weight of amorphous phosphorus, and 8 parts by weight of manganese dioxide. Accepted December 31, 1903.

8,640* (1903). **Single-Trigger Mechanism.** D. M. Fraser. Edinburgh.

10,780 (1903). **Recoil Gear of Heavy Ordnance.** A. Reichwald, London (Agent for *Fried. Krupp, Germany*). A method of providing against the digging of a trench below barrel-recoil guns of the heavy type which are fired at great elevations. By means of an adjustable stop mounted upon the carriage in the path of the cradle, the barrel when recoiling from its greatest elevation is caused just to clear the plane touching the wheel and trail bottoms. Accepted December 31, 1903.

10,781 (1903). **Hydraulic Brakes for Ordnance.** A. Reichwald, London (Agent for *Fried. Krupp, Germany*). In hydraulic brakes of the type in which the passage of the liquid from one side of the piston to the other is governed by a rotary valve, a non-rotatable flap valve is fitted to the piston to act in controlling the return movement. The area of escape for the liquid is by this means opened as quickly as possible when recoil takes place. Accepted December 31, 1903.

16,464 (1903). **Barrel Bands for Small-Arms.** The B.S.A. Co., Ld., and C. Proctor, Birmingham. In order to allow of free expansion of a rifle barrel without setting up metallic bind, whilst at the same time providing that the barrel shall be held steady, the inside of the barrel bands are lined with some non-metallic yielding substance such as asbestos, felt, cork, papier-maché, or soft wood. Accepted December 31, 1903.

19,282 (1903). **Range Finder.** G. N. Saegmuller and G. M. Searle, U.S.A. In patent No. 18,760, 1901, a telemeter was dealt with which was adapted to obtain the mathematical result of what is known as Buckner's method of distance measurement. This telemeter is modified, the alterations being intended to enhance the accuracy of the instrument, and to locate the parts in a smaller and more convenient compass. Another object is to provide a reflecting attachment by which an observation may be taken towards the the shore, the visible horizon behind the observer being reflected. Accepted December 10, 1903.

22,486 (1903). **Electrical Range Finder.** H. Shoemaker, U.S.A. By means of two sighting telescopes a gun operator is constantly advised of the relative position of the object, though it may not be visible to him. Each of the two sighting instruments is trained upon the distant object. Two indicating needles follow the movements of their respective controlling telescopes, and the point of intersection of these needles or pointers upon a chart corresponds with the location of the object to be aimed at. Accepted December 3, 1903.

24,478 (1903). **Percussion Fuses.** H. H. Lake, London (Agent for *H. Wilson and M. A. Lynch, U.S.A.*). A percussion fuse in which the firing pin is held in a "safe" position until the shell is discharged. Upon firing part of the block carrying the firing pin is forced by centrifugal force against the action of a spring into alignment with the primer. A sudden stoppage of the shell brings them into engagement. Should the shell strike a slanting blow another part is caused to elongate and to ensure active engagement of pin and primer. Accepted December 17, 1903.

*These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

BACK SIGHT FOR RIFLES.

28,268 (1902). T. J. Britten, C. W. Abbott and C. W. Kelly, South Africa. A back sight, capable of adjustment for the purpose of counteracting the effect of wind or inaccuracy in the sighting of the rifle, is described in this Specification. Compared with the sight at present used upon the service rifle, the only difference exists in connection with the bar sliding upon the leaf. The sighting notch carried by the bar may be shifted from one side to the other through the medium of a screw working in the notch-carrying block.

Fig. 1

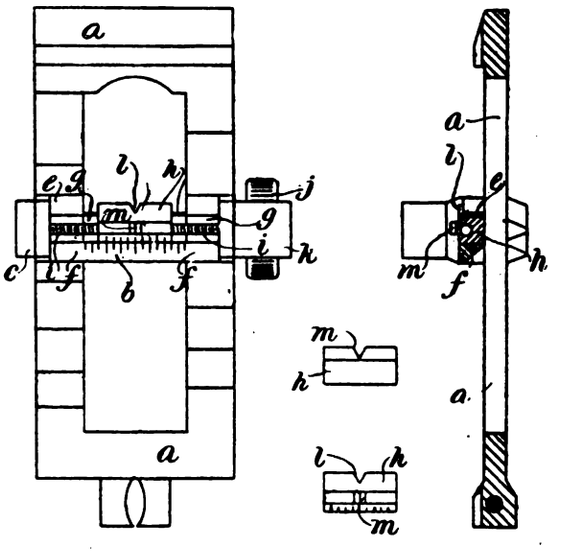

Fig. 2

The folding leaf *a*, illustrated in the appended drawings, is fitted to the sight bed and is graduated in an ordinary manner. The sliding bar *b* consists of two end pieces *c* and *d*, which are connected by the front bar *e* at their tops, and by the triangularly shaped bar *f* at their bases. Between these two bars *e* and *f* a slideway *g* is formed, in which slideway the notch-carrying block *h* moves. The top and bottom of this block *h* are engaged respectively by the

bar *e* and by the bar *f*. The lower bar *f* is formed of triangular section in order to allow the bar to be carried down into its lowest position, the inclined undersurface clearing the protruding part of the leaf base. The bar is graduated upon its face so that the sighting block, which also possesses a scaled front, may be adjusted laterally in relation therewith to 150th of an inch on either side of zero.

The screw *i*, Fig. 2, is supported in bearings in the end pieces *c* and *d*. The sight block *h* is tapped longitudinally in such a fashion as to enable the screw *i* to work through it, and to move it along the slideway *g* when the screw is rotated. One end of the screw projects beyond its bearing in the end piece *d* and upon its outer extremity the milled head *j* is fixed (Fig. 2). This milled head, through which the screw is turned, is encased by the covering *k*. The sighting block carries two V-notches the one *l* for use when the leaf is in its raised position, and the other *m* for use when the leaf is in the position about parallel with the barrel. Accepted December 17, 1903.

THE FRASER SINGLE-TRIGGER MECHANISM.

8,640 (1903), D. M. Fraser, Edingburgh. In the single-trigger mechanism dealt with in this specification, what is called a "rocking double hook-shaped flat plate" is pivoted upon the top of a sliding bar, and is adapted to lift the sears in predetermined order. The involuntary pull is obviated by an upstanding projection on

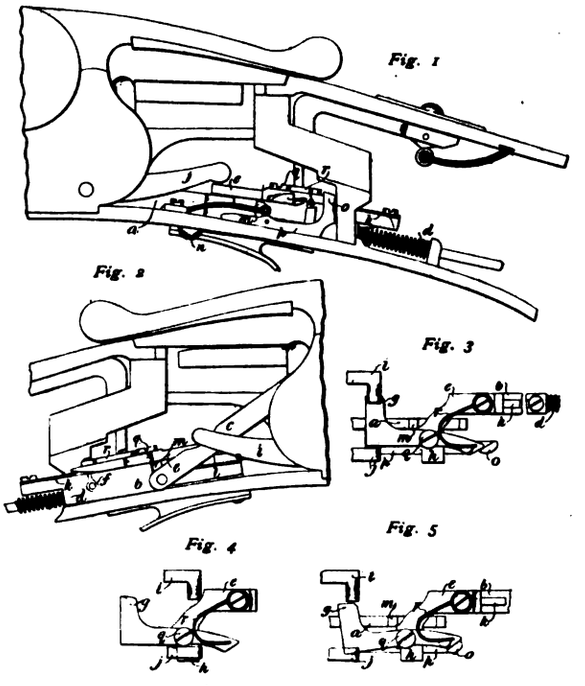

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

the trigger blade which holds the sliding part against movement until the trigger is finally released After firing the left barrel first the parts have to be turned over to the right by the manipulation of an outside slide.

In the drawings the trigger blade *a* is illustrated as taking the place of the ordinary two triggers. At the side of and close upon the top of the blade is fitted a sliding bar *b* (Fig. 2) the position of which is governed either by a cocking lever *c* or by the spiral spring *d*. The hook-shaped plate *e* is hinged at *f* upon the sliding bar *b*, and it is through the medium of the hook *g* and the projection *h* that the sears *i* and *j* are raised. When the gun is opened the hammers are cocked in the ordinary way, and the right-hand hammer, during its backward progress, is, through an engagement with the sliding bar *b* caused to force that part into the position shown in Figs. 2 and 3. The bar *b* carries the hook-shaped plate *e* with it, the forward end of this part being kept right down upon the trigger blade *a* by the spring *k*. This spring which is attached to the bar *b* acts also as a trigger spring.

In this cocked position the nose *g* of the hook-shaped plate *e* lies beneath the right-hand sear tail *i*. A pull of the trigger turns the plate *e* upon its pivot *f* and the right-hand barrel is discharged. The fall of the right-hand hammer removes the rod *c*, the end of which travels along the groove *l*. But the sliding bar *b*, although free from this obstruction, does not immediately fly forward under the influence of the spring *d*. Following upon the first discharge the involuntary pull jams the trigger upwards again and the projection *m* is forced into the path of the bar *b* and holds it until the effect of the recoil has passed away. Then, the pressure upon the trigger being released, the part *m* is removed and the spring *d* forces the bar *b* into the position shown in Fig. 4. The projection *h* is thus carried beneath the left-hand sear *j* and a second deliberate pull of the trigger discharges the second barrel.

The firing of the left barrel first is provided for by the supply of the thumbpiece *n*. When this part is forced forward, i.e. towards the barrel of the gun, the upstanding projection *o* upon the end of the slide *p* attached thereto, is caused to turn the forward part of the hook-shaped plate around upon its pivot *q* against the pressure of the spring *r*. The end of its leg is by this means carried beneath the left-hand sear tail *j*, Fig. 5, and when the trigger is raised the cartridge in the corresponding barrel is emptied. The slide *p* has to be forced forward again in order to allow the spring *r* to take the hook back beneath the sear tail *i* preparatory to firing the right-hand barrel. Accepted December 10, 1903.

SAFETY EXPLOSIVES.

5,791 (1903). C. E. Bichel, Germany. In our issue of December, 1903, we described at length the safety explosive compound which was dealt with by the above patentee in his Specification No. 28,245, 1902. This firedamp proof compound consisted of ammonium chloride with equivalent amounts of potassium or sodium nitrate, or both. The two last-named substances were entered into the composition in order to render it safe. Examination has shown the patentee that the safety effect is obtained by the generation of vapours of sodium or potassium chloride, and that all chlorides of alkalies and earth-alkalies act in the same manner. It is not essential that the vaporizing chloride be added to the compound. It may be formed by chemical conversion upon detonation of the explosive. With similar success, the chlorine required for the formation of the chlorides may be added in the form of a chlorinated carbon vehicle.

Examples of the explosive with equivalent added amounts of alkaline-chlorides and alkaline nitrates are as follow:—

(1). Nitroglycerin 25·30 per cent., collodion cotton (wool) 0·70 per cent., gelatinized glycerin (1 part of glue dissolved in 3·5 parts of glycerin) 6·90 per cent., chloride of sodium 25·60 per cent., and nitrate of ammonia 41·50 per cent. This example produced in Franze's lead block a distension of 400 cubic centimetres, and has proved safe at 550 grammes.

(2). Nitroglycerin 26·00 per cent., collodion cotton 0·75 per cent., gelatinized glycerin, 6·50 per cent., trichloid-acetate of sodium 9·20 per cent., nitrate of soda 8·50 per cent., and nitrate of ammonia 49·50 per cent, produced a distension of 440 cubic centimetres, and possesses a safety of 500 grammes. The proportions in which the substances are mixed in this example are exactly as they are given in the patent specification.

(3). Nitroglycerin 22·00 per cent., collodion cotton 0·60 per cent., chloride of potassium 11·00 per cent., saw dust 0·60 per cent., glue-glycerin-gelatine (1 part glue, 3 parts glycerin) 8·00 per cent., nitrate of ammonia 57·80 per cent. Distension 345 cubic centimetres, and possesses a safety of 500 grammes. Accepted Dec. 31, 1903.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

War Office Reorganisation.—However slight may be one's business connections with the War Office, the fact remains that any measure to reform its organisation must be a matter for great satisfaction, since the closer the methods of the War Office can be made to approximate to those of a business house the better is it for all who have dealings with them. It is of course impossible to prophesy at this moment how far the alterations of method which are now in course of initiation will affect those who have to do with this department as contractors for munitions of war. Of late years many firms have made exceedingly large sums of money from contracts given out by the War Office. On the other hand there have been many complaints to the effect that large plants, which have been established under the direct encouragement of the War Office, have only been intermittently supplied with work. As the contracting firms require to show a satisfactory result to the shareholders it must follow that they take suitable account of the conditions under which they are employed when framing their tenders. If, therefore, improved business methods are to rule in Pall Mall, one of the things that should certainly come up for attention in due course is to endeavour so to allocate contracts as to enable manufacturers to make suitable provision for carrying them out over a reasonable period. The disorganisation which results from the present methods of working naturally causes so much inconvenience to the contractors that they would doubtless welcome an opportunity to give the War Office the benefit of a reduction in price in exchange for a more regular sequence of orders, such as would enable the firms interested to maintain their manufacturing organisation on a more systematic basis of regular employment.

The Past Year's Finance.—The balance sheets and other records of financial progress which come before us at this season of the year reflect in many instances the disastrous consequences of the phenomenally bad game season of 1903. Not only was there a great deficiency in the head of game available for shooting, but the financial position was such that many shooters of a lifetime's standing left their guns in the cases, and decided that, birds or no birds, they must for once deny themselves the pleasure of engaging in partridge driving and covert shooting. Such a combination of bad conditions has never before existed in the entire history of the industry. Under such circumstances it is not surprising that a great falling off has been shown in the consumption of cartridges. A deficiency in this respect naturally involves the business of the gunmaker, whose doings are not the subject of annual balance sheets to anything like the extent that is represented by the consumption of sundries connected with ammunition. The fact that we are all alive to tell the tale naturally leads us to adopt the very human course of wishing for better things in the future. Notwithstanding the vagaries of the climate in the British Isles some sort of an average exists; and the fact that we have gone so far below it in the year just passed justifies us in assuming that with a return to normal conditions a distinct improvement will be registered. At the present

time signs of an improved state of affairs are still wanting; but in so far that the critical period of the breeding season is not due for several months we may watch the present unfavourable conditions without undue anxiety. Meanwhile the most serious omen is the continuance of bad financial conditions; but even so these seem to follow no special rule, so that we may at any time find ourselves face to face with a rising market and a more satisfactory tone all round.

The New Proof Rules.—The continued delays in the settlement of the outstanding questions concerning the new proof rules have now been explained by the announcement of a joint conference to be held at the Board of Trade offices to discuss the question of the marking of foreign guns. It seems, therefore, that the whole of the delay in connection with putting the new rules into force has arisen from the difficulties incidental to the settling of this very debatable question. It is a matter for regret that the workmen's organisation in Birmingham appears consistently to have adopted a policy rather of opposition than of construction ever since its leaders interested themselves in proof procedure. The gunworkers were instrumental in causing the loss of the whole of the money spent by the Birmingham Proof House in its endeavours to strengthen the proof regulations by obtaining a new Act to take the place of the current one of 1868. In regard to the new rules they have adopted the same policy of asking for more than could possibly be granted by the masters, the latter being thus once more tempted to adopt the previous policy of abandoning the whole structure rather than have it passed in a top heavy condition. It is impossible by mere argument to overcome the disadvantages of class prejudice, and yet if any two parties could be supposed to have the same general aims it must be the master on the one hand and the workman on the other. We nevertheless find that proposals which are put forward by the masters for the amelioration of conditions in the gun trade receive the bare approval that is involved in a desire to carry them a lot further. Failing this the attitude of the workman is not to accept an instalment of their ultimate desires, but rather to act in opposition to the intermediate course and so run the risk of getting nothing. It is to be hoped in the present instance that the Board of Trade will be less easy to convince than was Sir Henry Fletcher's House of Commons Committee. The present scheme for the marking of foreign made guns thus stands a chance of coming into force, leaving open for future consideration the extension of a similar principle to gun barrels. It is the earnest hope of all true well wishers to the trade that in the meantime Birmingham will have equipped itself with the means for replacing the supplies at present derived from the foreigner.

The late James Paris Lee.—A telegram from the United States has told us of the death of Mr. James Paris Lee. The deceased inventor never received anything approaching a true measure either of credit or of remuneration for the magnificent services he rendered in connection with his epoch-making inventions. He was born in Scotland in the year 1831. Four years later his father emigrated to Ontario, where James's boyhood was spent. From the earliest times the natural bent of his mind seems to have been in the direction of firearms construction. His education in mechanics was concerned with the watch and clock business, which was his father's trade. He started in business for himself, but soon spent a great portion of his spare time in the working out of various forms of rifle. He commenced by making the mistake of going too fast, in so far that his first effort was a 40-shot repeater with a hollow steel stock containing a series of magazines. In due course, however, he took up a more practical form of firearm, being the first to apply the bolt system of breech closure in combination with a vertical magazine, to military firearms. Had he possessed the business faculties of an Edison or a Marconi he would have created nearly a world's monopoly for the original features of the first Remington-Lee magazine "gun." This was a true counterpart of the modern bolt rifle; but others reaped the benefits of the original conception involved in the parent model. Bad health, and the want of a powerful manufacturing concern at his back, largely interfered with the prosecution of his many-sided enterprise. Had he been more vigorous in body and better equipped from the laboratory standpoint, he would doubtless have been able to eliminate the mechanical difficulties which have made the Lee system of mechanism less satisfactory than others based thereon. These latter were evolved as a result of experiments involving an outlay beyond anything that he had the power of incurring. He ought to have died a millionaire; but instead of that he retained to the end the modest position which is the natural status of inventors who are not gifted with commercial pushfulness, and who have not the funds wherewith to uphold their claims in a court of law.

Our Lecture on Smokeless Powders.—Our last month's lecture to young gunmakers dealt with the many interesting questions that are raised by systematically examining the physical properties of smokeless powders. We showed that it is these which are of chief concern to the gunmaker, since his connection with a smokeless powder is rather of a mechanical than a chemical nature. The visible and obvious characteristics of a sample of powder are the things which mainly interest him as the man who is called upon to produce evenly divided charges and fill them into cartridges, such as will pass a test of mechanical exactness. In the second lecture, which appears in the current issue, we have dealt with the ballistic properties of smokeless powders, and in so doing we have shown that the influence which is exercised by the gunmaker cartridge loader on the behaviour of a smokeless powder may be traced back to the correctness or otherwise of the mechanical treatment accorded to the powder in the various processes connected with loading it. We have also shown that the scientific attributes of a smokeless powder can concern but little the gunmaker who aims at turning out a satisfactory cartridge. He cannot with the means at his disposal set up an independent check of the powder maker's work such as will enable him to exercise due discretion as to the deliveries which are worthy of acceptance or otherwise, and therefore, he must practically speaking take the powder as he finds it, being careful meanwhile to deal only in those varieties where he knows that manufacturing and scientific skill of a high order has been exercised in their production. The skill required in selecting the series of smokeless powders which he intends to use for his season's output of cartridges is a very important part of his professional work, and if in addition to this he works out standard combinations of load in accordance with the latest recognised practice, he is in a fair way to attain success in his own particular field of operation.

TRADE CONDITIONS OF THE FUTURE.

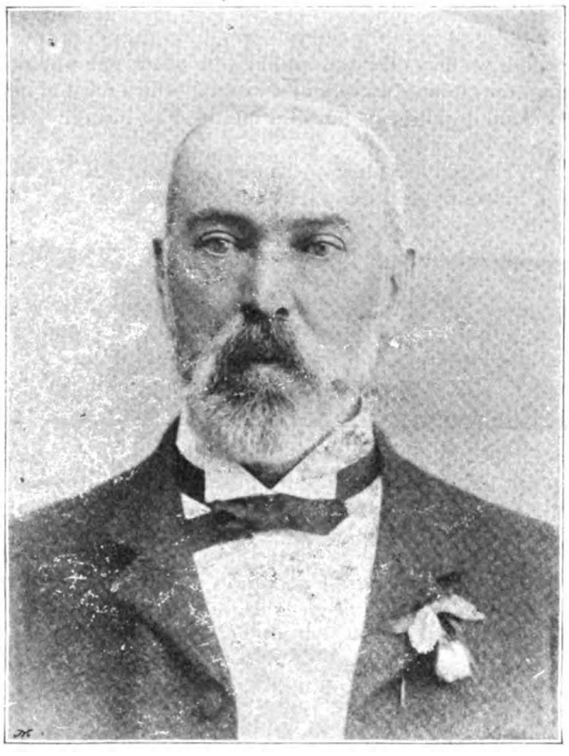
The continual additions to the stock lines that are sold in the gun trade go to show that the turnover in manufacture is gradually passing over to those big firms and corporations that specialise in the repeated duplication of a single model. Years ago this was mostly confined to rifles; now it has extended to shot guns, and is showing an ever-increasing tendency to cover the lion's share of the loaded ammunition business. If one were to make a list of the proprietary articles that are now circulated by the aid of the gunmaker and the general dealer, they would make a wonderful array of automatic pistols, revolvers, air guns, rifles and single shot guns. Those who pause to consider the why and wherefore of this growing traffic cannot fail to come to the conclusion that it represents the soundest method of supplying the great majority of consumers with what they want at a minimum of cost.

Shooting is not so different from other things that it necessarily involves a separate set of principles from other industries. The buyer is the master of the situation, and it is he who must say whether guns must have the same individuality and fitness for the user, say, as a suit of clothes. Many can afford to follow this course, and they get good value as they regard value in proportion to their general wealth. But the bread-and-butter trade in any line of manufacture is concerned with the class who want a maximum of value for their money. These have shown unmistakably already that the article they require is something of guaranteed fitness for the purpose involved. They cannot afford to cover mistaken purchases by the giving of fresh orders. Consequently, when they find a certain class of weapon uniformly efficient wherever it is in use, they buy one if they have need of it in preference to taking a leap in the dark by purchasing some little-known type of weapon on the interested recommendation of the person who sells it.

The conscientious manufacturer with an eye to future trade, abhors the principle that forces him to combine best quality finish with second grade workmanship in essentials. The public in due course of time learn the same lesson in a different way. Hence they are in a fit state of mind to patronise any weapon that has the manufacturer's own guarantee that the various desirable qualities of excellence are suitably proportioned to the price asked. If, therefore, a manufacturer is to show himself, or rather his work, at the best, he is bound to make a direct bid for public support, and when he does so the first thing he will consider is the margin that should be allowed for the distributor. This will naturally be fixed at a mean value between the extremes of high profits that limit business and cut prices that make the goods hardly worth handling. Granting that a happy medium is fixed that will steer free of these objectionable extremes, a sound principle of working is thus established for the better carrying on of that part of our trade which is at present threatened. The fact that gunmakers already handle such large quantities of proprietary goods suggests that in the future they may handle more, and it would surely be no disadvantage if some of them were English. Gunmakers who have a name for good work, and whose individuality has been earned by unremitting care in the inspection and due regulation of all weapons sold will not be likely to suffer.

THE LATE MR. T. W. WEBLEY.

IT is with great regret that we have to record the death on the 13th ult., of Mr. T. W. Webley, at the age of 65 years. Only a few months ago on the occasion of his last attendance at one of the Gunmakers' Association meetings he remarked that a life of stress and hard work had made him an old man before his time. On the occasion of his last visit to the Transvaal he was laid up with a severe illness, recurrences of which sadly diminished his powers of endurance of late years. Mr. Webley had one of the most charming personalities it has ever been our lot to come into contact with. One of the old school, he was a business man from start to finish, and yet his methods were such that everyone with whom he came into contact felt that in him was a kind and sympathetic friend. Although his activity has of late years been less than it formerly was, his grip of affairs was in no way diminished; he was a voluminous correspondent. and an interviewer of great

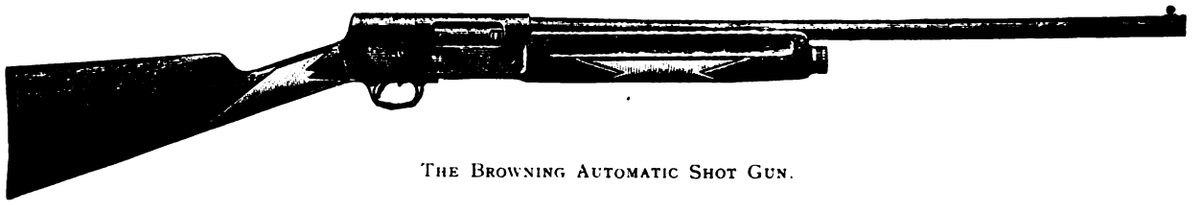


skill, in so far that he had a thorough grasp of everything he discussed, and was prompt in putting his undertakings into practice.

Apprenticed to the gun business at the age of eleven years, he rapidly required a thorough grasp of its many intricacies. By the age of 20 he was practically its sole manager, his father, Mr. Philip Webley, having died somewhile back. During the interval Mrs. Philip Webley managed the concern, and Mr. Webley has often spoken with pride of the manner in which she took the coach to London for the purpose of canvassing the London trade for orders. The firm originated with William Davis who started business at 84 Weaman Street shortly after his return from fighting at the battle of Waterloo.

THE NEW BROWNING AUTOMATIC SHOT GUN.

A SPECIMEN of the new Browning automatic shot gun was sent to us by the inventor some time back to give us the needful facilities for introducing it to our readers. It really affords a remarkable insight into the mechanical skill and thoughtfulness of Mr. J. M. Browning, who, in our opinion, ranks among the greatest fire-arms inventors of this or any other day. An invention of this order makes us pause in wonder as to the possible developments of the future. It is not a question of puffing foreign enterprise. Our office is that of a mere chronicle of current developments, and the opinions we may offer are not likely to affect, one way or the other, the ultimate success of a weapon which must of necessity stand or fall by its inherent merits or its demerits, if such are found to exist.

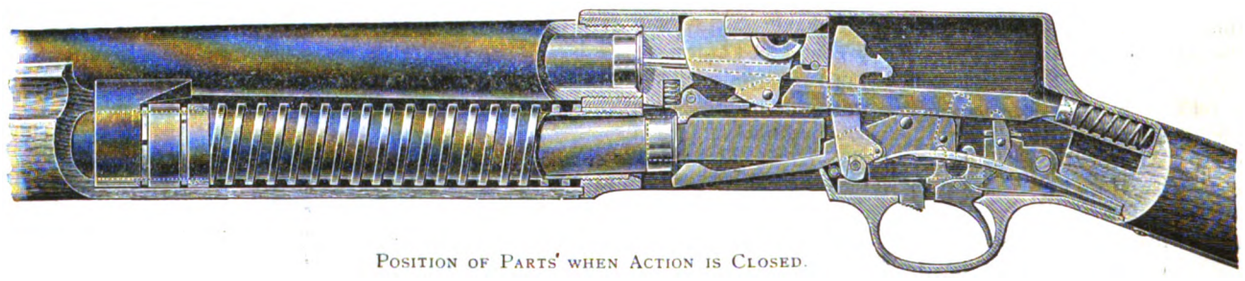


THE BROWNING AUTOMATIC SHOT GUN.

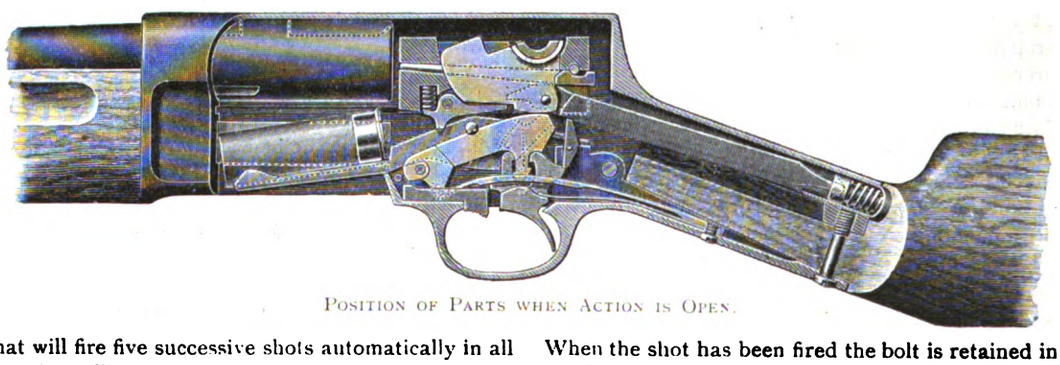
It is claimed on behalf of the new weapon that it ranks as as a single-trigger, five-barrel, hammerless ejector. While gunmakers have imparted to the ordinary double-barrel gun all the embellishments that have been suggested and put into practice by generations of workers, a man of original turn of mind comes along, and gives us an extraordinarily life-like weapon that will fire five successive shots automatically in all respects bar the pulling of the trigger.

Turning to the gun itself, we see from Fig. 1 that, though it has the wooden and box-like outline of all products of the machine shop, it is nevertheless a workmanlike looking weapon, whose unaccustomed outline would be pardoned by the large class of shooters who look first to the results and afterwards to appearance. Though the sample before us weighs 7 lbs. 9 oz. when empty, it handles very easily, this being no doubt due to the great lightness forward of its slim single barrel. The length of the gun over all is 48 ins., that of the barrel being 28 ins. It takes down in a very simple manner. By holding the gun butt downwards on a table, the left hand is free to grasp the barrel and pull hard upon it. This compresses the main recoil spring and so frees the nut at the extremity of the fore-end, thereby allowing it to be unscrewed. When this is removed the barrel and fore-end can be drawn away from the stock, the two pieces respectively measuring 31 and 32½ inches.

The operation of the gun is very simple. To use it as a single loader the bolt handle on the right-hand side is drawn back against the resistance of what is known as the action spring, in which position it remains, the receiver being thus wide open. A cartridge is dropped into the receiver, and the pressing of a button on the side of the action releases the bolt, and allows it to fly forward, carrying the cartridge into the chamber. The gun is then loaded and ready to fire.



POSITION OF PARTS WHEN ACTION IS CLOSED.



POSITION OF PARTS WHEN ACTION IS OPEN.

When the shot has been fired the bolt is retained in the backward position, thus informing the shooter that there are no cartridges in the gun. To utilise the magazine the chamber may first of all be filled in the manner already described in respect to the use of the weapon as a single loader. The gun is then turned round with the trigger guard uppermost, so exposing the entrance to the magazine, which is situated

similarly to that of the Winchester repeater. To clear the entrance to the magazine, it is necessary, while grasping the gun in the right hand, to press on the cartridge lifter with the thumb. The button on the side of the action is then pressed, and the lifter falls down and leaves the way clear to the magazine. The cartridges may then be inserted singly, a little deftness being necessary to hold the cartridge lifter down till the magazine is charged with its complement of four rounds. We might here call attention to the only point of criticism we wish to bring against the weapon. It is that on each occasion when we have used it we have experienced a peculiar soreness at the side of the nail of the right thumb, and we attribute this to its contact with the unduly sharp sides of the gap in the action by way of which the cartridges are inserted in the magazine. A little rounding off of this edge would doubtless effect a remedy.

As a test of the shooting powers of the gun, we have fired some hundreds of shots at clay birds, and although one does not immediately become accustomed to the alignment of its single barrel, the rapidity with which its peculiarities are mastered shows it to be a thoroughly practical weapon. In the entire series of shots fired we have not encountered a single miss-fire with cartridges of standard strength, though on one occasion when trying the gun in an enclosed range the ammunition supplied was of a very reduced grade of strength, and the recoil proved insufficient to operate the mechanism. The possible rate of firing is as fast as with a single-trigger double-barrel gun, except that five cartridges can be discharged with the time interval between the rounds that applies to a double-barrel sporting shot gun. We have fired as many as four shots at a clay bird in the course of its flight, and although this says more for the mechanism than the writer's marksmanship, it is only fair to say that the reason for not firing the fifth cartridge was that the fourth succeeded when the others had failed.

The mechanism of a weapon of this description is not very easy to describe. Figs. 2 and 3 show sections of the interior the former view in the position of the parts when ready for firing and the latter when the action is open. Fig. 2 shows that the main recoil spring lies inside the fore-end, and on the outside of the magazine tube. Its rear end abuts on the action, and the front acts against a sleeve that is fixed bracket-wise on to the barrel. The barrel, which is capable of longitudinal movement, compresses this spring in the act of recoil, and at the same time forces the bolt backwards. The two are positively locked until the full movement of recoil has been accomplished, the hammer being meanwhile cocked. The recoil spring then moves the barrel forward, unlocking and opening the breech, and ejecting the empty shell. The cartridge litter then raises a fresh cartridge into the receiver, this being carried forward into the chamber by the returning bolt. The breech is closed by the action spring, which is situated in the butt, and operates through what is known as the link. The locking of the barrel extension to the bolt is effected by the pressure of this link on a rocking lever carrying on its upper surface a book-shaped projection. In Fig. 2 this is shown locked into the barrel extension, and in Fig. 3 in its lower position. As the bolt moves forward under the impulse of the action spring the hook of the locking lever is pressed into a square recess in the barrel extension. Altogether the parts are remarkably simple for the diverse functions they are called upon to perform.

The question to be decided by practical experience is whether Mr. Browning has been able to foresee all possible sources of mishap and forestall them with appropriate mechanical safeguards. That many will be willing to give the weapon a trial we have no doubt, judging by the opinions which have been expressed by sportsmen to whom we have shown the sample in our possession. This, by the way, we believe to be the first that was sent to this country. It has been made by the celebrated Fabrique Nationale of Herstall, and it does them every credit both for finish and all-round evidence of soundness. It is made in several grades, but the price of it is not stated. It seems, however, that a spare barrel of different boring may be had at an extra cost of 48s. gross. The boring of the barrel is true and straight, judging by the one before us, but the calibre is ·720 in. this being distinctly undersize for a true 12 calibre. In conclusion we should mention that an effective safety bolt is fitted within the trigger guard, and it is readily put into operation by the shooter.

PROOFS AT ST.-ETIENNE.

According to the *Bulletin Mensuel de L'Armurerie Francais* the Chamber of Commerce of St.-Etienne has just published a report of the work done by the proof house of that city. The following figures are excerpted from the official report:—

Total number of barrels submitted		93,427
Barrels rejected before proof ...	2,017	
Barrels rejected after proof ...	446	
Barrels rejected after second proof	2,467	
Total barrels passed... ...		88,497

From the details given in the full report showing the various classes of barrels comprising the above total it is made clear that double-barrel weapons account for 76,192. Of these 59,472 were steel barrels, more than 78 per cent., as against 73 per cent. in the year 1902. The proof of finished weapons shows an excess over the preceding year.

Total submitted for proof in 1903 ...		52,535
Rejected before proof	3,579	
Rejected after proof	1,583	
Rejected after the second proof	201	
Total passed		47,172

These proofs may be classified as follows:—

Double-barrels proved with for black powder	20,127
,, extra proof	38
,, proved with J powder ...	5,941
,, ,, M ,, ...	7,855
,, ,, R ,, ...	80
,, ,, S ,, ...	7,775
,, ,, T ,, ...	1,211
Single-barrels ,, black ,, ...	4,145
	47,172

The total of definitive proofs thus displayed shows that 48 per cent. were carried out with smokeless powder. Our contemporary points out that the figures for 1903, although inferior to those of the previous year, show none the less a smaller degree of depression of business than was evident in other industries subject to the same general influences.

THE MONTH'S FINANCE.

ELEY BROS., LD.

THE 30th annual general meeting of this company was held on the 9th ult. Mr. T. R. Bayliss, who presided, moved the adoption of the report. The directors, were, he said, pleased to be able to recommend a dividend of 15s. per share, free of income-tax, making, with the interim distribution, a dividend of 10 per cent. for the year. The whole of the machinery had now been removed from King's Cross to the new factory at Angel Road. The board found that foreign competition with a free entry was "a very nasty thing" to deal with. Home competition was very keen, but the directors did not care so long as it kept on fair lines, as the company's means of production were very large, and could be made still larger. The past season had been the worst in the history of the company —a matter over which the board had no control. He desired to call attention to the two items in the balance-sheet—the reserve fund, £50,000, and the special reserve of £25,000. The latter sum was set aside partly to pay for the new factory, and the former amount was used in the business. The conditions of trade were very different from what they were 20 years ago, when the greater part of the company's work was to sell empty cartridge cases. At the present time they sold principally loaded cartridges, and this involved the keeping of a much larger stock. Mr. E. F. Quilter seconded the motion, which was adopted. Mr. Wittet asked for an explanation of the fall in the value of the shares. The chairman replied that competition was very keen, and that a great many foreign cartridges were dumped into this country. The secretary stated, in reply to further questions, that in 1888 the loading factory was removed from Edmonton to Angel Road. The special reserve of £25,000 was expended in the purchase of the property and in erecting a new building. In 1893 it was found that the factory at King's Cross could not turn out the work required. The conditions were neither sanitary nor safe for the workpeople, and a further transfer of machinery and plant was made to Angel Road, where a factory, constructed on the most modern principles and complying with the rather strict requirements of the Home Office, had now been put up. The old factory had been sold for a sum showing a considerable surplus over the amount at which it stood in the books. The chairman pointed out that, notwithstanding the large amount of money that had been spent, the shareholders had not been asked to provide additional funds. The paid-up capital was £250,000, and it appeared likely to remain so.

NEW EXPLOSIVES CO., LD.

THE annual report of this company for the year 1903 shows a net profit of £3,827, which, after deducting debenture interest, £1,657, and income-tax, £883, payable on the profits of 1902, leaves £1,377, which, added to the unappropriated balance of last year, leaves a disposable sum of £7,485. The directors recommend that this sum should be utilised for the payment of a 5 per cent. dividend for the year, and for writing off £2,000 from the property purchase account, this leaving £985 for carrying forward. The directors report that the profits have diminished by reason of the decrease of Government orders during the past year and the consequent increase of competition, which has caused a material loss in sales. The trade in blasting explosives has been well maintained, and considerable orders, both from the Government and other sources, are now in hand, so that the business generally shows signs of improvement. The works have been kept up in a thoroughly efficient state, and to meet the requirements of the Government in the manufacture of M.D. Cordite, and to expedite the orders in hand, the area of the company's works has been increased by the purchase of a further twenty-one acres of freehold land. This adjoins the present works, and all possible progress is being made with the erection of the necessary buildings.

THE ROBURITE EXPLOSIVES CO., LD.

THE report for the year ending December 31, 1903, shows that after providing for all necessary charges, the net profits are £8,126, which, added to £1,351 brought forward from 1902, gives a total of £9,477 for appropriation. Of this amount £812 11s., being 10 per cent. of the profits on the year, has been set aside for the reserve fund, making £4,508. Out of the remaining balance an interim dividend of 5 per cent. on the preference shares was paid in August last. This leaves a sum of £6,195 now available for distribution, and the directors recommend a further dividend of 10 per cent. on the preference shares in discharge of the arrears of cumulative dividend for the six months ending December 31, 1902, and in payment of a dividend of 5 per cent. for 1903. This leaves £1,225 to be carried forward to the next account. Mr. William T. Spark is announced as the new member of the board, and he has been been provisionally appointed to fill the vacancy caused by the death of their late chairman, Mr. S. Loewe.

WEBLEY AND SCOTT REVOLVER AND ARMS CO., LD.

The report and accounts of this company for the year 1903 discloses a balance of £8,831, after making ample provision for repairs, maintenance and depreciation of buildings, plant, machinery and tools. Adding to this sum the amount brought forward from last year, viz., £4,959, there is a total of £13,750. This allows for paying the remaining amount due on the preference shares in addition to the interim dividend already paid, the remaining balance of £5,415 being carried forward. The directors report that Lord Ebury has resigned his seat on the board, and that Col. Macdonald has been elected to the vacant chairmanship. In the interval between the issue of the report and the holding of the annual meeting, Mr. T. W. Webley's death occurred, and the chairman referred in his speech to the sorrow which the directors felt at this loss to the company. In dealing with the reduced volume of profits, he explained that the twelve months under review had been the worst for fifteen years. Among his other remarks it is interesting to note one to the effect that the Belgian company, although trade had been bad, had earned sufficient profit to pay a dividend. An interesting feature of the balance-sheet is the substantial amounts which are yearly written off for depreciation, the sum of £16,136 having been taken from profits for this purpose during the seven years since the company's formation. Its effect has been to transfer this substantial sum of money to items which strengthen the financial resources of the company, cash and investments standing at the very satisfactory sum of £38,640.

ROUND THE TRADE.

The winner of the Grand Prix at Monte Carlo shot with Mullerite powder and a Scott gun.

We are pleased to hear that Mr. Cartwright is now progressing favourably and may shortly be expected to resume his attendance at 151 New Bond Street.

Gunmakers will be interested to note that our patent columns contain this month a description of Messrs. Kynoch's patent for the Opex system of constructing cartridges.

The business of Mr. F. E. Hopewell, of Topsham, Devon, described as a gunsmith among other things, has been turned into a limited liability company with a capital of £3,000.

The Marylebone Gun Club has just been formed for clay bird and live pigeon shooting. It is reported that their meetings will be held at Messrs. Westley Richards' shooting ground at Hendon.

Mr. Frank Murray and Mr. W. J. Whiting have been appointed joint managing directors of the Webley & Scott Company. Mr. Henry Webley has been appointed a member of the board in the place of Mr. John Rigby, resigned.

General Luard has issued an appeal through the Press on behalf of the Society of Miniature Rifle Clubs asking for support and donations in connection with the Miniature Bisley Meeting which will be held at Olympia during the last week of April.

The *Société de Tir aux Pigeons de Florence* will hold its annual prize meeting from the 24th to the 27th of April at Florence. The prize list includes 32,000 francs of added money in addition to prizes, and the chief event of the meeting will be the *Grand Prix d'Italie.* with a gold medal and money prize of 20,000 francs to the winner.

Messrs. Kynoch have recently erected a very fine suite of offices on their Witton site, and the chairman of the Company inaugurated their approaching completion by a luncheon which was held on the 23rd ult. In the course of his remarks he reviewed the political situation with special reference to free trade and licensing reform.

Mr. Henry Hawkins and Mr. C. R. Borland, the experts who have hitherto been responsible for the manufacture of American Schultze and E.C. powders severed their connection with the American Company upon its amalgamation of interests with Messrs. Du Pont, and both of them have arranged terms of service with the American Powder Mills of Boston.

Messrs. W. J. Jeffery & Co. have recently issued an exceedingly useful rifle cartridge of ·275 bore, which they have designed mainly for the purpose of converting or altering worn out or damaged ·22 (central fire), ·250 and ·255 rifles into practically new weapons of a slightly larger bore. The necessary alterations can be effected at a cost of from 20s. to 30s.

Mr. William Cullen seems to be taking a leading part in the agreeable task of securing the sympathy and confidence of Transvaal mine managers in the South African Explosives Company. The warmest sentiments of mutual good fellowship were expressed by the mine managers on the occasion of an inspectional visit they paid to the Modderfontein factory on January 16th last.

We have received from the offices of the Tariff Commission a copy of the circular notice containing the series of eleven questions which they have addressed to the leading firms of the country, and they have asked us to refer to the same in order that any firm inadvertently overlooked may have an opportunity of communicating with the Committee at their offices at 7 Victoria Street, S.W.

We very much regret the excessive bad luck which has been the lot of Messrs. Curtis's & Harvey at their Cliffe factory. Notwithstanding their great care and vigilance another explosion has occurred involving one the nitroglycerin plants. There were several deaths, and among those injured was Mr. Soddy, who had only just joined the firm. We are pleased to hear that he is making rapid progress towards recovery.

Major Cooper-Key has issued his report concerning the explosion of fulminate at the Blenheim Company's Greenwich factory. In the course of his summary he asserts that Mr. Rogers and Mr. Hengst are deserving of censure, the former for omitting to observe the strict terms of the licence, and the latter for the generally careless manner in which he carried on an operation which, with a few simple precautions, would have been rendered comparatively free from danger.

Messrs. J. R. Watson & Co. are sending out a circular stating that they have purchased the goodwill and other rights of the Arms and Ammunition Manufacturing Co., Ld., lately carried on at 140 Southwark Street, S.E., and 143 Queen Victoria Street, E.C. They will continue to supply the "Britannia" and other brands of sporting cartridges, also empty cartridge cases and other ammunition supplies. Messrs. Watson explain that they will not supply guns, rifles, or revolvers.

The Lord Mayor of Birmingham, Alderman Rogers, who has lately been appointed a director of the Birmingham Small Arms Co., Ld., distributed the prizes to the successful students at the gun trade classes on the 24th ult. From all accounts it would appear that the classes are serving a very useful purpose, and the decision to impart technical as well as practical instruction has been very favourably received by all those who have specially concerned themselves with the welfare of the future generation of gunmakers.

Capt. J. H. Thomson has issued his report on the circumstances attending the explosion of nitroglycerin which occurred in the final washing house of the Cotton Powder Company's factory at Faversham on November 9th last. While he does not attribute blame to the Company in respect to the accident, he still holds that the use of heavy filters for examining samples of the product under treatment should be avoided, and that this operation should, where possible, be carried out in the laboratory on a much smaller scale.

Mr. Paul North recently wrote to us explaining the principles of a new form of clay bird trap which the Chamberlin Target Company, of Cleveland, Ohio, are putting on the market, not, however, for sale, but on lease, subject to the proviso that it be only used for birds of the Company's make. The principle of the trap is that is fitted in a pit, and while it is fed by an attendant the latter has only to insert fresh birds and alter the angle from shot to shot, the setting of the spring and the releasing of the trap being effected by the puller at the firing point.

The following firms are sending specimens of their work to the St. Louis Exhibition:—Messrs. J. Blanch & Sons, six guns; Cogswell & Harrison, Ld., samples of barrels, shot guns and Certus magazine rifles; W. W. Greener, sporting guns and rifles; Holland & Holland, Ld., a large collection of shot guns and rifles; Charles Lancaster, sporting guns and rifles; J. Purdey & Sons, a selection of highest quality hammerless guns and rifles; Webley & Scott Revolver and Arms Co., Ld., a large selection of useful and ornate firearms and rifles, both double and single, also a specimen of the new pendulum *Field* pressure gun; Wilkinson Sword Co., Ld., a collection of shot guns, rifles and revolvers.

There is now good reason for stating that the vexed question of chamber sizes has at last been put upon a satisfactory basis. Hitherto gunmakers have been perplexed by the existence of two sets of sizes, viz., those for 12, 16 and 20-bore guns, which have been jointly adopted by the ammunition makers and the two Gunmakers' Associations and a later series, embodying all the bores of shot gun, attested only by the two associations. There has hitherto been a general understanding that the second series of standards was to be regarded as in suspense. Specially appointed representatives of the two associations have now been successful in the framing of a new set of sizes which meet all previous objections. This has been accomplished in combination with the highly desirable condition that the taper of the chamber walls should be a uniform ratio for all the sizes dealt with.

LECTURES TO YOUNG GUNMAKERS.

XXVI.—THE BALLISTIC PROPERTIES OF SMOKELESS POWDERS.

WHILE the physical properties of a smokeless powder have been shown to relate to its qualities as they mainly appeal to the cartridge loader, the ballistic properties are those which are concerned with the behaviour of the cartridge in the process of discharge. These properties are mostly expressed by measurements of the chamber and forward pressure exerted in the gun and by the velocity imparted to the shot. The distribution of the pellets on the target is related to both these, but the connection is not always easy to trace. Recoil again is related to the ballistics of the cartridge, while finally we must not lose sight of the rapidity or otherwise of the ignition. It will now be clear that the ballistics of a powder comprise its entire behaviour both inside the gun and during the transit of the charge up the range. In view of the necessity to deal comprehensively with the several divisions of a powder's behaviour, about each of which whole lectures have been written, it will be necessary to speak of the separate items under appropriate headings.

PRESSURE.

If a sample of powder is completely freed from moisture, so as to impart to it the power of very rapid combustion, the gases within the chamber will attain a pressure higher than that with which guns are proved. Conversely, if a powder contains an undue percentage of moisture the pressures go so low as to detract from the effectiveness of the cartridge. Hence we find that satisfactory pressures are obtained between two extreme rates of combustion. Generally speaking when all the conditions are right the powder attains a chamber pressure of about three tons on the square inch. This pressure gradually subsides as the shot passes into the barrel and the evolution of gas from the unburnt powder begins to diminish.

The entire art of modern powder manufacture is to turn out every delivery of explosive so that the pressure experienced in a well loaded cartridge lies nicely between the extremes of violence on the one hand and undue feebleness on the other. This is a subject which is better understood to-day than it was ten years ago. We find but few manufacturers and agents who make a point of claiming low pressures for their powders. A low pressure is just as bad as a high one, and good behaviour lies between the extremes. Granting the correctness of the powder we will now summarise the conditions that affect the pressure experienced.

High pressure is produced by:—

(1) Unduly drying the powder,
(2) firing in a gun with a tight chamber,
(3) using unduly soft or greasy felt wadding,
(4) over-ramming the charge,
(5) using over charges either of powder or shot or of both,
(6) using card wads of undue thickness or diameter,
(7) the use of small sizes of shot,
(8) heavy turnovers,
(9) defective caps.

Low pressures result from:—

(1) Allowing the powder to get damp,
(2) firing in a gun with an over-large chamber,
(3) using unduly hard or insufficiently greased felt wadding,
(4) leaving the powder charge too much space in the cartridge,
(5) low charges of powder or low charges of shot, the latter when unaccompanied by suitable compensation in the amount of felt wadding used,
(6) using unduly thin cards or feltine where cards are specified,
(7) the use of large sizes of shot,
(8) poor and inadequate turnover,
(9) defective caps,
(10) weak gun strikers.

It is the business of the powder maker to turn out his powder so that in the presence of fair conditions of loading it shall give an adequate pressure, not too low in cold, damp weather and not too high in the dry, warm days of early autumn. A powder maker who knows his business goes even further than this, for experience tells him that for Scottish consumption a powder of slightly higher pressure is desirable than for England. The present limits of pressure are fixed as a result of practically averaging existing conditions. A powder standarised to give not more than two tons pressure could be made to-morrow and would be a great success provided it would only be used in guns accurately chambered and in cartridges containing good wadding and properly turned over. As things stand, powders are made to give the highest possible pressure consistent with the stability of the gun, so that the results shall not be absolutely bad in the presence of open-chambered guns, inferior wadding and inadequate turnover. The propulsive influence on the shot of a given pressure need not specially worry the young gunmaker. The powder maker so blends the constituents that if the powder is ignited under fair conditions a sufficiency of gas is evolved to insure the proper propulsion of the charge.

VELOCITY.

The gunmaker occupies a somewhat invidious position with regard to velocity. His own inclination is to regard penetration as a much more effective test of a cartridge than the figures of velocity which are supplied to him by the experts upon whom he must rely for information. Penetration tests are of but little scientific value, and the force gauge is likewise affected in its readings by so many things other than penetration that it too must be dismissed as of but little account. During the past few years it has become widely recognised that a well-loaded cartridge containing a correct charge of a nitro powder of approved characteristics has a mean velocity of 1,050 feet per second over a 20 yards range, measuring from the muzzle of the gun. Recent research shows that with standard cartridges this velocity is unalterable whatever may be the size of shot used or whatever may be the boring of the gun, that is whether it be choke or cylinder. At no other distance are the various antagonistic elements thus brought to a dead level of mutual compensation.

Accepting the velocity as standard, there is no course open but to assume that penetration is greater or less according to how it varies. The gunmaker would prefer to know the striking velocity at 30 or 40 yards rather than the average over the first 20 yards. So equally would everyone else, but there are, for the present at any rate, difficulties in the way of its accomplishment. We know that No. 6 shot, with its velocity of 1,050 feet average over the first 20 yards, has an actual striking velocity of less than 700 feet at 40 yards, but even so,

we have yet to learn the true amount, and what relation it bears for other sizes of shot, and more than this, what proportion of any excess or deficiency that may be evident over 20 yards is apparent at the distant mark. Then again, we require to know in simple phases how these variations affect the action of a cartridge, that is, given a certain deficiency, by how many yards does it relatively shorten the range of effectiveness of the cartridge. These things are in a fair way towards solution, but the gunmakers must for the time being rest satisfied with the information that is already available.

This tells him that, granted a good sample of powder, he can, by reproducing in his own loading the conditions under which the powder is regulated to do its best work, ensure with reasonable certitude a thoroughly effective velocity for all cartridges of his filling. If on the other hand he has views or other instinctive perceptions that certain things happen in a certain way for certain reasons, and if he seeks to put these views into practice, then it is a question of saying adieu to all chance of expecting from him a well loaded cartridge. We do not desire to condemn the experimental frame of mind, but we do say that it is not only bad but sometimes dangerous to make experiments with cartridges unless the operator is able to judge the results of each combination tried, and these results cannot be gauged elsewhere than in the eight or ten laboratories in Great Britain where the necessary equipment is installed.

PATTERN.

One way of making sure of a good pattern is to get on the right side of a powder maker and ask him to supply a batch of his product of such weakness as to be incapable of giving proper ballistics. To demonstrate the shooting of one's guns when loaded with such a sample of powder would naturally be characterised as a deliberate fraud, and yet good patterns are often obtained by equally illegitimate methods. Therefore the true pattern of a gun is only to be obtained by testing it with cartridges that give the correct standard of velocity as laid down above. Supposing a gun to have a chamber of the correct size, a cone of not greater length than a quarter inch, and a truly bored barrel with a choke regulated as a result of practical trial, then the patterns thrown by a standard cartridge should be good. As this lecture does not profess to deal with the art of barrel boring no more will be said under this head, the question that is uppermost for the moment being the influence exerted on the pattern by the powder.

Assuming the powder to give the correct combination of pressure and velocity the quality of the patterns thrown will be related to the skill exercised in the boring of the gun. This skill must not take the form of altering the ballistics of the cartridge. The barrel must before all things be such as will give the correct velocity, and this end may only be attained by working within reasonable limits of the gauge sizes laid down. The powder maker regulates his product with a truly bored and chambered gun, so that the gunmaker in his turn is expected to conform to the standards which the best intelligence in his profession has laid down for general guidance. Thus we see that the giving of a true velocity by a gun is safeguarded by following the dimensions that rule the boring of the barrel. Therefore the influences that tend to modify the pattern given by a powder are those which modify the pressure and by inference the velocity. Generally speaking, the abnormalities which cause low pressure as tabulated above, will tend to improve the pattern, while those which raise the ballistics of the powder have the opposite effect of making the patterns wild and irregular.

So far, therefore, as present knowledge goes, pattern in the cartridge is simply a question of ballistics. High ballistics work against a regular pattern, and low ballistics favour it. To obtain good patterns in the presence of a cartridge giving standard results with the requisite evenness is mainly a question of the gun. Some are better than others in this respect; but as regards the powder all we can at present ask of it is that it shall give us the requisite combination of pressure and velocity shot by shot and round by round. Good patterns as the gunmaker understands the term, should then follow, and if they do not, then he should be more inclined to look to the gun than the powder for an explanation. To change the powder might remedy the defect, but even so the improvement might result from alterations of the ballistics, and this according to previous arguments is inadmissable.

RECOIL.

The last of the general ballistic effects of a powder which will here be considered is that which appertains to recoil. This is a part of the powder's behaviour which can be judged by the trained senses of an experienced shooter. Recoil as the scientist knows it, is a question of foot-lbs., this being the unit of energy in which it is measured. The measure has no meaning except in relation with a given weight of gun, and 7 lbs. is the weight generally related to the recoil measurements that are commonly published. In all respects but one, recoil is a reproduction in miniature of the work done by the powder on the shot. This means that the recoil values rise in a definite proportion in relation to increases in the weight of the shot charge and the velocity imparted to it. Hence a cartridge giving a low recoil is either charged with a small measure of shot, or else the velocity is low. The only alternative is that there may be a combination of both the factors which tend to lower the recoil. As a definite amount of the recoil in a gun is due to the powder, the recoil of some smokeless powders is less than that of others in just the same way that all smokeless powders give less recoil than black powder when the weight and velocity of the shot charge is identical for both cases.

CONCLUSION.

It will be seen that if we dismiss from consideration the highly technical theories that underly explanations of the ballistic properties of smokeless powders the issues involved are very simple. If a powder is well turned out it will give satisfactory results under reasonable conditions of loading. If on the contrary there is something wrong with the powder, it is a difficult matter for the gunmaker to provide a remedy. It is doubtful even whether he would be well advised to try and distinguish between the relative merits of one powder and another, beyond paying very careful attention to his own practical experience and that of his clients. Where he should understand powders lies in the direction of appreciating their susceptibility to various small changes in their treatment under loading and when in the gun. The more precise becomes his knowledge upon this very complex question, the more certain is he to take a powder as he finds it, and to concentrate all his powers on giving it a fair show as regards loading. Here he can do a lot, but there is little scope for originality.

THE WEBLEY BARREL DEPARTMENT.

Since our January issue appeared we were invited by Messrs. Webley to write an article dealing with the highly efficient barrel department, which they established at their factory some five or more years ago. We are in an exceptionally favourable position to carry out the suggestion thus made, since we have periodically visited this shop in connection with experimental work of one kind and another which Messrs. Webley have carried out on our behalf. The range of barrel work which this firm is called upon to perform necessarily involves a very comprehensive study of the entire question. At the time of their original incursion into this new branch of manufacture, they conducted an important series of experiments on barrel steel. Some of the information obtained from their experiments was published in our issue of April, 1899. Reviewing the different classes of stress to which various forms of weapon are subjected under service conditions, they arrived at an ideal of metal for each class of work, the characteristics of each grade of steel being determined by the relation of elastic to ultimate stress, coupled with the amount of elongation sustained by the test pieces up to the moment of their giving way. Having thus determined the most suitable qualities of metal for each grade of work, Messrs. Webley then proceeded to order barrel forgings according to strict specification, every delivery being carefully tested, and accepted or rejected according to the margin of variation shown to exist.

Their barrel plant was in a very short time in a thoroughly efficient working order, the amalgamation with the Scott Company having made it necessary for the firm not only to maintain the Webley reputation, but also that of the sister firm, the boring of whose guns has been regarded in many markets as the standard by which perfection could be judged. The Webley and Scott firm felt that in view of their comprehensive programme of manufacturing operations, they could not possibly be dependent upon outside supplies of tubes, this not only applying to shot guns, but also to another very important branch of barrel work, viz., that of express and other high power rifles. Just at that time when the Henry Rifled Barrel Company ceased to supply the trade in this respect, Messrs. Webley were ready with their highly equipped shops in which every class of boring and rifling could be carried out with the exactitude that is necessary to ensure accurate results at the target. The development of cordite express rifles made it advisable to go very carefully into the most suitable grade of steel to be used in these weapons.

The very high pressures commonly experienced with express cartridges in hot climates placed a stress upon the metal which would produce a slight bulging if its tensile strength were of an ordinary character. Although it might be possible to leave a little additional metal in the chambers to be removed after definitive proof, it was felt all along that this was unsound gun practice, in so for that although the chambers of the finished rifles might be of correct dimensions the fact of the metal having been previously bulged to the slightest possible extent, altered the characteristic qualities of the steel, so depriving the metal of a part of its natural power of elongation. What was wanted was a very high grade of steel having a sufficient elastic stress to withstand proof pressure, at the same time being sufficiently ductile after the limit of elasticity has been reached to bulge before bursting. By the use of a superior quality of nickel steel Messrs. Webley were able to satisfy these obvious requirements. Express rifles of their manufacture thus have barrels of great toughness, combined with a minimum liability to bulge when subjected to exceptional pressures.

In making shot tubes a different combination proved necessary, the strain put upon the metal being of a much more moderate character than is the case with express rifles. On the other hand, a shot barrel must be exceedingly tough, in order that the sportsman may be warned by the bulging of his barrel that his gun has been subjected to bad treatment, his safety depending upon a big margin of endurance between the first disturbance of the proper form of the barrels and the culmination which is represented by a burst. The following table gives particulars of the two brands of metal now used by the firm for rifles and shot gun tubes :—

Description of Steel.	Elastic Stress in Tons per sq. in.	Ultimate Stress in Tons per sq. in.	Contraction at Fracture in percentage of Original Area.	Ultimate Extension per cent.
1. Webley's Rifle Steel ..	27·90	51·8	41·6	20·50
2. Do. do.	29·23	51·8	41·6	20·50
3. Do. do.	29·23	53·1	38·6	19·16
Average	28·79	52·2	40·6	20·05
1. Webley's Shot Gun Steel ..	19·9	35·8	47·6	25·0
2. Do. do.	19·9	35·8	48·8	25·0
3. Do. do.	19·9	35·8	48·8	25·0
4. Do. do.	19·9	34·5	50·5	25·0
Average	19·9	35·5	48·9	25·0

Comparing the figures here given it will be seen that in the case of the rifle steel the first visible elongation of the test pieces commences when a tension of from 28 to 29 tons per square inch has been reached, and that the resisting power of the metal ceases when something over 51 tons has been reached. The test piece contracts in area about 40 per cent. at the point of fracture, while its length is increased some 20 per cent. before giving way. The shot gun steel on the other hand, is constructed to stand about 20 tons elastic stress and gives way at some 35 tons tension per square inch of section, the elongation being 25 per cent. These figures will be recognised by all who are familiar with the properties of metals as representing highly specialised grades of steel which are specially suited to the peculiar conditions met with in express rifles and shot guns.

Having such excellent materials to work upon, it is not surprising that Webley tubes and rifle barrels have consistently maintained a high reputation amongst gunmakers. Their barrel department is equipped with the latest modern machinery, and they pride themselves on their ability to turn out, week by week and month by month, straight, concentric, and in all other respects, thoroughly sound tubes, these after assemblage in double-barrel form being regulated and finished to give the balance and hard shooting properties that are a *desideratum* to the modern sportsman.

NO. 6½ SHOT.

DURING recent months our contemporary, the *Field* has called attention to a strange and hitherto unsuspected species of neglect which has beset all sorts and conditions of cartridge loaders. It is that they have persistently ignored the many of the obvious virtues of the size of shot that lies midway, more or less, between Nos. 6 and 7. A superficial examination of any table of shot sizes will show that sizes 4, 5 and 6 are nicely graduated with appropriate intervals of separation. Between 6 and 7, on the other hand, there is a considerable gap. Consequently while a large amount of the shooting that is carried on in the British Isles requires the use of a size smaller than No. 7, the next whole-number size is not popular, because the balance of practical experience goes to show that it is, generally speaking, defective in killing power. Hitherto but little account has been taken of the intermediate size 6½, and yet it seems to fill a blank that must have been keenly felt by many practical shots. So little is it used that few cartridge loaders, even of the highest rank, are in the habit of holding a stock of top wads so marked. As a size for clay-bird shooting it is practically perfection, and if it is effective against so small a mark as a clay-bird, then surely it must be sufficiently small for use during the opening weeks of the shooting season and for such other occasions as demand a well-filled pattern and a killing one besides. If this size of shot became recognised as standard for shooting school use it is probable that its many inherent merits would in due course of time become recognised. Since it adds some 34 extra pellets to the ordinary game charge, comprising No. 6 size, it stands to reason that it would be a useful substitute for the half-size larger for cases where the gun does not throw a sufficiently close pattern for ordinary purposes. The difference of killing power is not anything like so great when a jump is made to No. 7. More than this, commercial samples of 6½ shot are, as a rule, as regular in shape and as uniform in size as samples of No. 6. No. 7, on the other hand, is generally very irregular, and of a decidedly poorer standard of quality. At any rate, it cannot be denied that there are many guns which perform well enough with No. 6, but become patchy when throwing No. 7.

CORRESPONDENCE.

A KYNOCH DIRECTOR ON THE TARIFF QUESTION.

TO THE EDITOR OF *Arms and Explosives*.

SIR,—My attention has been drawn to the current topic on the above subject in your issue of February, 1904. In the first place I must point out that the argument to which you refer dealt with the export business of Kynoch Limited. You do not attempt to controvert what I have said on that point, and therefore it seems reasonable to suppose that you endorse my contention that protection will, by increasing the cost of food and other raw materials, reduce, and not increase, exports.

On the other hand, you draw attention to the success of the Kynoch, Birmingham Small Arms and Vickers-Maxim Companies, which you attribute to their Government business. I would remind you that there are other large and successful businesses in Birmingham, such as Cadburys, Tangyes, and Nettlefolds Limited (now amalgamated with Guest, Keen & Co.), which have been built up without Government protection in any shape or form From this it would appear that there are other causes which go to the building up of a large business besides protection—that is to say, the existence of a few large businesses is not an argument in favour of either free trade or protection.

If you suppose that Kynoch's business has been built up by large profits made possible by protection, then you are entirely mistaken, the competition between English manufacturers being much too keen to allow of this. If again you think that we should suffer from foreign competition in Government business, I have to say that we do not believe any foreigner could produce goods of the quality and exactitude made necessary by the strictness of our Government specification at anything like as low a price as we produce them. In other words, we are quite prepared, and indeed prefer, to stand on our own merits—our experience being that the less politicians interfere with business questions, the better it is for the nation's commerce.

With regard to the protected portion of Kynoch's business, it is common knowledge that the great irregularity of Government contracts entails serious hardships on the work-people, who are one day called upon by the Government to work overtime and the next day are turned off for want of work. This also makes it very difficult to keep dividends regular, and therefore, as is well known, the Kynoch Company have for some years past been widening their sphere of operations, as, for instance, by going into soaps, candles, nails, metals, steel castings, cycle fittings, gas and oil engines, roller bearings and blasting explosives, etc., etc., in all of which we are exposed to foreign competition.

The irregularity of employment above referred to is a striking example of that experienced in all protected countries and industries. It would appear from your article that you are opposed to free trade, and yet I do not think that the large number of customers among whom your valuable journal circulates would be pleased if an import duty were put on cartridges, thereby enabling the manufacturers to put up the price of the goods your readers buy. It might be argued that your readers would be able to get more if they had to pay the manufacturer more, but it must not be forgotten that high prices reduce consumption, thereby in the long run injuring those interested in production and distribution.

Yours faithfully,

Witton, Feb. 22, 1904. JNO. S. NETTLEFOLD.

TRADE MARKS.

APPLICATIONS ADVERTISED FEB. 3—24, 1904.

259,634. Westfalisch Anhaltische Sp.-Ag., Germany. The word "TUTOL." To apply to explosive substances. Dec 22, 1903.

259,635. Westfalisch Anhaltische Sp.-Ag., Germany. The word "DEINOPHOR." To apply to explosive substances. Dec. 22, 1903.

260,103. The Webley & Son Revolver and Arms Co., Ld., Birmingham. The word "WINGBULL." To apply to arms and ammunition. Jan. 3, 1904.

260,142. Lincoln Jeffries, Birmingham. A device representing a man dressed in sporting costume in the act of shooting. To apply to small arms and accessories. January 14, 1904.

REGISTERED JAN. 21—FEB. 17, 1904.

259,010. Kynoch, Ld.
258,823. } John Holt & Co.
258,824. }

APPLICATIONS FOR PATENTS.

JANUARY 25—FEBRUARY 20, 1904.

1,905. Automatic Small-Arms. T. R. R. Ashton.
1,965. Mirror Sighting Attachment for Fire-arms. T. R. R. Ashton.
1,969. Ammunition Carrier. H. T. Bru-de-Wold.
1,993. Ammunition Carrier. A. H. Corbet.
2,078. Shot-Gun Cartridges. R. Fryer and Kynoch, Ld
2,124 Ammunition Carriers. A. H. Corbet.
2,223. Automatic Fire-Arms J. H. Topham
2,264.* Tubular Magazine Fire-Arms. W. Mason and F. F. Burton. (Date applied for in U.S.A., July 2, 1903).
2,463. Small-Arms. W. Youlten.
2,507.* Range Finder. E. M. Neilson.
2,569. Air Gun Pellet. E. Bowen and Kynoch, Ld.
2,667. Telescopic Sights. J. Stuart and G. Jochumsen.
2,668. Telescopic Sights. J. Stuart and G. Jochumsen.
2,735. Mining Explosives. T. G. Tulloch.
2,736. Propellant Explosives. T. G. Tulloch.
2,798. Optical Sights. W. Youlten.
2,815. Armour Piercing Projectiles. L. M. Ames and J. Lang & Son, Ld.
2,819. Explosives H. Boyd.
2,837.* Spring Air Guns. J. Lane.
2,911. Ordnance Sighting Apparatus. A. T. Dawson and G. T. Buckham.
2,917. Ordnance Projectiles. Eva S. D'Odiardi.
2,919. Field Gun Carriages. A. T. Dawson and G. T. Buckham.
2,926. Time and Percussion Fuses. A. T. Dawson and G. T. Buckham.
2,962. Imitating Sounds of Firing. W. H. Young.
3,024. Ordnance. A. T. Dawson and G. T. Buckham.
3,029. Correctors for Sighting of Guns. P. Tsoucalas.
3,127.* Automatic Small-Arms. C. von Mannlicher.
3,234. Sighting of Naval Guns. L. J. M. R von Markhof.
3,253. Explosives H J. Haddon (Agent for *J. Führer*).
3,333. Range Finder. R. Bryant.
3,352.* Cannon Pinion Movers. E. Hanson. (Date applied for in U.S.A April 16, 1903).
3,496. Adapter for Miniature Cartridge Shooting. F. Cantelo.
3,521. Small-Arm Cartridge Ejecting Mechanism. E. Smith.
3,561. Ordnance Firing Mechanism. A. T. Dawson and G. T. Buckham.
3,820. Automatic Fire-Arms. The Webley and Scott Revolver and Arms Co., Ld. and W. J. Whiting.
3,971. Small-Arm Carrier. J. H. Patterson.
4,028 Blasting Compounds. A. F. Hargreaves and Curtis's and Harvey, Ld.
4,033. Rifle Magazine Charges. E. Duncan.
4,076. Projectiles. T. Taylor.
4,090. Explosives. C. E. Bichel.
4,182. Increasing Velocity of Projectiles. C. Coventry and J. Smith.
4,222. Armour Piercing Projectile. R. A. Hadfield and A. G. M. Jack.

* These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

JANUARY 28th—FEBRUARY 18th, 1904.

COMPILED BY HENRY TARRANT.

27,564 (1902). **Range Finder.** Lieut. F. H. Baker, Woolwich. An instrument intended accurately and quickly to indicate the change in range between moving vessels. By means of the device the range may be found, given the base height of a distant object, or the base height may be discovered, given the range The object is reflected from a fixed mirror on a movable glass, and range is indicated on a scale when the reflection is seen through a telescope. Accepted January 14, 1904.

1,567 (1903). **Telemeter and Aligning Device.** C. E. Liles, London, and J. W. A. Rule, Wealdstone. A range-finder, in which, combined with moveable sights for aligning the instrument upon the object, are two adjustable prisms. By means of these prisms the necessary angles are determined for computing the range. Accepted January 22, 1904.

3,680* (1903). **Shot-gun Cartridges.** G. Hookham and Kynoch, Ld.

4,258 (1903). **Binocular Range Finders.** Professor G. Forbes, F.R.S., London. In a binocular range finder two prisms are mounted in a base such as was described in Patent No. 5,267, 1901. The two prisms rotate in opposite directions about the axis of the beams of light passing to the telescopes. The distance of the object is ascertained by reading the angle through which the prisms have to be turned to make its images coincide at the marks permanently fixed in the focal planes of the telescopes. Accepted January 28, 1904.

4,181 (1903). **Ammunition Hoist.** A. T. Dawson, London, and J. Horne, Barrow-in-Furness. Ammunition hoisting apparatus, in which the revolving trunk of the gun-turntable is provided with hoists adapted to convey the shell and powder charges separately to the gun platform. The hoists are arranged in various combinations for double and single gun mountings. The shells are received at the platform by fixed or pivoted inclined trays, and are automatically deposited from these trays into auxiliary cages for conveyance to the gun breeches. Accepted January 14, 1904.

4,559 (1903). **Shield and Mounting for Q.-F. Guns.** J. A. Wilson, London A combined shield and mounting for quick-firing guns, constructed especially to facilitate transport. The curved shield is shaped so that it fits nicely over a pack saddle. The gun is so pivoted to this shield that when on the pack saddle it lies parallel with the shield, but when in firing position is at about a right angle with the shield which is stood upon the ground. Accepted January 14, 1904.

4,843 (1903). **Single-Trigger Mechanism.** H. W. Holland, London and T. Woodward, Willesden. To obviate the inability to fire the second barrel of a single-trigger double-barrelled gun owing to an insufficient release of the trigger after the involuntary pull, a part is added to the locks. This part is adapted, through the fall of the hammer, to lock the sears, and so to prevent the involuntary pull lifting the trigger from the position it occupies after the involuntary release, and immediately before the involuntary pull. This arrangement is intended to allow the parts to shift over to the second lock with certainty. Accepted January 7, 1904.

5,205 (1903). **Ordnance Breech Mechanism.** Sir W. G. Armstrong, Whitworth & Co., Ld., and A. G. Hadcock. The breech mechanism dealt with in this specification is of the type in which the breech block, of oblong shape, slides horizontally in the breech transversely to the bore. Such mechanism is so modified as to allow it to be easily taken apart or assembled. Accepted January 14, 1904.

5,669 (1903). **Quick-Firing Gun Mechanism.** A. T. Dawson and L. Silverman, London. Modifications of the quick-firing gun mechanism of the type described in Patent No. 5,873, 1900. By means of the alterations, an increased time is allowed between the extraction of the empty cartridge case and the insertion of a fresh cartridge, thereby obviating the risk of one striking the other. The cartridge also is shifted by a lever instead of by a curved surface at the rear end of the carrier, as was set out in Patent No. 15,639, 1899. Among many other parts dealt with, the extracting mechanism described in Patent No. 26,382 is improved. Accepted January 21, 1904.

5,790 (1903). **Automatic Ordnance.** Sir W. G. Armstrong, Whitworth & Co., Ld. and A. G. Hadcock, Newcastle-on-Tyne Mechanism adapted more simply and easily than heretofore to open and close the vertically sliding breech block in automatic or semi-automatic guns. The transference of the cartridge from the hopper to the barrel chamber is also facilitated. Accepted January 21, 1904.

5,858 (1903) **Signalling Guns.** J. Weed and J. Lewis, U.S.A. A signalling gun, by means of which a number of cartridges may be discharged at predetermined intervals for any desired purpose. A number of vertical tubes carry cartridges at one

end and weights at the other. A clockwork mechanism releases these weights and so discharges the cartridges at intervals. Accepted January 14, 1904.

7,046* (1903). **Single-Trigger Mechanism.** H. A. A. Thorn (trading as Chas. Lancaster), London

7,188 (1903). **Automatic Small-Arms.** O. Imray, London (Agent for *Colt's Patent Fire-Arms Manufacturing Co., U.S.A*). The gas-operated magazine pistol, in conjunction with which the automatic mechanism is described in this patent, is constructed with a view to simplicity and safety. The whole of the parts are enclosed within an outer casing, and may be taken apart and reassembled without the aid of tools. The safety of the weapon is especially attended to, for besides an ordinary safety device, a "grip-safety" is provided. Should both these "safes" go wrong, the mechanism is rendered incapable of firing a shot. Accepted January 21, 1904.

11,187 (1903). **Ordnance Sighting Attachments.** A. Reichwald London (Agent for *Fried. Krupp, Germany*). The type o attachment, which is so secured to the gun that the barre may be elevated or depressed while the sighting line remain on the target, is dealt with in this patent, the intention being to simplify it. By means of clutches, the modified form may be locked either to the barrel or to the cradle, or to a portion of the gun not capable of movement vertically in relation with the carriage, so as to allow of the adjustment of the sighting line as well as the movement of the gun to be operated by the elevating and traversing gear. Accepted Janury 7, 1904.

12,113 (1903). **Firing of Naval Ordnance.** L. J. M. R. von Markhof, Austria. Electrical firing mechanism for naval ordnance, by means of which discharge is effected automatically at the moment when the gun, having been correctly trained in the lateral direction, attains the proper inclination to the horizon. The elevation given to it by the gun carriage is added to by the rolling of the ship. Accepted January 21, 1904.

13,071 (1903). **Armour-Piercing Shell.** P J. Penney, Plumstead. Within an open-based shell of hard steel is screwed another complete shell containing the bursting charge and a fuse at its nose. Upon impact the strain is first distributed throughout the outer shell, which is supported during penetration by the inner shell. An interval is so secured between impact and bursting. The inner shell also protects the bursting charge from the spontaneous cracking of the outer shell. Accepted January 21, 1904.

16,507 (1903). **Small-Arm Barrel Clamps.** R. M. Basilone, Italy. A method of laterally supporting the breech end of shot-gun or rifle barrels is described in this patent. Two side "clamps" are so arranged that when the gun is closed they are brought to bear up against the sides of the barrel walls. The top lever shifts them out of engagement when the gun is opened. Accepted January 7, 1904.

22,756 (1903). **Sighting of Ordnance.** Lieut.-Col. A. H. Gordon, Aldershot. A method of rendering unnecessary separate calculations for the correction of drift and of the want of level of gun and trunnions. Such corrections are made by the apparatus described. The sight proper, more particularly of the goniometric type, is made capable of horizontal angular movement through a complete circle over a graduated dial. The apparatus can be used, and the object set out attained, only when the gun has been elevated to the desired position for firing. Accepted January 21, 1904.

27,090 (1903). **Turret Ordnance.** V. P. Poutet, France. In order to counteract, or at least lessen, the strain to which the gun and carriage are subjected by the shock of a projectile against a closed movable turret and the reactions of inertia which they exert on their supports, an elastic connection is established between the cannon and cradle and the platform. Accepted January 21, 1904.

28,066 (1903). **Automatic Rifle.** T. A. F. and O. A. Fidjeland. An automatic rifle, in which the mechanism is claimed to be of simple construction, and to operate in a reliable manner. The gases of combustion are conducted from the muzzle by means of a tube back to the movable breech, part of which is actuated by them, and is caused to eject the spent case and to reload. The rifle is not larger than the ordinary magazine weapon, and the weight has been especially looked to. Accepted January 21, 1904.

*These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

SPORTING CARTRIDGES.

3,680 (1903). G. Hookham, and Kynoch, Ld., Birmingham. The waterproof "Kynoch Perfect" case, as is well-known in the trade, being an all-brass case, requires to be shot from a specially bored barrel. Another drawback exists in its top edge, which is left sharp and exposed. The "Grouse," a paper case almost entirely covered with brass, possesses a disadvantage in as much as the exposed part of the paper case often swells if exposed to wet, and interferes with extraction from the gun chamber. The disadvantages of these two cases it is sought to obviate by building up the case described in this Specification. The metallic shell extends slightly beyond the paper case, when the latter is turned over on to the shot wad. The end of the brass shell is slightly turned inwards to protect its edge. The total resistance of the ends of the internal and external casings to the expulsion of the shot is overcome in two stages.

Fig. 1

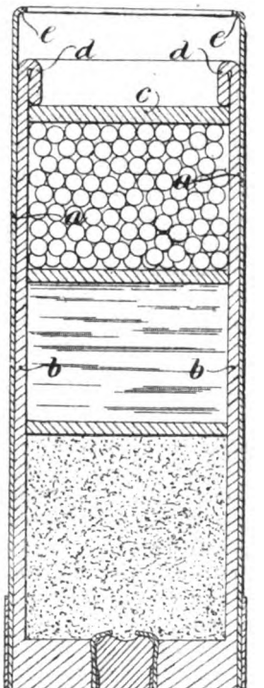


Fig. 2

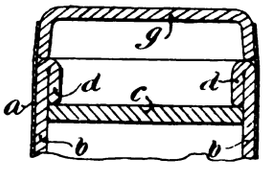
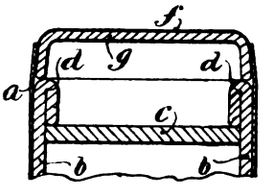


Fig. 3



Such a cartridge, with two modifications, is illustrated in the accompanying drawings. The brass case *a* is of such a length as to exactly fill the chamber of the gun after firing. Within the shell is the paper casing *b*, such as is used in the "Grouse" cartridge. This case extends about one-sixteenth of an inch beyond the metallic case before being turned in. The cartridge is loaded in the usual manner, and, after turning the end of the paper case over on to the shot wad *c*, the brass shell stands up about one-eighth of an inch beyond the turnover *d*. In order that the end of the brass case shall not be left sharp and exposed it is slightly turned in as is shown at *e*. Or it may be protected by the insertion a cup-shaped wad of light card *g* as is set out in Fig. 2. The wad is inserted with its open end towards the shot wad, and it rests upon the top of the turnover *d*. The end of the brass shell is slightly reduced in diameter by coning so that its edge lies closely around the cupped wad. No disadvantage arises if this cup wad becomes damp. If it is so desired the wad may be covered with a soft metal capsule *f* such as is illustrated in Fig. 3, or the cupped wad may be replaced by a thin brass cup of similar shape.

The end of the brass shell, if it were bent directly over upon the turnover, would present too much resistance to the expulsion of the shot, because both the paper turnover and the bent brass end would have to be straightened out simultaneously. Excessive pressures and irregular shooting would result from this heavy resistance. By adopting the method illustrated of closing the case, the total resistance is overcome in two stages. First, the turnover *d* is opened, and second, the cup *g* is forced off and the metal end is straightened. In addition the patentees say that the shooting is rendered more regular by the complete filling of the gun chamber by the brass case. Accepted January 14, 1904.

SINGLE-TRIGGER MECHANISM.

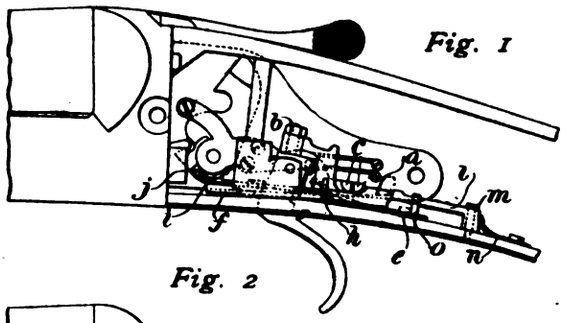
7,046 (1903). H. A. A. Thorn (trading as Charles Lancaster), London. The mechanism principally dealt with in this patent is intended to prevent the involuntary pull, or "convulsive clutch," discharging the second barrel of a double-barrelled single-trigger gun. To quote from the patentee's specification—

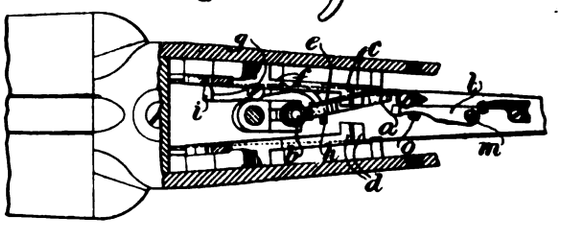
"As is well-known, there is liability, when using guns of this class, of firing the charge of the second barrel involuntarily immediately after the firing of the first barrel. Hitherto, the involuntary discharge of the second barrel was considered to be due to the fact that the recoil of the gun against the shoulder on firing the first barrel, momentarily moved the gun away from the trigger finger, and that upon the person operating the gun instinctively following the trigger up, the reaction from the shoulder pressed the trigger against the finger and so caused the second or involuntary discharge. In order to overcome this liability of second discharge, a "timer" or other mechanical device has been used which allowed for a certain amount of the inoperative or idle movement of the trigger after the discharge of the first barrel and before the trigger blade moved into firing position relatively with the sear of the second barrel. As the result of experiments recently carried out it is believed that the involuntary discharge of the second barrel is due to the elasticity of the hand, which, notwithstanding the fact that the gun is firmly held, yields under the sudden backward leap of the gun, and that instantly, under an involuntary convulsive clutch, the trigger finger is again pressed on to the trigger and causes the second discharge in an incredibly short space of time after the first discharge and whilst the gun is still moving backwards towards the shoulder under the recoil."

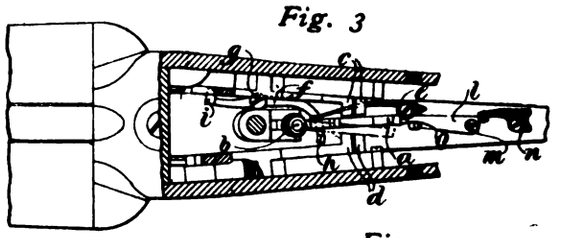
The convulsive clutch referred to has the effect, in relation with the mechanism to be described, of releasing the swinging trigger lever and blade from a stop against which it impinges when the pressure upon the trigger is released immediately after the first discharge. When released from the stop by the convulsive clutch the swinging trigger blade is carried up against the left-hand sear, and not until the pressure upon the trigger is removed again is its blade allowed to take up a position beneath the left-hand tails.

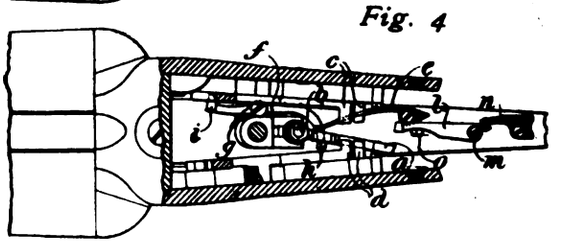
In the illustrations appended, the mechanism is shown in the various positions which it is caused to occupy during the operation of firing the two barrels In Fig. 2 the swinging blade *a*, which is pivoted upon the trigger at *b*, is illustrated in the position it assumes before the firing of the right-hand barrel. The blade *a* is capable of a lateral swinging movement between the sears *c* and *d*, the spring *e* tending always to drive it over from the right-hand to the left-hand lock. The lever *f*, pivoted at *g*, holds the blade *a* in its position beneath the right-hand sears *c*, against the pressure of the spring *e*, through the medium of the upstanding projection *h*, and the cam-shaped projection *i*. This projection *i* works in conjunction with a cam-shaped surface *j* upon the right-hand tumbler. Upon opening the gun for reloading the consequent cocking of the tumbler turns the lever *f* upon its pivot *g*, causing the finger *h* to pull the blade *a* over from the left to the right.

When the trigger is pulled the blade *a* is caused to lift the sears *c*, and so to discharge the right-hand barrel. The fallen right-hand tumbler no longer holds the lever *f*, and the spring *e* is free to force the trigger blade over towards the left. As the gun recoils the elasticity of the hand allows the pressure upon the trigger momentarily to be removed and midway in its passage towards the left end of the blade, which it will be noticed is slightly bevelled, is carried into engagement with the slightly bevelled end of the stop-arm *l*. The relative lengths of the blade *a* and the arm *l* are such that when in contact they form a sort of toggle, the point of contact between their ends being on one side of a line passing through their









pivots. So the swinging blade *a* is brought to a dead stop until the involuntary clutch carries it upwards again. The end of the blade, which is undercut, is then carried over the top of the stop *l* by the spring *e* to a position against the sear *d* of the left-hand barrel. The pressure of the involuntary clutch being removed, the blade falls, and is carried beneath the sear-tails *d* ready for the second discharge.

When the gun is opened for reloading and the lever *f* pulls the blade *a* over again to the right, the end of the blade pushes the stop-arm *l* around on its pivot *m*, and so out of its path. The arm *l* is held in its position by the spring *n*. This spring is prevented from turning the arm over towards the left by a stop *o*. A selective slide can be arranged to enable the left-hand barrel to be discharged first. Accepted January 28, 1904.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

The Establishment of Transatlantic Proof Houses.—Judging from several enquiries which have been referred to us during the past few months, there seems to be a general desire to establish properly equipped proof houses on the other side of the Atlantic. Not only is it felt in America that the enormous output of arms justifies the establishment of a proof house, but even in Canada the arguments in favour of such a development seem to appeal with great strength to various persons interested. Whether there is really any need for safeguarding the sportsman from accident, or whether it is because the buyer demands a mark denoting stability in the weapon he uses, we cannot say; but there is little doubt that in many of the markets of the world there is a strong preference in favour of weapons which have been subjected to an independent test, and are, therefore, guaranteed with an authority greater than that of the maker. Countries electing to have a proof house of their own will find that the difficulties of its initiation have been greatly minimised by the special knowledge gained by the existing proof authorities. At the present time the proving of many classes of firearms is reduced to the very simple condition of firing a cartridge in them which has been specially put together so as to give a margin of stress over and above that of the ordinary service ammunition. Given the ability to load cartridges satisfying these conditions, the actual carrying on of the proof establishment may be governed by the adoption of a very simple code of rules. In the case of the United States, it is probable that the idea underlying the establishment of a local proof house is rather to facilitate the carrying on of trade with countries with which the proving of weapons is obligatory rather than to protect the consumer from using unsound weapons. It would make a good deal of difference in this country if American weapons were eligible for importation without being proved upon arrival. The fact that such arms must receive the definitive proof in the finished condition, this involving the firing of the provisional charge, militates in a great measure against the importation of certain classes of weapon which would otherwise be seen in great numbers. The considerations involved are not, however, for us to consider, since any proof house established under State control could secure as by right the recognition of its marks in this country. We shall, therefore, watch with interest the manner in which the present proposals develop.

The New Service Rifle.—We shall very shortly be in a position to regard the new service rifle from the point of view of a product of the machine shop. No longer may it be spoken of as in the experimental stage. The different arms factories in the country have been engaged for some time past in its manufacture, and we may any day hear that samples may be purchased by the ordinary buyer. There are signs that the abuse and contumely to which it has been subjected are based upon a very inadequate conception of its real characteristics. The fact that the new rifle reproduces many of of the more objectionable constructional features of the older

pattern, has influenced the criticisms of many writers who are in other respects well informed. Yet in these matters we are at least no worse off than before, and it is, therefore, wrong to speak as though the faults repeated in the new rifle can be treated as special failings. It is, in fact, just possible that the Small-arms Committee have accomplished something really brilliant in bringing out a rifle which may be issued to all branches of the service, whether mounted or on foot, and of a handiness that no other military weapon possesses. The fully covered barrel, the reduced length and the undiminished ballistics are all features which, to the unprejudiced mind, may represent a very solid advantage from the point of view of military serviceability. When to these is added the advantage of an exceedingly well thought-out system of sighting, we really believe that the features of the new rifle, which may be regarded as novel, are more than justified, in so far that they carry out the requirements indicated by actual war service. While, therefore, we prefer to maintain an attitude of suspended judgment for the present, we still feel that there are many indications that the judgment in question, when the time comes for its delivery, will be essentially favourable to the changes which have been sanctioned and adopted.

Merchandise Proof Marks.—The time and trouble which have been devoted to the framing of rules governing the marking of foreign arms submitted for proof may be dismissed as so much wasted effort. A whole industry finds an urgent need for a certain reform, everyone being agreed upon that point. There are, as all in such matters, difficulties in applying a general principle in the form of specific wording. Personal interests pull in different directions, and we have the extraordinary spectacle of individuals vigorously opposing the very thing they know to be good, because it fails to satisfy in detail the whole of their ideas. The proposed new rules dealing with the marking of foreign firearms had been drafted with infinite pains so as to lie in the path of least resistance. The obdurates who were still dissatisfied consisted of certain persons who desired, at the inconvenience of others, to develop a business in gun barrels, which their own limitations had prevented them from accomplishing unaided. In other words they demanded what amounted to a monoply without being able to show the capacity to deal with it. The Board of Trade, to whom the question was referred for settlement, refused to take any action unless the parties interested were unanimously agreed upon the policy to be adopted. In due course, therefore, the two proof authorities have withdrawn their proposals for the differential marking of firearms of foreign manufacture, in order that progress might be made with the other rules covering the less debatable ground of ordinary proof procedure. It is indeed unfortunate that work devoted to public objects is so frequently liable to go wrong in this way.

Our Lecture on Striking Velocities.—It is always an exceedingly difficult matter to establish a precise relation between theory and practice in connection with any kind of industry. To state the value to a trade of an important discovery in the theory underlying recognised happenings is more often than not a thankless task. On the other hand it seems certain that the true understanding of the scientific aspects of gunnery must exercise a certain amount of useful influence on the general habits of thought of the practical man. It is in this spirit that we have placed on record in the current lecture to young gunmakers the results of an important series of experiments, which for the first time give absolute and reliable values to the relative striking velocity of different sizes of shot during the successive stages of their flight through the air. It is open to the reader to digest the figures given in the lecture, and apply them in his own way to the solution of the many problems which are for ever turning up in the daily routine of conducting a gun business. Questions involving the most important scientific principles are frequently asked by the sportsman of an enquiring turn of mind. The relative efficiency of different sizes of shot probably forms the basis of one-half the conundrums which are thus propounded. To say which is the best powder is not a difficult matter, because each man is entitled to his own opinion, but to give sound advice concerning the rival claims of the alternative sizes of shot requires a certain amount of special knowledge, the absence of which is not easy to conceal, however vigorous may be one's powers of imagination. The figures of striking velocity will at least afford valuable *data* for the use of those who desire to give reasons for the faith that is in them. We therefore commend our present lecture to the earnest attention of all who desire to back their firmly held opinions with plausible explanations.

War Office Committees.—A very interesting section of the report on War Office reform is concerned with the principles involved in the establishment of special committees. It is pointed out that their reports accumulate and are not adequately studied, the general result being to delay necessary action, to destroy responsibility and to entail a large aggregate expenditure. On the other hand it is stated that where specialist knowledge not available at the War Office is required, the temporary association of experts with officials may be beneficial. The duty of a committee of this necessary kind should, it is stated, be only to work out details and not to formulate policy. It is distinctly pleasing to note that although the reform committee recommend that certain committees be abolished, they specifically include among those which are required as a permanent feature of War Office administration, the Ordnance Committee, the Explosives Committee and the Small Arms Committee. While we are not in very close touch with the two first named committees we at least know that the Ordnance Committee has carried out an extensive programme of work in connection with the introduction of quick-firing field artillery. In a similar way the Explosives Committee has given us modified Cordite and has been instrumental in introducing various necessary reforms of procedure. More than this it has accumulated a large amount of special information of genuine national importance which, though it may not be published, is none the less available for War Office use. The Small Arms Committee has likewise within its own proper field done very useful work, and in course of time we hope to see yet further evidences of its active interest in practical problems. There can be no doubt that there is a lot of work to do before the national small arm and its cartridge can be considered as up-to-date and in harmony with existing standards of progress. The Committee will no doubt be familiar in due course with what is wanted, and it will then rest with the War Office to sanction several much-needed improvements.

THE FINAL CHAMBER SIZES.

We are at last in a position to welcome the publication of a revised set of chamber sizes which may unhesitatingly be adopted by all gunmakers. The anomalies which crept into the previously issued dimensions have been entirely removed, and gunmakers have the advantage of a uniform taper. The justification of the new series of sizes is to be found in the tabulated particulars which display the deductive processes whereby the dimensions of the chamber are obtained from the bore of the barrel. Starting with the latter as a basis a suitable addition provides a sufficient margin to allow for the thickness of the walls of the cartridge. These differences between the bore of the barrel and the front of the chamber are suitably graduated for all calibres. The mean diameter of the wadding is specified for every bore, and is in correct relation with the bore of the gun. The uniform taper of ·005 in. for every inch of length in the chamber has also been provided for. Consequently the diameter at the back end of the chamber is arrived at by a very simple calculation. The size of head is similarly obtained by a series of carefully graduated additions to the size under head, that is, the size at the mouth of the chamber.

It will be apparent from this short sketch of the principles upon which the new sizes have been fixed that the arithmetic portion of the programme has been systematically arranged. The relation of the new sizes to practical dimensions has also been very carefully safeguarded. In no instance has the arithmetical ideal been allowed to interfere with the production of a chamber that represents a true average of existing conditions. Here and there it may have been found that the agreement with practice was not as close as might seem desirable; but on the other hand the divergence in most instances indicated the opportunity for an advantageous change in the currently recognised dimensions for chamber or cartridge. At any rate it is safe to say that the adopted dimensions will not necessitate any radical alteration of existing practice.

A satisfactory feature of the memorandum on the new chamber dimensions consists in the fact that the two Gunmakers' Associations have worked hand in hand in the accomplishment of this most desirable piece of work. The outcome of their labour would have been wanting in some of its present merits had either body sought to carry out the work without the help of the other. It is impossible in presenting the briefly stated result of many months of labour in the form of a simple table of values to lay special emphasis on the innumerable points which had to be considered and settled before the final result could be achieved. However this is now past history. The sizes have been adopted, and there is every reason for believing that they will gradually achieve extensive recognition by reason of their inherent merits and freedom from controversial points. While it is possible that many persons will question the possibility of the new sizes receiving the recognition which is embodied in their actual adoption by tool makers to the trade there is none the less good reason for the belief that little by little they will come to govern actual practice. The new sizes at least represent practical figures where hitherto traditional values have been passed down from one generation of workers to another.

CARTRIDGE PRICES.

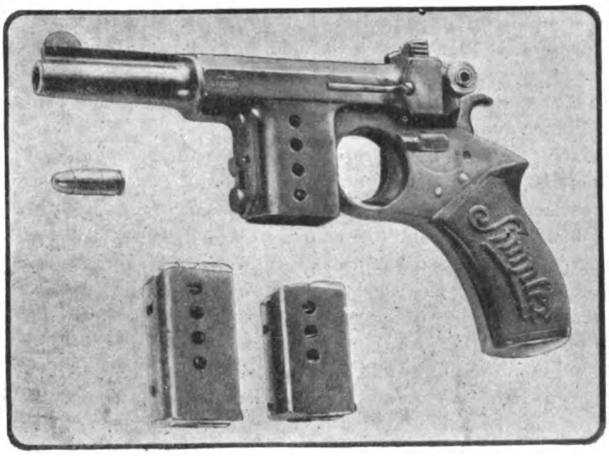
A very interesting question was raised in a letter which we published last month from Mr. J. S. Nettlefold. While the letter itself dealt with the desirability or otherwise of protection for the cartridge industry, Mr. Nettlefold incidentally raised a point which we should like to develop in greater detail. He said that it could not be to the interest of our readers if an import duty were put on cartridges, thereby enabling the manufacturers to put up the price of the goods. As a matter of fact, we entirely disagree with the proposition put forward by our correspondent.

We can trace the present very unsatisfactory state of the trade in loaded cartridges to the unfortunate cutting of prices which has in practically every instance been initiated by the attempts of the foreigner to gain a position in the home market. Some German or other Continental firm issues a cheap cartridge loaded with a foreign powder and with foreign wadding, the combination representing something cheaper than has hitherto been available to the sportsman. English manufacturers respond with a cheap cartridge of their own make, and in order to compensate for the reduced profit they seek to increase the quantity of their sales. Unfortunately the cheap cartridge cases, as a rule, represent far too high a value for the price charged, and in the end these cartridges with the good looking exterior displace those of higher price and higher quality.

At the present time the prices obtained for sporting cartridges make it impossible for the conscientious loader to use the best materials unless he is willing to carry on his business at a loss. Progress in thus checked, and we are forced to recognise as standard qualities of wadding which should only be seen in inferior cartridges. Were there a small margin of duty to control the dumping operations of our foreign competitors the extra price which would then be charged for sporting ammunition would represent a very valuable margin of extra profit. We do not believe that the effect of an import duty would be solely to raise the cost of the goods to the sportsman. There is quite sufficient competition within this country itself to ensure the sportsman receiving as good value as at present. The change we should anticipate would be that the sportsman would pay rather more for his ammunition and that its quality would be increased out of proportion to the additional price charged. In other words an extra sixpence per hundred added to the cost of the materials would make the resulting ammunition worth say an extra two shillings a hundred to the sportsman. We do not vouch for the absolute accuracy of these figures, but we do maintain that at the present time the sportsman is not obtaining as good value for his money as he would if he paid a little more. Yet so long as the fashion is set by the foreign competitor, and while the English sportsman considers price before quality, the cartridge business is unsatisfactory to both parties—to the gunmaker because he does not receive a fair profit on the transaction, and to the sportsman because he unwittingly uses cartridges which might for a very small additional price be substantially improved in quality. At present there is little or no margin to pay for improvements, and progress is checked accordingly. It must, therefore, seem reasonable to suppose that the general acceptance of a higher scale of prices would produce benefits equally apparent to the gunmaker and the sportsman.

THE SIMPLEX AUTOMATIC PISTOL.

The Wilkinson Sword Co., Ld., has submitted for our consideration an automatic pistol in which they are interesting themselves. It stands apart from all other pistols owing to the extraordinary simplicity of its parts. Those who remember the Borchardt pistol, practically an automatic gun on a small scale, will be astonished at the surprising diminution of the limbs which were at one time considered essential. Browning showed us to what a long way the process of simplification could be carried, and yet we see in the "Simplex" pistol something that goes even further. We do not say that the pistol under consideration necessarily possesses the same refinements as more expensive weapons, but it at least shows that the automatic principle can be applied to pistols put together for sale at a very low price. The reduction of parts reminds one of the analogy of the black and white artist who first draws the figure in detail and then bit by bit replaces the fine shading with broad outlines giving the same general effect to the eye.



The accompanying illustration of the Simplex pistol shows that it lacks nothing in general harmony of appearance. The grip lies nicely in the hand, and the magazine is so placed as not to appear obtrusive. The dismounting of the bolt mechanism can be performed entirely without the aid of tools. By pressing upon the firing-pin a cross-piece can be removed. This frees various others of the working parts, so that the main-spring, striker and back-sight piece may be drawn from their places. The bolt can then be taken out, so leaving the barrel free for cleaning from either end. This particular pistol belongs to the class with a fixed barrel. That is to say, the cartridge and bolt recoil while the shot is still in the barrel, a system which is quite permissible when the ammunition is suitabiy designed with a view to the work expected of it. Altogether it looks as though the Wilkinson Sword Company have got hold of something really good in this pistol. It seems to be well suited for house protection and for carrying in the pocket. The simplicity of its mechanism will go far to recommend it in the eyes of the man who likes to be able to take a pistol to pieces without indulging in the mysteries of a Chinese puzzle. We learn that the Company anticipate being in a position to supply these pistols to the trade at rates that will allow a fair margin of profit.

THE REVISED CHAMBER SIZES.

THE two Gunmakers' Associations have issued the following memorandum and table of revised chamber sizes. It will be seen that the figures arrived at are justified stage by stage by a system of development starting with the bore of the barrel as a basis:—

The first series of 12, 16 and 20-bore sizes were approved jointly by Messrs. Eley, Kynoch and Joyce, and the two Associations in November, 1900. The dimensions for the bores other than those above quoted were provisionally settled by the above parties at a Conference held in October, 1901. Before the time had arrived for their final ratification, Mr. Greener pointed out the great advantage of a uniform taper for all chambers, also that this could be introduced in respect to 12, 16 and 20-bore sizes, with but slight alterations in the dimensions which had been already agreed to.

After consultation with the two Associations in regard to this desirable reform, Mr. Greener suggested other changes which were embodied in a set of rules drawn up by him for the fixing of all the dimensions of gun chambers. The dimensions so worked out were adopted by the two Associations, but the ammunition makers refused to approve them. They were, however, issued in card form under date August, 1902, by the joint authority of the two Associations.

It became apparent that these sizes would never be wholly adopted by the Trade for the following among other reasons:—

(1) The published sizes were not in accordance with the rules laid down:—

(2) The 5-bore cartridge put forward to replace the conventional so-called 4-bore was not wanted.

(3) No chamber for the above 4-bore was specified.

(4) The 32-bore cartridge specified could not be used with a barrel of the calibre laid down.

(5) Several of the chambers departed from existing sizes to an extent requiring the manufacture of the old as well as the new cartridges, in order that existing guns might not be thrown out of use.

(6) The reduction in length of the $2\frac{9}{16}$ in. cartridge to $2\frac{1}{2}$ in. was regarded as undesirable alteration.

The two Associations accordingly admitted the necessity of re-issuing the chamber sizes in a new form that would secure the approval of the cartridge makers, while giving gunmakers the advantage of a uniform taper.

The following rules have been adopted in framing the new sizes:—

(1) That as rules cannot be strictly followed in all cases none shall be quoted.

(2) That where possible sizes previously agreed to shall be adopted.

(3) That there shall be a suitable relation between the front end of the chamber and the bore of the barrel.

(4) That the chamber taper shall be ·005 in. per inch of length.

(5) That though the size under head may vary with different lengths of the same cartridge, the diameter of the rim shall be unaltered.

(6) That in order to save complication in regard to the uniform taper, two sets of sizes shall be given for the size under head, viz., to the nearest thousandth of an inch for chambers, and the nearest ten-thousandth for gauges.

MINIMUM SHOT GUN CHAMBER SIZES.

(All decimal dimensions are given in inches).

Bore of Gun.*	Mean Diameter of Wadding.	Length of Chamber A. Nominal.	Length of Chamber A. Decimal.	Depth of Rim E.	Length of Chamber Taper A-E.	Diameter at Front B.	Calculated Taper.	Size under Head C. For Gauges.	Size under Head C. For Chambers.	Size of Head D.	Radius of Rim Circle
4 (·935)	·948	4 in.	4·000	·130	3·870	1·035	(Does not apply)	1·0900	1·090	1·200	·030
8 (·835)	·845	3¼ in.	3·250	·115	3·135	·914	·015675	·9297	·930	1·035	·020
10 (·775)	·784	3¼ in.	3·250	·074	3·176	·845	·015880	·8609	·861	·933	·020
10 (·775)	·784	2⅞ in.	2·875	·074	2·801	·845	·014005	·8590	·859	·933	·020
12 (·729)	·738	3 in.	3·000	·074	2·926	·800	·014630	·8146	·815	·886	·020
12 (·729)	·738	2¾ in.	2·750	·074	2·676	·800	·013380	·8134	·813	·886	·020
12 (·729)	·738	2½ or 2 9/16	2·560	·074	2·486	800	·012430	·8124	·812	·886	·020
14 (·693)	·702	2½ or 2 9/16	2·560	·068	2·492	·763	·012460	·7755	·775	·847	·020
16 (·662)	·671	2¾ in.	2·750	·062	2·688	·732	·013440	·7454	·745	·815	·020
16 (·662)	·671	2½ or 2 9/16	2·560	·062	2·498	·732	·012490	·7445	·744	·815	·020
20 (·615)	·623	2¾ in.	2·750	·060	2·690	·685	·013450	·6985	·698	·766	·020
20 (·615)	·623	2½ or 2 9/16	2·560	·060	2·500	·685	·012500	·6975	·698	·766	·020
24 (·579)	·587	2½ in.	2·500	·060	2·440	·649	·012200	·6612	·661	·728	·020
28 (·550)	·557	2½ in.	2·500	·060	2·440	·614	·012200	·6262	·626	·688	·020
32 (·502)	·509	2½ in.	2·500	·060	2·440	·562	012200	·5742	·574	·636	·015
·410 (·410)	·415	2 in.	2·000	·060	1·940	·465	·009700	·4747	·475	·537	·015
·360 (·360)	·363	1¾ in.	1·750	·050	1·700	·415	·008500	·4235	·424	·479	·015

* The Decimal Diameters of Bore are the minimum sizes as recognised for Proof Purposes, except in the case of 4-bore and 32-bore, where special values have been adopted.

(7) That the shape of the rim recess shall be altered to give a square edge for gripping the cartridge.

(8) That the mean diameter of wadding for each bore of cartridge shall be specified.

The calibres for which chambers are specified are the decimal values given in the proof rules, except that the diameter of the 4-bore is taken as ·935 in., and the 32-bore as ·502 in., instead of 1·052 in. and ·526 in. respectively. To ensure a proper relation between bore of gun and nose of chamber, the following were taken as the amounts by which the front end of the chamber should exceed the bore of the barrel:—4-bore, ·100; 8-bore, ·079; 10-bore, ·070; 12-bore ·071; 14 to 24-bore, ·070; 28-bore, ·064; 32-bore, ·060 in.; ·410-bore and ·360-bore, ·055.

The front of the chamber having thus been established, the depth of rim most suitable for each bore was decided on the basis, of previously agreed sizes. Subtracting the depth of rim from the total length of chamber, the length of the taper wall of the chamber was arrived at. Thence the number of thousandths of tapers was determined. The size under head was then fixed by adding the taper so obtained to the diameter of the front end of the chamber. The size of head was obtained by adding the following amounts to the size under head:—4-bore, ·110; 8-bore, ·105; 10 and 12-bore, ·074; 14-bore, ·072; 16-bore, ·071; 20-bore, ·068; 24-bore, ·067; 28-bore to ·410-bore, ·062; and ·360-bore, ·055 in.

The chamber sizes worked out are shown in detail in the accompanying table. They have been subjected to a comprehensive series of checks which, while they cannot be specified in detail here, seem to show that the sizes recommended for adoption are in close agreement with existing practice, and at the same time in correct mathematical proportion. The particulars contained in the accompanying table afford all necessary information for guns using the ordinary paper cases. Special wad sizes and bores of barrel are requisite when thin brass cartridges are employed. While it is proposed that the sizes now submitted shall not be accompanied by any mention of the rules or principles upon which they are based, it is appropriate to state here that the actual values fixed have been arrived at by aid of the previously approved system of reducing chamber dimensions to a well-ordered code of mathematical treatment. The sizes contained in the accompanying table have been accepted by Messrs. Eley, Kynoch and Joyce, this Memorandum is issued jointly by the two Associations for the information of their respective members.

SAFETY EXPLOSIVES IN MINES.

IT is always with interest and with expectation of good things, we read the publications of the French authorities on explosives, because they have been such a fruitful source of information in the past. The latest issue of the *Mémorial des Poudres et Salpêtres* represents the first half of volume XII., and contains the usual departmental reports and some articles of a scientific character, of which the following are the more important: Experiments on, and the history of, firing against hail storms, muzzle pressures in guns, notes upon the nitro-celluloses and cellulose, the decomposition of nitric ethers and nitroglycerin by alkalies and its relation to stability, by M. Berthelot, and lastly, Safety Blasting Explosives.

The research with regard to Safety Explosives will no doubt be of interest to many others besides those who are concerned with the manufacture and use of blasting powders in mines. Apparently the French safety blasting powders are:—

Grisounite-Couche Favier	Ammonium Nitrate ...	95·5 %
	Trinitro-Naphthalene...	4·5 %
No. 2 P. Explosive ...	Ammonium Nitrate ...	90·5 %
	Soluble Guncotton ...	9·5 %
Grisounite-Couche ...	Ammonium Nitrate ...	88 %
	Nitroglycerin	12 %

The use of these explosives, which give a calculated temperature of detonation less than 1500 °C., has been accompanied with a remarkable reduction of accidents in mines due to the

explosion of fire-damp or the firing of dust. While in the above respect there is every reason for congratulation, in others there is room for improvement. More especially, the explosives are not sufficiently plastic to take the form of a bore hole, the paraffin paper covering is not sufficiently air-tight to keep the hygroscopic mixtures dry. The paper covering frequently takes fire on explosion. Missfires are frequent, the explosives being insufficiently sensitive to the detonator. In view of these objections researches have been made with regard to (1), The adoption of airtight metallic envelopes for the cartridges (2), The improvement of the sensitiveness of the service powders by the addition of small percentages of sensitive salts, and lastly (3), Experiments with new powders with a view to their adoption.

The experiments with metallic envelopes were made with tinfoil varying in thickness from ·005 in. to ·0004 in. The foil was used in just the same manner as is usual with paper and not as adopted by some manufacturers, in the form of tubes. The tests were made to determine to what extent such envelopes prevented the explosive taking up atmospheric moisture, how they affected the passage of detonation from cartridge to cartridge and how far they withstood the knocking about incidental to actual use. Tinfoil thinner than ·0012 in. was too easily torn in making up into cartridges, but foil of this thickness covered externally with paper would stand a considerable knocking about and keep the powder dry in a humid atmosphere much better than the service covering of paraffined paper. The adoption of this envelope would however increase the price of the finished article, and appreciably decrease the susceptibility of the passage of detonation. One gathers however, that as missfires are due to damp explosive, there would be on the whole a gain in this respect by its adoption. The attempts to increase the susceptibility of the service explosives to detonation were negative. Experiments were made with mixtures composed of the service explosives and up to 10 % of various oxidizing substances. Potassium chlorate did not increase the sensitiveness, and was objectionable on account of decomposition which commenced a few days after manufacture. Similarly potassium bichromate, potassium permanganate, nitrates of lead barium and aniline, had no affect on the sensitiveness, so that the experiments under this head were all unfruitful.

Blasting powders with ammonium perchlorate as base were given a good trial because this substance enabled them to make an explosive mixture of low temperature of combustion which in view of its non-hygroscopic properties had an advantage over ammonium nitrate. For instance, a mixture of 89 % perchlorate and 11 % nitroglycerin would on detonation transform as follows:—

$$31\ NH_4\ Cl\ O_4 + 2\ C_3\ H_5\ (NO_3)_3 =$$
$$6\ CO_2 + 31\ H\ Cl + 51{\cdot}5\ H_2\ O + 18{\cdot}5\ N_2 + 39{\cdot}25 O_2,$$

which gives a calculated temperature of combustion of 1,480 °C. This mixture is more susceptible to detonation than service No. 2 P, and is quite stable under the storage and heating tests. Unfortunately, the large amount of hydrochloric acid given off on firing makes the explosive useless for blasting operations in mines or confined places. Attempts were therefore made to get rid of this defect by replacing part of the perchlorate by potassium nitrate in sufficient amounts for the potassium to unite with the whole of the chlorine. These latter mixtures were satisfactory from an explosive point of view, but as an interaction between the nitrate and the perchlorate set in after a few days' storage, producing ammonium nitrate with all its hygroscopic characteristics, the mixtures were in reality no better than the service explosives.

It has been pointed out above that missfires with service powders were due to the absorption of moisture. On this point a long series of experiments were made to ascertain the conditions under which damp service explosives could be detonated with certainty. Apparently the solution is one of size of detonator, thus the least sensitive of the service powders, viz.: Grisounite-Couche Favier containing 4 % moisture, and which is not fired by a detonator containing 2 grammes of fulminate is completely detonated by a 2½ gramme to 3 gramme fulminate detonator. The same certainty of action can be obtained by the use of smaller detonators and a primer of a more sensitive explosive, just as wet guncotton is now fired by means of a comparatively small detonator and a primer of dry guncotton.

The conditions which obtain in this country are not the same as those in France, but these researches we are now reviewing are so suggestive, we think they cannot be other than useful to all interested in safety blasting powders. The French authorities place the superior limit of the temperature of detonation at 1,500 °C., this being arrived at by calculation. It is a question whether a temperature limit is not more satisfactory than actual firing into an explosive mixture of coal. Low temperature of combustion is obtained by one or other of two methods, viz., either by the admixture of a comparatively low percentage of oxidizer, so that there is not sufficient oxygen to burn the hydrogen and carbon to water and carbonic acid gas respectively, or a comparatively large excess of oxidant, the low temperature being obtained by decomposing more oxidizer than is required. In the former case the presence of carbon monoxide in the products is an objection, and in the latter it is necessary to make sure that the oxidant is such that it will decompose and absorb heat, as is the case with ammonium nitrate or perchlorate. An instance where this condition was not obtained is given in the article under review. An explosive mixture was formed by mixing 33 % nitroglycerin with 67 % potassium nitrate which on detonation should transform as follows:—

$$4\ C_3\ H_5\ (NO_3)_3 + 18\ K\ NO_3 =$$
$$3\ CO_2 + 10\ H_2\ O + 15\ N_2 + 23{\cdot}5 O_2 + 9\ K_2\ CO_3.$$

This reaction gives a calculated temperature of combustion 1,450 °C., but on firing under conditions similar to service, considerable percentages of potassium nitrate were found in the solid residues, showing that the transformation did not take place and that therefore the temperature of combustion was higher than that calculated.

Mr. Markle, of the Tatham Shot Co., left with us just before his return to the United States, the *Sporting Life's* annual trap shooting review. In the course of its pages a summary is given of the shooters, who are described as average winners at flying target tournaments. In the year 1902, 750 men were selected for this special mention, and as a proof of the growth in the popularity of this form of trap shooting in the United States, it may be stated that the number of shooters whose names are similarly recorded for 1903 reach a total of 1,243. A part of this increase is probably due to the improved collection of statistics, but it is still a remarkable fact that there are so many shooters of a specially high grade of skill.

ROUND THE TRADE.

The summer season at the Gun Club opens on Saturday the 9th inst.

Messrs. J. Blanch & Son have opened a new establishment at 15 Broad Street Place,

The death is announced of Colonel J. L. de Plat Taylor, C.B., Chairman of the Nobel-Dynamite Trust Co., Ld.

Messrs. Hunter & Warren, of 72 Waterloo Street, Glasgow, have been offered, and have accepted, the sole representation in Scotland of the Stevens Arms Company.

The Normal Powder and Ammunition Co., Ld., appear to be interesting themselves in the motor car industry, to judge by a post-card which they have sent to this office.

The net profits of the Vickers-Maxim Company for last year were £556,121, which with the sum brought forward from the previous year leaves £626,883 available for distribution.

Mr. Charles Lancaster has forwarded to this office a copy of the pamphlet he has prepared for issue in connection with his display of goods at the forthcoming St. Louis Exhibition.

In the action Ludlow *v.* Kynoch, Ld., the latter were ordered to pay £250 damages for breach of an agreement not to sell fog signals of a certain kind below a specified price.

The bankruptcy proceedings of Major H. F. Woodgate, of rifle inventing fame, disclose estimated liabilities of £852 with assets *nil*, the discharge being accordingly suspended for two years.

It was stated in reply to a question in the House that under the most favourable circumstances, it is unlikely that the manufacture of rifles at the Johapore factory can commence before December next.

A copy of the second edition of Cundill's Dictionary of Explosives which recently passed through our hands shows from the authorisation under which it was purchased that the total sales up to date reach 285 copies.

At the annual general meeting of the Cotton Powder Co., Ld., held under the presidency of Major-General Stuart Nicholson, C.B., full dividends were declared on the first and second preference shares, and a dividend of 15 per cent. on the ordinary shares for the year ending December 31st, 1903.

The British Uralite Co., Ld., have forwarded us a copy of a handbook they have lately issued, which deals, amongst other things, with the adaptability of this material for the construction of fireproof buildings for explosives manufacture. As is well known, Uralite is a fireproof substitute for match-boarding.

The *Field* announced in a recent issue that Mr. G. A. Battcock had been forced by ill-health to resign the secretaryship of the Gun Club, a position he has held for longer than most of us can remember. He has also held the positions of secretary of the Keepers' Benefit Society, and the Field Sports Protection Association.

We have before us a circular letter issued from the Schultze office under date February, 1904, informing this Company's customers in the North of England and Scotland that Mr. Frank Izzard has been appointed travelling representative for that district. This gentleman being in our opinion one of the most popular and pushful men on the road, we feel that our readers will join us in wishing him the best of luck on his journeys.

We much regret to announce the death of Mr. G. E. Bond, the well-known gunmaker of Thetford. In the accounts of his career which have appeared in the local press full justice is done to the altogether exceptional interest which he has consistently taken in the well-being of his native town. His name has been specially identified as a gunmaker with the use of granular wadding in sporting cartridges. He also made a very practical form of treadle turnover machine.

Capt. J. H. Thomson, H.M. Chief Inspector of Explosives, has issued a report on the circumstance attending the explosion of nitroglycerin which occurred in the precipitating and final washing houses of the factory of the National Explosives Co., Ld., at Hayle, on the 5th January last. He concludes with the very important declaration that he will in future hold manufacturers responsible who use heavy utensils of lead when aluminium is equally suitable and much less objectionable.

We have received a pamphlet which states at some length the details of a dispute between Colonel P. S. Lycoudis, of the Grecian Army, and Messrs. Vickers, Sons & Maxim, concerning the alleged infringement of the Colonel's patent for a new system of breech mechanism for big guns. As these questions are difficult enough to settle even with the aid of an action at law, it is not for us to pass an opinion upon such slender material, comparatively speaking, as is contained in the pamphlet referred to.

Herculite is the name of the latest prodigy in explosives. Needless to say, it is much more powerful than the blasting compounds commonly in use. It is also much cheaper, and is the only explosive that does not give off dangerous fumes. These things seem to have been satisfactorily established in the mind of the *Bristol Mercury* reporter as the result of an afternoon's demonstration carried out at Fishponds. It seems that in one instance ten ounces of the explosive displaced some 37 tons of rock.

We have received from Glasgow a leaflet announcing that the firm of J. D. Dougall & Sons, of 23 Gordon Street, have been compelled to take new premises. They have been unable to obtain a renewal of the lease at the old address, at which business has been carried on for fully half a century. To minimise the inconveniences of removal they are offering their entire stock at considerable reductions. In May next they expect to be duly established at 3, West Nile Street, which is situated at the corner of Gordon Street, Glasgow.

We understand that Mr. V. T. Mitchell, of 6 Lloyd's Avenue, E.C., has been appointed sole representative in this country for the United Lead Company's brand of Tatham's chilled shot. Mr. Mitchell is so well-known to our readers by reason of his long connection in the past with the Schultze Company that we hardly need refer to him by way of special introduction. We, however, feel safe in saying that if he puts half the energy into the Tatham business that he consistently devoted to the promotion of the Schultze interests the success of his representation is more than assured.

The latest balance sheet of Messrs. Walkers, Parker & Co., Ld., discloses a continuation of the more satisfactory condition of affairs which was reported a year ago, the past year's profit amounting to £37,537 against £34,013 for the year 1902. The profit in question leaves a balance after the payment of general expenses, including debenture interest, of £21,771. £6,000 has been set aside for the payment of 3 per cent. on account of arrears of dividend, the remainder being carried forward. The Directors report the improving state of the business as a result of the funds which have been reserved out of current profits for working expenses. Reference was also made at the general meeting to various improvements in plant and administration which are being made.

Our American contemporary, *Mines and Minerals*, of Scranton, Pa., U.S.A., has issued a useful little directory which contains a more or less representative list of American firms employed in the manufacture of mining plant and supplies. It is curious, however, to note that only three firms are classified under the heading of explosives, these being the Connell Powder Co., the Masurite Explosive Co., and the Metallic Cap Manufacturing Co. We seem to have a vague recollection of a firm named Du Pont, and one or two others, such as the Aetna Powder Co., but it is possible that these firms were not considered of sufficient importance to merit a position in the list. Were we to issue a similar directory for this country it would of course be necessary to decide whether the Nobel Company should be allotted a position. We cannot apply a similar test to detonator makers, since this heading appears to be absent.

LECTURES TO YOUNG GUNMAKERS.

XXVII.—SHOT VELOCITY AT ALL RANGES.

THE *Field* has recently brought to a satisfactory conclusion a series of experiments concerning shot velocities which, from the intrinsic importance of the results obtained, must be regarded as of permanent reference value to all gunmakers. Hence our reason for bringing our young gunmaker readers into touch with the subject.

Hitherto there has been extremely little information of a really reliable character concerning the progress of the shot broken by reason of the passage of the charge of shot through a frame intersected by a screen of fine electric wires. By arranging these screens at suitable distances apart the time occupied by the shot in traversing various sections of the range was duly recorded. These times were then very carefully examined by arithmetical and other checking processes, whereby an average value was struck truly recording the mean behaviour of the charge of shot.

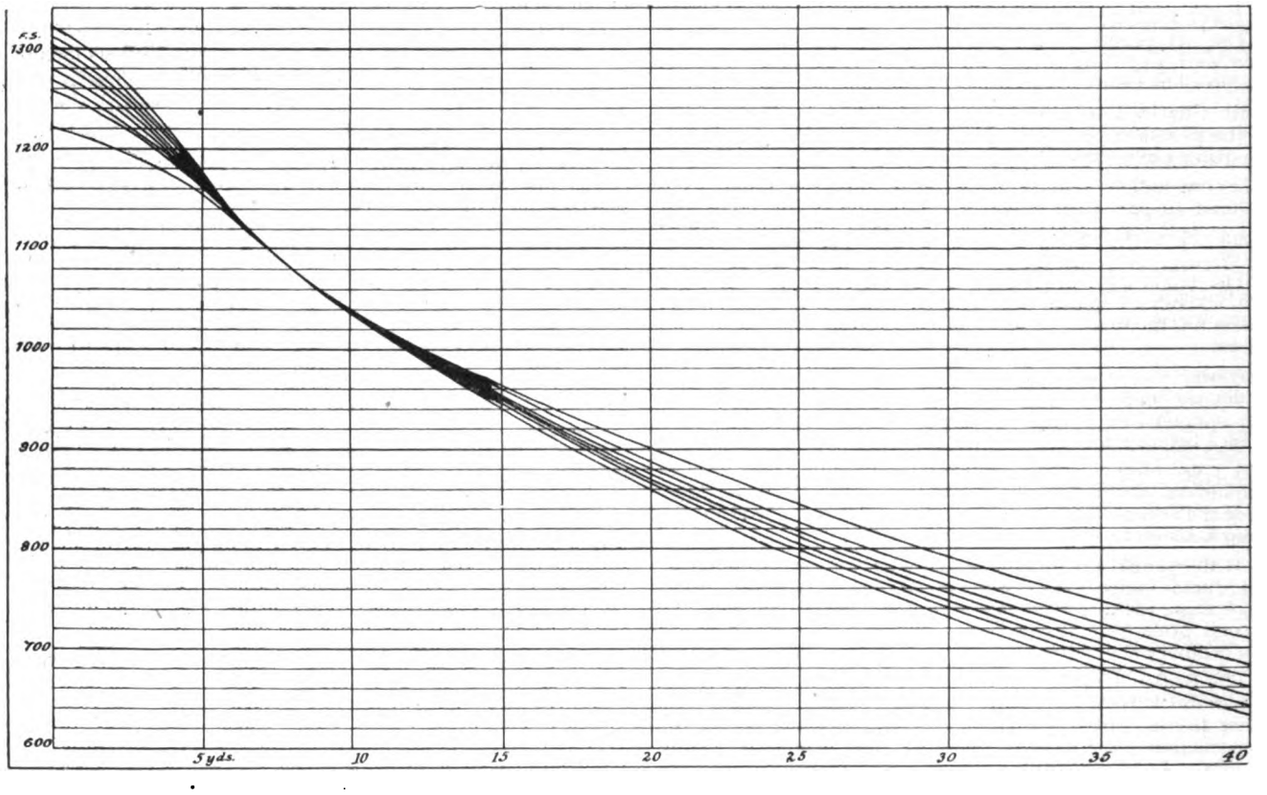


DIAGRAM SHOWING THE VELOCITY OF VARIOUS SIZES OF SHOT AT ALL RANGES AS FIRED IN A STANDARD CARTRIDGE. The curves of velocity of departure from the muzzle, run in the following order. Sizes 7, 6½, 6, 5½, 5, 4, and 3 from a cylinder gun. The lowest curve represents the departure of all sizes from a full choke. Their relative rate of arrival at 40 yards is shown by the finish of the curves, the top relating to size 3, the lowest to size 7 and the other sizes in due intermediate order.

from the muzzle of the gun to the distances commonly regarded as sporting ranges. Existing instruments give us trustworthy readings of mean velocity between the muzzle and any point up the range; but it is exceedingly difficult, and in fact well-nigh impossible, to infer from these readings with any approximation of accuracy the relative velocity of different sizes of shot at different points along the range. In order to investigate this subject in a more complete manner than has hitherto been attempted, the *Field* made use of their Smith chronograph, which is an instrument having the important characteristic of being able to make a series of four time measurements in respect to every shot fired. That is to say the instrument is fitted with five recording contacts, each of which marks the point of time at which an electric contact is

The accompanying curve illustrates in a comprehensive manner the outcome of the experiments made. It shows the velocity of every size of shot at every point along the range from the muzzle to 40 yards. The actual experiments were conducted with shot sizes 3 and 7, these being the extremes which were considered to cover the sizes most commonly in use among sportsmen. The behaviour of the two extreme sizes having been duly laid down the curves relating to the intermediate sizes were filled in with due regard to their proportional relations of weight and diameter.

The first thing which became clear in the course of the experiments was that the smaller sizes of shot offered a greater resistance to expulsion from the cartridge than the larger sizes. The consequent increase of pressure

in the chamber produces a proportionally greater velocity along the barrel which is duly shown by an increased velocity over the first five yards of the shot's travel. The accompanying curve consequently indicates that the highest muzzle velocity experienced with a cartridge loaded in a standard fashion and fired from a cylinder gun is obtained with No. 7 shot. The other sizes of shot, of which the relative rate of departure from the muzzle is shown, comprise 6½, 6, 5½, 5, 4, and 3. These different sizes of shot leave the muzzle at a velocity varying with the number of pellets to the ounce. We thus account for the first seven curves at the muzzle end of the diagram. The lowest curve which has yet to be explained relates to the shooting of all sizes of shot from a fully choked gun. That is to say that although the small sizes increase the pressure at the chamber, and have a superior velocity along the barrel, they lose the exact amount they have gained by their increased resistance to the act of expulsion through the choke. Thus all sizes of shot from 3 to 7, whatever may be their velocity in the barrel, when fired from a standard cartridge leave the muzzle of a fully choked gun at the same pace.

The next remarkable feature about the curve, which represents a discovery never before published, is that all the curves meet at a point between the 5 and 10 yards screens, and, therefore, that all sizes of shot fired from whatever kind of gun have about the same velocity at say seven yards from the muzzle. This may be explained in theory by the very reasonable supposition that what the small sizes of shot gain in velocity at the muzzle they lose further on as a result of their smaller ranging power. The larger sizes conversely make up by their increased size for their disadvantage in velocity at the muzzle. A theoretical explanation of the equalising of the choke gun results may be found in the supposition that although the velocity of departure from the muzzle is low in a choke gun the close formation of the pellets enables them to afford such mutual assistance to one another as to arrive at the seven-yards distance with the same velocity as is registered by a shot charge projected from a cylinder barrel. At or about the seven-yards distance the pellets appear to be so separated as to travel henceforward as independent bodies, each being subject to such diminution of velocity as arises from the inter-working of its own energy and the air-resistance which slows down the rate of travel. Earlier experimentalists assumed that the pellets gave mutual support to one another up to a distance of at least 20 yards; but we now find that beyond say ten yards the velocity of the different sizes of shot diminishes in accordance with the laws laid down by Bashforth for spherical lead projectiles.

Returning again to the curve we see that after the seven-yards distance the curves gradually open out like the fingers of the outstretched hand. The top curve, representing the highest velocity at every distance along the range beyond seven yards, discloses the behaviour of No. 3 size. The lowest curve represents No. 7 shot, and the intermediate curves the remaining sizes in due order. The cartridges fired in the course of the experiments were carefully examined with reference to their mean velocity over 20 yards and it was found that all sizes gave the standard reading of 1,050 feet per second, the inference being that what is gained or lost at the muzzle is compensated in the opposite direction beyond the seven-yards distance. A careful scrutiny of the curves shows that the average velocity over 20 yards is as nearly as possible the absolute velocity at about 9 yards 1 foot from the muzzle. The curve showing the rate of departure from the choke barrel would appear to indicate a slightly lower mean velocity over 20 yards than occurs with the cylinder barrel; but the fact that actual readings show that this does not occur suggests that there may be some slight advantage in velocity between say seven and 10 yards in a choke which, while it is not specifically shown in the curve, may arise in actual practice. The experiments conducted by our contemporary were not so absolutely minute as to be capable of determining such a fine point as this, but they are nevertheless sufficiently conclusive to make it quite clear that the curves here reproduced contain a true representation of the characteristic behaviour of all sizes of shot for the sporting distances specified.

While the accompanying curve can only be regarded as an approximate sketch from the point of view of the reading of values, the actual curve from which the deductions of our contemporary were based, was drawn on a very much larger scale which enabled the reading of values to be conducted with microscopic exactitude. The *Field* accordingly issued the two following tables as representing the absolute values deduced from the experiments made:—

TABLE OF MEAN VELOCITIES FROM THE MUZZLE TO VARIOUS DISTANCES.

Size of Shot.	Distance over which the mean velocities are specified.				
	0—20 yds.	0—25 yds.	0—30 yds.	0—35 yds.	0—40 yds.
3	1050	1009	971	944	903
4	1050	1005	962	929	888
5	1050	1003	959	923	882
5½	1050	1001	955	917	876
6	1050	1000	952	912	871
6½	1050	998	949	906	865
7	1050	996	946	901	860

All velocities are stated in feet per second.

TABLE OF SHOT VELOCITY at various ranges from 10 to 40 yards, for standard cartridges giving 1050 ft. per second over 20 yards, this being the absolute velocity at about 9 yards.

Size of Shot.	Distance from Muzzle in yards.						
	10	15	20	25	30	35	40
3	1038	960	896	841	791	746	706
4	1036	953	884	824	771	723	680
5	1036	949	876	814	759	711	668
5½	1035	946	871	807	751	701	657
6	1034	944	868	803	746	695	649
6½	1034	941	862	794	735	683	638
7	1033	938	858	789	729	676	629

All velocities are given in feet per second.

The first table shows the mean velocities between the muzzle and various distances along the range for the sizes of shot specified, and the second table the absolute velocity at each point on the range. Another table which we next reproduce shows the time occupied from the fall of the hammer to the arrival of the different sizes of shot at the specified ranges. These were derived by calculation from the first table, and each value so obtained was supplemented by the addition of ·0040 of a second to cover the time occupied between the fall of the hammer and the arrival of the shot at the muzzle:—

TABLE OF TIME VALUES FROM THE FALL OF HAMMER TO ARRIVAL OF SHOT AT THE DISTANCE NAMED.

Size of shot.	Points on range for which time delays are specified.				
	20 yds.	25 yds.	30 yds.	35 yds.	40 yds.
3	·0611	·0783	·0967	·1162	·1369
4	·0611	·0786	·0975	·1177	·1391
5	·0611	·0788	·0979	·1184	·1401
5½	·0611	·0789	·0982	·1189	·1411
6	·0611	·0790	·0985	·1194	·1418
6½	·0611	·0792	·0988	·1200	·1427
7	·0611	·0793	·0991	·1205	·1435

All times are stated in decimals of a second.

We thus have the average velocity of the charge over a series of distances, then the absolute velocity at specified distances and finally the time elapsing from the fall ot the hammer to the arrival of the shot at the object aimed at. These three tables represent virtually three ways of saying the same thing, though of course it must be understood that the second table contains the original information, and the other two tables what is derived therefrom. In other words it would be impossible to derive the values in table (2) from the figures given in the other tables. The importance to the shooter of the third table will be obvious when we point out that by its aid the exact values of allowance for aiming at crossing birds can be readily deduced. The next table accordingly shows the distance that a bird travelling at 60 feet per second or 40 miles per hour would cover during the time elapsing from the fall of the hammer to the arrival of the shot at the various distances named :—

TABLE OF ALLOWANCES FOR AIMING AT A CROSSING BIRD.

Size of Shot.	Distance of bird when the hammer falls.									
	20 yds.		25 yds.		30 yds.		35 yds.		40 yds.	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
3	3	8·0	4	7·4	5	9·6	6	11·7	8	2·6
4	3	8·0	4	8·6	5	10·2	7	0·7	8	4·1
5	3	8·0	4	8 7	5	10·5	7	1·2	8	4·9
5½	3	8·0	4	8 8	5	10·7	7	1·6	8	5·6
6	3	8·0	4	8·9	5	10·9	7	2·0	8	6·1
6½	3	8·0	4	9·0	5	11·1	7	2·4	8	6·7
7	3	8·0	4	9·1	5	11·4	7	2·8	8	7·3

This table shows that the differences of velocity of the various sizes of shot make practically no difference to the amount of the allowance that the shooter should make according to the size of shot he uses. No. 7 shot only lags at forty yards behind No. 3 to an extent that would allow the bird to travel a bare five inches. As this may be absolutely ignored, the following table of allowances, which has been deduced from the behaviour of No. 6 shot, may be accepted for birds travelling at the pace above specified :—

When the bird is at 20 yards the shooter must allow 3 ft. 8 in.
" " 25 " " 4 ft. 9 in.
" " 30 " " 5 ft. 11 in.
" " 35 " " 7 ft. 2 in.
" " 40 " " 8 ft. 6 in.

Slower birds naturally require a proportionately reduced allowance, but even so we have in a most concise form a very clear relative statement of the allowances necessary according to the distance of the bird. The following table is interesting, in so far that it gives particulars of the sizes of shot used in the experiments, the various *data* therein recorded having formed the basis of the calculations and comparisons which were utilised by our contemporary for the interpretation of the experimental results obtained :—

Size of pellet.	Pellets per oz.	Weight per pellet.	Relative blow at equal velocity.	Diameter of Pellet.	Sectional Area.	Value of $\frac{W}{d_2}$	Relative penetrative power.
		grs.		in.	sq. in.		
3	140	3·13	193	·127	·0127	194·1	124·67
4	172	2·54	157	·120	·0113	176·2	113·17
5	218	2·01	124	·109	·0093	169·1	108·61
5½	240	1·82	112	·106	·0088	162·0	104·05
6	**270**	**1·62**	**100**	**·102**	**·0082**	**155·7**	**100·00**
6½	300	1·46	90	·099	·0077	149·0	95·70
7	340	1·29	80	·095	·0071	142·9	91·78

Having duly recorded the results of the interesting series of experiments which have thus been brought to so satisfactory a conclusion, it will be well to make a few general remarks in explanation of the new light they throw upon the problems of sporting gunnery. In the first place the second table showing the absolute velocities at the different distances is the only one for which real originality can be claimed. The other tables which are based on mean velocity are only of subsidiary interest. These give particulars which have been available for many years past in a more or less disjointed form, and they are, therefore, only reproduced so as to show how the second table compares with the *data* already in the possession of various experimentalists. The chief value of the experiments does not, therefore, relate so much to the deductions shown by way of the table of allowances as to the fact that the absolute shot velocities at each distance along the range enable us to estimate the relative energy or striking power of the different sizes of shot. Knowing their velocity at each distance we can express this in the form of a table of energies, from which can be deduced their comparative.

More than this the recent experiments have given us such a clear insight into the behaviour of shot as to make it quite clear that the velocity of a charge of shot of any distance can be deduced from a single reading of mean velocity say between 15 and 25 yards. An experiment on this basis can be conducted with any kind of chronograph, and the whole of the remaining flight of the shot can be satisfactorily worked out by calculation. Such a test clears the way for examining the influence on striking velocity of sundry methods of loading which are known to give inferior results as measured over the usual 20 yards from the muzzle. Hitherto it has been impossible to say what a given shortage of mean velocity over this distance may represent in actual striking velocity say at 40 yards. It is impossible to obtain reliable measurements of velocity over a distance of say five yards when the two measuring screens are further than 25 and 30 yards from the muzzle respectively. We are now, however, sufficiently clear that the behaviour of the shot over measurable distances tallies with Bashforth's laws to feel quite safe in assuming that the agreement between theory and practice is equally exact beyond the limit distances above specified. Hence the experiments which have been reviewed in this lecture may clearly be accepted as indicating the path which research may take in the future, so enabling us to increase the volume of our available information.

EXPRESS RIFLE PRESSURES.

Our knowledge of high velocity express rifles is increasing day by day in a more or less imperceptible, but still certain, manner. The line which is followed by our extending knowledge is the more exact definition of the specification of rifle and ammunition which is most suitable for the conditions under which these weapons are used. The reports which come from the Soudan, India and various portions of South Africa are the outcome of practical experience by individual shooters. The slight mishaps which occur from time to time in the use of these weapons indicate the presence of objectionable features which have only to be specified in order that a remedy may be found.

The chief consideration seems to relate to the question of chamber pressure. A couple of years ago it was freely maintained that a chamber pressure of 20 tons was well within the practical limit of strength of the rifle, and it has been conclusively shown that a well constructed rifle is unlikely to burst when subjected to the repeated effects of this level of pressure. It, however, became clear that the satisfactory working of the rifle was not a question as to whether or not it would burst, but rather of various little minor mishaps which were a trouble to the sportsman. Careful experiments have shown that when rifle steel is subjected to a high pressure of this character it is quite possible that the chamber will sustain a minute internal expansion which creates a state of stress so disturbing the characteristics of the metal of which the barrel was constructed. In ordnance manufacture it is regarded as unsound practice to construct any weapon in a manner that leaves it subject to these minute alterations in the internal arrangement of its fibres.

In considering the position of express rifles from the point of view of the sportsman, we may even dismiss this question of microscopic expansion of the chamber. A weapon is most subject to mishaps arising from an undue level of pressure in connection with the cartridge. As a well-known gunmaker at one time pointed out the most prevalent inconvenience and trouble arises from the blowing back of the cap against the face of the action. This seems to be due to the expansion of the metal at the head of the case, whereby the cap chamber is slightly enlarged, so losing its grip upon the sides of the cap. When the cap is thus free to move it is pressed with such considerable force against the striker and breech face as to mould itself into the crevices which must inevitably exist around the striker hole. As a consequence great resistance is set up to the opening of the breech, and metal has frequently to be sheared away from the cap before the breech can be opened.

Another difficulty which is apt to arise when the cap becomes unseated, is that the gas tightness of the cartridge will be destroyed. It is well-known that so long as the products of combustion can be retained within the cartridge their enormous power is concentrated on the propulsion of the bullet. The moment, however, the tiniest jet of gas escapes its power is manifested in a most unpleasant fashion. The weight of the issuing gases may only amount to a few grains, but the energy of matter being proportional to the square of its velocity, the action of a few grains of powder gas turned hose-fashion on to a steel surface produces the most serious eroding results.

Escaping jets of high temperature powder gas have a double destructive power, viz., that of temperature as well as mechanical energy. It is, therefore, not by any means an unusual experience to find that a blown-back cap has allowed gas to enter into the action and tear out grooves and ruts around the chamber, which destroy the effectiveness of the weapon. To sum up the experience of recent years, we seem to be approaching nearer and nearer to the conclusion that 13 tons pressure is the maximum that should be allowed in any express cartridge when fired under English conditions of temperature. This would allow a margin for increased values in tropical countries which would still lie well within the limits at which minor casualties would be unlikely to occur.

TRADE MARKS.

APPLICATIONS ADVERTISED. MARCH 2—23, 1904.

259,706. 259,707. Harrod's Stores, Ld., London. Device representing winged figure distributing general stores over the world, partly obscured by clouds. To apply to ammunition and explosive substances.

260,141. Lincoln Jeffries, Birmingham. Representation of a shooter firing in prone position. To apply to small-arms and their accessories. Jan. 14, 1904.

269,670. The Delta Metal Co., Ld., London. The word "DIXTAMPO." To apply to arms and ammunition. Feb. 1, 1904.

REGISTERED. FEB. 18—MARCH 10, 1904.

256,650. Querette (Patent) Co., Ld.

258,995. R. J. Harmer, trading as Jas. R. Watson & Co.

259,391. 259,392. 259,393. The Lagos Stores, Ld.

259,634. 259,635. The Westfälisch-Anhaltische Sp.-Ag.

APPLICATIONS FOR PATENTS.

FEBRUARY 22—MARCH 19, 1904.

4,405. Firing of Guns R C. Holme and A. B. Chatwood.
4,527. Small-Arms. J. Rogers.
4,536. Ordnance. W. Beardmore, G. A. Köhler and A. E. Mascall.
4,537. Howitzer Carriages. W. Beardmore, G. A. Köhler, and A. E. Mascall.
4,692. Nitrate of Ammonia Explosive. R. Haddan (Agent for *J. Führer*).
4,719. Shell. J. W. Gillet.
4,729.* Small-Arm Breech Adapter F. Greener.
4,742. Explosives. The Miners' Safety Explosives Co., Ld. and W. Levett.
4,774. Small-Arms. J. W. Esser.
4,784*. Floating Batteries. H. H. Lake (Agent for *A. P. Stokes*).
4,789. Targets. H. G. Dee.
4,870. Ammunition Hoist. Sir W. G. Armstrong, Whitworth & Co., Ld. and C. Murray.
4,873. Small-Arms. W. Foggs.
5,024. Small-Arms. J. S. Heath.
5,126.* Nitrocellulose. A. Voight.
5,209. Machine Guns. E. Dumortier.
5,316. Ordnance. A. Boucher and T. J. McCloskey.
5,332. Targets. W. F. Brisland.
5,488. Sighting Apparatus. G. Forbes.
5,536. Range Finder. J. A. Rowe.
5,725 Air Guns. M. Pulvermann (Agent for *F. Langenhan*).
5,732.* Small-Arm Triggers. S. Turndiji.
5,742. Sighting Device. T. Gilbert-Russell.
5,809. Projectiles. P. A Vaile.
5,847. Small-Arm Triggers. S. H. Manners.
6,105. Gun Case E. P. and H. W. Lawrence and J. Row.
6,116.* Shooting Practice. F. Wallock and C. Lorenz. (Date applied for in Germany December 21, 1903).
6,118.* Magazine Rifles. J. J. Roydon (Agent for *A. Cei-Rigotti*).
6,141. Cartridge Pouches. P. A. Martin.

6,170. Torpedo Steering. H. F. Christie.
6,254. Windgauge Rifle Sight. R. A. Rogers and F. Cantello.
6,300. Small-Arm Heel Pad. W. Fletcher.
6,353. Blasting Compound. A. H. Hargreaves and Curtis's and Harvey, Ld.
6,417.* Machine Guns. A. W. Schwarzlose. (Date of application in Germany Oct. 21, 1903).
6,421. Breech Adapters for Small Arms. J. T. Musgrave.
6,550. Small Arms C. R. S J. Hallé.
6,561.* Targets. R. M. V. Bremer.
6,589. Torpedo Firing. J. Bray.
6,613. Gun Laying. F. J. Heather.
6,679.* Electric Blasting. F. Render.
6,693. Projectiles. J. M. Herring.
6,729.* Spring Pistol. W. H. Ell.
6,730.* Targets. W. H. Ell.

* These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

FEBRUARY 25th—MARCH 24th, 1904.

COMPILED BY HENRY TARRANT.

3,020* (1903). **Manufacture of Nitroglycerin.** Maj. F. L. Nathan, J. M. Thompson and W. Rintoul, Waltham Abbey.

4,238 (1903). **Ordnance Sighting.** A. T. Dawson, London, and J. Horne, Barrow-in-Furness. Mechanism consisting of a telescope or other sight combined with a pointer, arranged to work in conjunction with another pointer upon the gun. The movement of this separate mechanism gives the necessary indication for the elevation of the gun, and when the gun has been moved in following such indication, a signal is given when it is properly trained to accord with the sights. By means of this system the different operations may be performed by different men. Accepted February 11, 1904.

6,409 (1903). **Manufacture of Guncotton.** J. Selwig, Germany. In order more thoroughly to strain guncotton than heretofore, the explosive is placed in the basket of a centrifugal machine. The vessel of the machine is closed and the basket is rotated, steam jets penetrating the cotton and so destroying the unstable products. The guncotton is afterwards washed in a similar manner. Accepted February 18, 1904.

6,538 (1903). **Sighting Device.** K. Fretsch, Austria. A sighting device for ordnance or small-arms, consisting of a single prismatic-shaped block of glass. By means of this piece of glass a reflected image of the object is for the purpose of correctly sighting the gun caused to coincide, with the object as seen through the glass. The adjustment of the line of sight in sighting devices consisting of a number of separate elements is not so stable. Accepted February 25, 1904.

7,269 (1903). **Manufacture of Nitrocellulose.** Maj. F. L. Nathan, J. M. and W. T. Thompson, Waltham Abbey. A process for the removal of water from the washed bulk of nitrocellulose, consisting in immersing it in water, floating upon the surface of the water a quantity of alcohol and then slowing drawing off the water so that the downward displacement of the water takes place with as little mixing with the alcohol as is possible. The water is, by means of this process, removed without mechanical treatment. Accepted February 18, 1904.

8,330 (1903). **Breech Adapter for Rifles.** F. Flatman, Erith. A modified form of the breech adapter dealt with in patent No. 7,927, 1889. The present form is composed of a tubular plug which is inserted in an outer case fitting into the chamber of the rifle barrel. A flange at the bottom of the tubular plug holds the striker in position. Accepted February 11, 1904.

8,674 (1903). **Loader for Sporting Guns.** Capt. W. J. Seton, London. A device for enabling two cartridges to be simultaneously inserted into the two barrels of a sporting gun, consisting of a plate provided with a pair of clips adapted to receive and hold the cartridges in parallel position side by side. When the cartridges are inserted into the barrels, the clip is removed by a sliding motion at right angles to the barrel axes. Accepted February 18, 1904.

8,843 (1903). **Submerged Torpedo Tubes.** Sir W. G. Armstrong, Whitworth & Co., Ld., and Lieut. E. L. D. Boyle, R N., Newcastle-on-Tyne When a torpedo is fired from the submerged tube of a ship going at full speed the inner tube does not always return. By means of a plunger in a cylinder charged from the impulse reservoir, the return movement of the inner tube is started, and is completed as usual, automatically Accepted February 18, 1904.

8,898 (1903). **Blasting Explosives.** J. Wetter, London (Agent for *Westfälisch-Anhaltische Sp.-Ag., Germany*). Recent experiments have ascertained that the disruptive power of explosives may be enhanced by the addition of metal in a woolly condition. These experiments have been set out in fully described patents in recent issues of this paper. The present patent deals with a method of keeping away damp, and of enhancing safety and disruptive power of explosives by enveloping them in a covering of felt composed of this metal wool. Accepted February 18, 1904

9,293 (1903). **Breech adapter for rifles.** R. Wake, Hull. The chamber of a rifle is fitted with a rifled tube to take miniature ammunition of the rim-fire type. A special striker for discharging such ammunition is provided in the breech mechanism, and the extractor is so arranged as to enter the chamber and to catch under the miniature cartridge's smaller rim A wire spring is inserted in the mouth of the magazine to prevent the empty cases falling among the parts. Accepted February 25, 1904.

9,688 (1903). **Gun Drill at Miniature Ranges.** F. E, Kelaart, London. Instead of fixing the firing tube parallel with the axis of a gun, it is mounted in such a way that it can be brought into the line of sight while the gun is elevated or depressed in accordance with the range indicated by the tangent sight. The tube is for this purpose fixed at its forepart, whilst its rear end is attached to the tangent sight. The firing barrel does not deviate from the line of sight necessary for ensuring a hit when discharged point blank. Accepted March 3, 1904.

11,106 (1903). **Unloading Cartridges.** J. Hildesheim, Germany. A method of unloading out-of-date rifle cartridges consisting in arranging a number of them vertically in a carrier which lies between a bullet catcher and a firing pin holder. The cartridges are fired quickly one after the other and the bullets and cases are saved for further use. Feb 8, 1904.

12,273 (1903). **Illuminating Gun-Sights.** Ann Common (Executrix of the late A. A. Common), Ealing. In conjunction with the form of sight described in patent 17,939, 1901, a luminous fiducial mark is provided. A screen showing radio-activity, such as a screen of blende or zinc sulphide washed over with a solution of a salt of radium, is employed; or the cross wires may be coated with a radio-active element. Accepted February 11, 1904.

14,344 (1903). **Moving Targets.** W. Loosemore, Cullompton. Movable target apparatus which is actuated from the firing point. In a base at the butts are two grooves. In the front one of these grooves is a transversely moving target, whilst in the back one are tilting targets upon tipping blocks. All the targets are actuated by a cord passing around pulleys. Accepted February 4, 1904.

14,672 (1903). **Armour-piercing Projectile.** H. Platz, Germany. An armour-piercing projectile which consists of two parts enclosed either in one or two envelopes. The front portion is of very hard metal, such as hardened steel, whilst the rear is composed of some heavy metal such as lead. This rear part is adapted to give the projectile as great a weight as possible and to take the rifling. Accepted February 25, 1904.

15,693 (1903). **Self-Feeding Device for Game.** W. Gray, Newcastle-on-Tyne. A self-feeding device for game which is so designed as to prevent waste of food caused by the bird hanging on to the cord which opens the valve and allows food to drop from a hopper. By means of the arrangement described only a predetermined amount of food can be discharged no matter whether the bird continues the pull upon the valve cord or no. Accepted February 18, 1904

23,472*(1903). **Picric Acid Explosive.** J. P. O'Donnell, London (Agent for *C. J. Frank, Melbourne*).

26,660 (1903). **Cartridge Caps.** P. Brighenti, Italy. A method of ensuring the complete ignition of the whole charge of powder in a sporting cartridge case consisting in providing a

tube above the top of the igniting cap. The flame from the priming composition is conducted through this tube, which is situated in the centre of the charge, and out of slots in its sides. Accepted February 4, 1904.

27,093 (1903). **Ordnance Recoil Brakes.** C. D. Abel, London (Agent for *Rheinische Metallwaren Mf, Germany*). According to this invention the elevation of a gun governs the size of the orifices through which the braking liquid passes from one side of the piston to the other when the gun recoils. The greater the elevation the smaller the sectional areas of these orifices, and the shorter will be the length of the gun's recoil. Immediately upon the return movement commencing a larger opening is provided for the flow of the fluid. Accepted February 18, 1904.

116 (1904). **Nitrocellulose Gunpowder.** O. Schmidt, Germany. Manufacture of nitrocellulose gunpowder, in which cellulose is first reduced to granular form by a special process. The cellulose grains are then converted to nitrocellulose by soaking in strong nitric acid, and by treating them with pure concentrated sulphuric acid to complete nitration. Accepted February 18, 1904.

834* (1904). **The Fulford Single-Trigger Mechanism.** E. D. Fulford. U.S.A.

870 (1904). **Shooting Cart.** A. Barnwell, Rugby. A spring connecting device for two-wheeled shooting carts by means of which the knee action of the horse going down hill is prevented from being communicated to the cart. The spring device prevents the weight of any person entering the cart from the back lifting the front. Accepted February 18, 1904.

1,105 (1904). **Shells for Artillery.** E. von Reichenau, Germany. Within a thin hollow casing two cylindrical layers of explosive and smoke-generating material are arranged. Between these two is a space packed with a layer of shrapnel. A dense volume of smoke is created when the shell bursts and the angle of the cone of dispersion of projectile material is reduced to a minimum. Accepted Feb. 18, 1904.

1,802 (1904) **Recoil Brakes of Ordnance.** C. D. Abel, London. (Agent for *Rheinische Metallwaren-und-Mf., Germany*). It is necessary in guns which recoil and are fired at a high elevation to vary the resistance of the brake in order to alter the length of recoil. The mechanism described in this patent allows the variation of the working of the brake, hitherto governed by the elevation, to follow according to a desired law, not necessarily directly proportional to the angle of elevation. Accepted February 25, 1904.

2,264 (1904). **Tubular Magazines for Small-Arms.** W. Mason, and F. Burton, U.S.A. A tubular magazine for small-arms, combined with a pivoted cartridge carrier by means of which loading is simplified and the assembling of the parts is facilitated. The loading opening is immediately below the barrel chamber and in front of the mouth of the tubular magazine. Accepted March 3, 1904.

2,266 (1904). **Sportsman's Call.** W. Winans, Ashford. By means of a mouthpiece which is inserted into the chamber of a gun barrel a powerful note may be produced. The mouthpiece is similar to those which are used to make notes on a cornet. The device is designed to allow of communication between shooters who have been separated. Accepted February 25, 1904.

2,460 (1904). **Case Hardening Compound.** J. Cadotte, U.S.A. A dry powder case-hardening compound consisting of 40 per cent. of white calcined powder, 40 per cent. of prussiate of potash, and 20 per cent. of lampblack. The metal to be hardened is heated to the necessary degree and is coated with this compound. The calcined plaster and the prussiate of potash combine to produce an annealing effect on the metal and to retard its cooling, whilst the lampblack penetrates the surface giving it a hardness without brittleness. Accepted March 3, 1904.

*These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

A PICRIC ACID EXPLOSIVE.

23,472 (1903). J. P. O'Donnell, London (Agent for *C. J. Frank, Melbourne*). In this specification a process is described of manufacturing a safety explosive of the picric acid class. A quantity of picric acid is dissolved in approximately half as much glycerin at a temperature of 212 deg. Fahrenheit. The solution is neutralised by adding a quantity of carbonate of ammonia. Whilst still in the dissolved state a quantity of infusorial earth is added, the amount being varied according to the desired strength of the explosive. An explosive of medium strength is produced by adding an amount of infusorial earth equal in weight to about three-quarters of the neutralised picric acid and glycerin.

The moisture in the "picrated mixture" so produced is evaporated by heat. To 35 parts of this mixture are then added 60 parts of nitrate of potash, which has been previously dissolved in boiling water, and five parts of sulphur. The mixture is kept boiling with the added ingredients and continuously stirred at a temperature of 240 deg. Fahrenheit until it is comparatively dry. The compound is laid out on trays and is thoroughly dried in the sun. The trays may be arranged in sheds with louvre boards. The operations are said to be safe and the resultant explosive of high power. Accepted March 3, 1904.

MANUFACTURE OF NITROGLYCERIN.

3,620 (1903). Maj. F. L. Nathan, J. M. Thompson, and W. Rintoul, Waltham Abbey. A method of preventing the formation and separation of nitroglycerin in the waste acids after the nitroglycerin, initially formed in the nitrating vessel, has been separated and removed, is set out in this specification. It has been found that if, after the separation and removal of nitroglycerin, a small quantity of water is added to the resultant waste acid, all further formation and separation of nitroglycerin is practically prevented, even though the mixture be subjected to a considerable degree of cold for a protracted period. The strength of the waste acids is only very slightly reduced, so that their separation and reconcentration are not affected.

This discovery enables the patentees to modify the present method of manufacturing nitroglycerin, the process of "after-separation" being dispensed with, and the plant required for manufacture simplified. The plant which may be used is of the type described in the patentees' previous specification, No. 15,983, 1901. After the required amount of nitroglycerin has been nitrated, the separation is started at such a temperature that when all the displacing acid has been added and the separation of the nitroglycerin is complete, the temperature of the contents of the nitrate shall not be lower than 15 deg. C. When the separation has been completed, a sufficient quantity of clear displacing acid lying in the lower part of the apparatus is run off through the waste acid cock, to allow of the remaining acids being air-stirred without splashing over the top. A small quantity of water is then added slowly through the separation cylinder. If the nitrating acids are approximately of the following composition—sulphuric acid (monohydrate) 62 per cent.; nitric acid (anhydrous) 33 per cent.; water 5 per cent.; and the temperature of the waste acids at the time of its addition is about 15 deg. C., a quantity of water, equal to about 2 per cent. by weight of the waste acids formed will be sufficient. If the nitrating acids contain less than 4 per cent. of water, or if the temperature is lower than 15 deg. C., from 3 to 5 per cent. of water may have to be added.

While adding the water the contents of the nitrator are air-stirred, but are not cooled, the temperature being allowed to rise slowly and regularly as the water is added. The air-stirring is continued for a short time after all the water has been added, in order to ensure uniform mixture. The agitation is then stopped, and a further quantity of displacing acid is admitted to remove by displacement any small quantity of initially formed nitroglycerin which may be adhering to the coils and sides of the vessel, and which would be disturbed by the agitation with compressed air. When this operation is finished the whole of the acids are ready for

de-nitration, or they can be stored in tanks until required, without being continuously watched. The "after separation" is thus eliminated and the nitrator and separator are available for the nitration of another charge of glycerin. Accepted February 11, 1904.

THE FULFORD SINGLE-TRIGGER MECHANISM.

834 (1904). E. D. Fulford, U.S.A. In this specification is set out a system of single-trigger mechanism by means of which the two barrels of a gun may be discharged one after the other in either order—right first and then left, or left first and then right. It is not necessary to operate an outside part between the firing of

Fig. 1

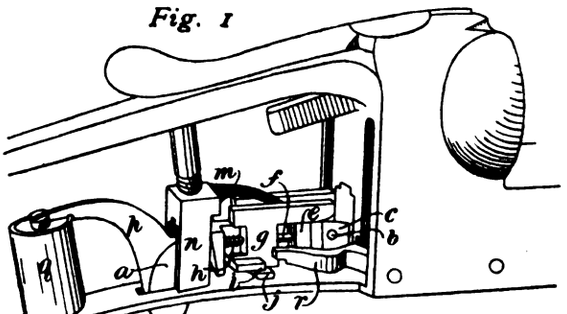


Fig. 2

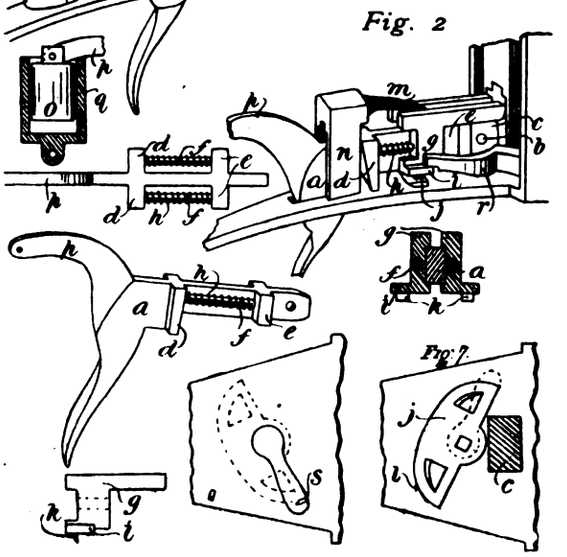


Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

the two barrels in either case. The involuntary pull, due to the recoil of the first discharge, is prevented from lifting the second sear by a piston and cylinder combination. This combination is slightly stronger than the trigger spring, and before the sear-lifting part can be carried beneath the second sear tail the intermediate pull is caused to take place whilst the trigger is yet in its raised position. The tumblers are so shaped as to raise the sear tails after discharge. The pull, therefore, has never to overcome the tension of more than one sear spring at a time.

The mechanism is illustrated in perspective in the drawings here reproduced. The trigger *a* is pivoted at *b* in the pillar *c* which is fixed to the trigger plate. The forward part of the trigger blade is upon both sides provided with shoulders *d* and *e*. Between these shoulders the bars *f* are arranged. Slidably fitted upon the bars are two "catches" *g* which are always pressed towards the barrels of the gun by the two spiral springs *h*. Through the medium of the shoulders *i* the catches are adapted to lift the sear tails, and their relative positions, in relation with the sears when the gun is loaded governs the order of discharge. Their positions are influenced by the part *j* pivotted to the trigger plate. This part is adapted to engage the projecting teeth *k* which depend from the shoulders *i*.

When the gun is opened for loading the breech-locking bolt pushes the two catches *g* backwards against the pressure of the springs *h*. Supposing the part *j* to be in the position illustrated in Fig. 1 the right-hand catch will be held by the engagement of its tooth *k* with this part *j* at the point *l* (illustrated in detail). The left-hand catch will not be held, and it will be pressed forward by its spring to a position in which its shoulder *g* is beneath the left-hand sear-tail. When the trigger is pulled the left-hand barrel is discharged, and the tooth *k* and part *j* are disengaged one from the other. The right-hand catch is thus released and it is pushed forward until its shoulder is brought up against the rear of—not beneath—the right-hand sear tail. The trigger spring *m*, attached to the post *n*, endeavours to depress the trigger to its normal position; but the plunger *o* attached to the rear arm *p* of the trigger blade, and the cylinder *q* allows this depression only to take place slowly. The speed of depression of the trigger is, of course, regulated by the fit of the plunger within the cylinder. Whilst the trigger is still in its raised position and the shoulder *i* is abutting against the rear of the sear the involuntary pull passes away harmlessly.

The depression of the trigger being completed after the removal of pressure thereupon, the spring *n* forces the catch slide forward, and its shoulder is carried beneath the right-hand sear tail *r* as is illustrated in Fig. 2. The tooth *k* drops into the slot provided in the part *j*. The right-hand barrel is discharged when the trigger is again pulled. The operations described above may be commenced with the discharge of the right-hand barrel, by simply turning the part *j* upon its pivot by means of the lever *s*, and so reversing the cocked positions of the catch slides *g*. Accepted February 18, 1904.

MISCELLANEOUS.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

Rook Shooting Season.—Once more the season for the shooting of rooks is upon us. Although this period is no longer one that represents the amount of business to the country gunmaker that it did in times gone by, there is still a certain amount doing with landowners and farmers who believe that a wholesome thinning down of the young rooks at a time when they can conveniently be got at is much better than the more expensive process of dealing with the old birds in detail in the open fields. The English rook rifle appears in a great measure to be a thing of the past. This at least is true in so far that, while the rook rifle is just about the same weapon as it was twenty years ago, its competitors have advanced surprisingly. Those who really understand and appreciate the shooting of finely adjusted rifles will refuse to have anything to do with a weapon which is not as a rule fitted with the Lyman aperture sight. Considering that the drop-down pattern of rifle is by far the most convenient, no matter with what it is compared, it is surprising that gunmakers have not been more energetic in bringing these weapons up to date. They should be chambered and rifled for all existing types of miniature cartridge, and the strap on the top of the action should be fitted with screw holes for the handy adjustment of the Lyman sight. Were the merits of the English rook rifle made better known there is little doubt that among the best class of sportsmen it would be largely used, where the market is at present ruled by other types of single shot rifles.

The Virtues of the Rook Rifle.—From the point of view of the English sportsman, it is very interesting to consider the various special aspects of the semi-Belgian and semi-English rook rifle which we all know so well. In the first place it is fitted with one of the most effective forms of take-down barrel in existence. Secondly, it opens more freely than most rifles, and with a total absence of the stiffness that mars so many machine-made rifles when new. It is, however, in the ejecting mechanism that it stands out pre-eminent. The cartridge is invariably flung free from the rifle with the precision we are in the habit of expecting from an expensive shot gun. More than this, when the gun is open the cartridge is very easily inserted in the chamber, and the closing of the action is very rapidly effected. For cleaning purposes there is probably no existing type of weapon which is so quickly taken down, at the same time creating such perfect accessibility of the bore. When we add to all these minor, but still important, considerations, the fact that the rook rifle has the lines of the English shot gun, and for that matter its balance as well, it is truly surprising that it should have been allowed to lapse into unpopularity. It is probably on account of its comparatively high price that the rook rifle has lost a great part of its earlier precedence. The wholesale price of these weapons is as a rule at least equal to the retail value of most machine-made weapons. Then, again, it is as a rule, customary for these weapons to be sold by skilful gunmakers who expend a

large amount of valuable time in the adjustment of the sights, this adding considerably to the retail cost. The shooter seldom appreciates the importance of this somewhat tedious operation, and he accordingly begrudges the extra price that it involves. In fact, if gunmakers could obtain 50 per cent. above the ordinary market value for American and other rifles, there is no doubt that the re-adjustment of the mechanism and the perfect arrangement of the sighting which they would be able to ensure, would fully justify the shooter in paying the extra price involved, that is, of course, assuming that the shooter has not the time or the facilities for carrying out the same operations on his own account.

The Coming Bisley Meeting.—The time is now about due for rifle specialists in the gun trade to commence making their final preparations for the coming Bisley Meeting. It is really astonishing to those who are unacquainted with the subject what a large amount of preliminary care and attention is necessary to turn out a set of rifles, which will satisfy the more intricate requirements of the rifle shooter. Since the excitement which arose in connection with the Palma match has died down, very little has been heard concerning further improvements in ·303 ammunition. This to be regretted in so far that the practical start which was thus obtained might have led to very important developments. This is not to say that manufacturers have been entirely idle in the meantime. Experiments are constantly proceeding for determining the best conditions for producing the most accurate results, and when the large number of possible variants is borne in mind, it is not surprising that the vastness of the subject makes progress appear somewhat slow and halting. There is bound in any case to be somewhat of a lull in rifle shooting developments pending the issue of the new service weapon, for rifle shooting in the near future is greatly involved in the special characteristics it will disclose. However, with other forms of shooting out of season, it is probable that interest in military weapons will be on the increase until it reaches its climax with the holding of the Bisley Meeting. As regards revolvers and miniature sporting rifles, there is again very little that is new to report. Some interest will doubtless be shown in the new type of revolver which has recently been brought out by the Colt Company. It is known as the officer's model, and is of ·38 calibre. The special feature of the weapon is the fine sighting, though whether it will be extensively adopted for target shooting will depend on characteristics of the weapon which have not yet been disclosed.

Adapters for Service Rifles.—Whatever may be the practical lessons of the Miniature Bisley Meeting one thing at least is certain, viz., that the adapter for the service rifle of the future will consist of an ordinary cartridge re-loaded with a nickel-based bullet suited for firing in the bore of the rifle itself. Mr. Trask has introduced a most interesting form of adapter based on this principle. The cap chamber is so opened out as to allow for introducing a fresh cap and chamber every time the cartridge is fired. The powder charge is inserted in the most ingenious manner, in so far that charges ready weighed are served in the form of miniature cigarettes, these being dropped bodily into the cartridge case. The bullet is then seated in the mouth of the chamber, and the cartridge is then once more ready for shooting. Two discoveries are involved in this seemingly simple method of providing cartridges for service rifle practice over miniature ranges. The first is that all the difficulties incidental to driving a lead bullet through the abrupt turns of the service rifling is got over by the use of a shallow nickel base on the bullet. The other discovery is involved in the fact that ordinary sporting smokeless powder is the ideal propellant for this class of work. It gets rid of the whole of the fouling difficulties which have hitherto made re-loaded cartridges so unsatisfactory. On the subject of cost there seems to be very little to stand in the way of the general adoption of the new form of adapter ammunition. The cases can be used over and over again, and the refilling with fresh caps, bullets and powder charges can be carried out by the most unskilled operator. The cost is, therefore, very small. As regards accuracy there can be little doubt that this class of cartridge will sweep everything before it when once it becomes generally used for competition work. The weight of the bullet, the perfection with which it takes the rifling, and the fact that no additional mechanism in the rifle is required are all material points in favour of the new system. Consequently it is only a question of time before we shall see the general application of this principle to a large proportion of the miniature shooting that is conducted with service rifles.

Cartridge Prices.—It will be seen in another part of our issue that Mr. Nettlefold remains unconvinced by the arguments we put forward in the last issue of this journal concerning the position of the cartridge industry. In matters of this sort there is of course a great opening for widely divergent views upon apparently obvious issues. For our own part we cannot help retaining the view that the progressive reduction in the price of sporting ammunition which has marked the past few years is at any rate exceedingly hurtful to the retailer who depends upon this branch of his business for a proportion of his livelihood. As the efficiency of manufacturing processes increases it is certain that prices will get lower, but when the margin of profit for the retailer diminishes beyond a certain point his existence is threatened. This is the unfortunate position of a great many gunmakers who have catered for the sportsman wisely and energetically in many parts of the country. To be told that he must become a mere distributor exercising no greater discretion than the ironmonger or chandler is not welcome information, and we feel certain that many of the best types of the class will fight hard sooner than admit that their period of usefulness has gone by, and that they have outlived the need for their services. Our own wish would be to see some form of agreement between the ammunition maker and the gunmaker, whereby the position of the best class of hand-loaded cartridge would be secured, at the same time leaving the factory loaded cartridge to be distributed by the gunmaker within his own circle of delivery.

Capt. J. H. Hardcastle, R.A., has been appointed Assistant-Inspector in the Army Ordnance Dept., in place of Capt. F. L. Galloway. Capt. Hardcastle is well known as an expert rifle shot at the ranges. Besides this he is a brilliant mathematician, having done a goon deal of special work in connection with the revision of Bashforth's tables.

THE NEW PROOF RULES.

The publication in the *London Gazette* of the new proof rules at last gives us an opportunity for reviewing the years of labour which have been expended upon them by several persons who do not in the ordinary way court the public gaze. Among these we must specially name Mr. Athol Purdey, whose enthusiasm for solid hard work is known to very few outside the restricted circle of his immediate associates. Mr. Thomas Turner, as Master of the Birmingham Proof House, has also put into the general drafting and preparation of the new rules an amount of persistent endeavour and practical knowledge of gunmaking which qualifies him for the earnest gratitude of the trade at large, present and future. In Mr. R. W. S. Griffiths and Mr. F. W. Jones we have two other men who desire to be judged rather by their deeds than their words.

Through these gentlemen the gun trade derives the benefit of an unexampled combination of practice and experience in the measurement of the stresses that are set up in various combinations of firearms and ammunition. Not only do the new proof rules represent the outcome of their general experience, but also a vast amount of special research calculated to bring the new rules into the closest touch with modern requirements. In arranging a satisfactory proof for any particular class of firearm it is not only necessary to ascertain the average level of the service pressures experienced but it is vitally important that the margin of extra stress allotted for the proof test shall be framed on a reasonable estimate as to what the margin of strength of such a weapon should be. That is to say the weapon must be tested, but the test must not reach a limit such as will disarrange the molecular formation of the structure, and so diminish the serviceability of the arm. When the margin that separates the service from the proof stress has been defined a large amount of extra work is necessary in order to ascertain the best way of reproducing the necessary conditions in large batches of proof cartridges.

The solution of the thousand and one problems which have been involved in the re-drafting of the new rules and scales of proof has taken several years, and yet there is little in the new proof rules themselves which will indicate even to the careful reader how great is the achievement they represent. It is probable as time goes on that gunmakers will find that the proof test affords them a far better indication of the strength of their productions than at any previous period in the history of the industry. Burst rifles, and guns which leave too small a margin of strength, are a constant annoyance to the trade, and it is more than likely that the operation of the new proof rules will give early indication of all needful openings for re-arrangement of existing practice. Although most of the work which has been put into the new rules is of a hidden kind many improvements in the arrangement of the context will be apparent. Line by line and paragraph by paragraph the draft rules have been subjected to microscopical analysis by a number of master minds, and we, therefore, trust that the new rules will fully justify the approval that has been officially expressed by those who have been consulted during the processes involved in their re-drafting.

THE MINIATURE BISLEY.

THE Miniature Bisley which was held at Olympia during the concluding week of last month merits the careful attention of all far-seeing members of the gun trade. Young rifle shots who, in the ordinary way, would never have acquired the slightest familiarity with shooting have by the encouragement and aid of the rifle shooting movement been brought into contact with a sport whose extension in the past has been mainly circumscribed by the difficulties of the first initiation. We can, therefore, see in the many thousands of civilian rifle shots a strong and vigorous rising generation of shooters who in one form or another will doubtless become liberal supporters of the gun and ammunition trades. The instinct for shooting is born in most of us, but the circumstances of environment have hitherto prevented more than a very insignificant proportion from securing early in life facility in the handling of firearms. In a great city like London middle-aged shooters are as a rule those who have by accidental circumstances of youthful environment been brought into contact with shooting in one or other of its branches, and the taste so acquired is seldom allowed to lapse. Very few who have not been brought into contact with shooting have acquired the art by sheer determination to become marksmen.

Now that the extension of miniature rifle ranges brings the sport of shooting within reach of every healthy-minded youngster the rising generation will obtain an introduction that may lead to important developments in subsequent years. In a very short time the keen member of the local rifle club will no doubt avail himself of a passing opportunity to test his skill in the rookery, the rabbit warren or in sporting excursions around the hedgerows. Relatives in the country in many cases afford the necessary introduction to outdoor shooting, and it is not long before the young marksman will find himself in possession of a shot gun. What has hitherto hindered the growth of the gun industry in this country is the very limited proportion of the population that is possessed of the necessary skill in the handling of firearms to accept a shooting invitation.

In the Miniature Bisley, and in the growth of rifle clubs generally, we can see the very opportunity which has been lacking for so many years. The valuable customers to the trade which this class of shooting may introduce should make gunmakers kindly disposed towards the recently developed aspect of that sport which is represented by the rifle club movement. From close observance of the individual competitors who presented themselves at Olympia we came to the conclusion that they presented an excellent type of raw material. They showed an intelligent interest in all that appertained to rifles, and they had in many cases already learnt the error of depending on club-owned rifles for satisfactory shooting, in fact most of them were already possessed of their own arms, feeling that by this means alone they were certain of retaining the adjustment of the sights in the particular position that affords a certainty of accurate marksmanship. It was clear that they had begun to show evidences of the fascination of the sport, and we fully believe that in due course of time many of those who shot at Olympia as youngsters will as their station in life improves become exponents, not only of the rifle, but of the shot gun as well.

CORRESPONDENCE.

CARTRIDGE PRICES.

To the Editor of *Arms and Explosives.*

SIR,—I have read with considerable interest your article on "Cartridge Prices." The doctrine advanced, that consumers get better value for their money when competition is restricted, strikes me, as I think it will most business men, as being entirely contrary to all experience. But I should not have troubled you with any further remarks on the controversy started in your issue of February, 1904, unless my name had been mentioned in the article above referred to. May I congratulate you on your caution in "not vouching for the absolute accuracy of your figures?"

It is not for me to contest your opinion that the cartridges loaded by men, however great their experience and knowledge may be, who are obliged to buy the components from several different sources, are not as satisfactory as they ought to be. The failure in regard to the wadding, mentioned by you, is a striking example of the objection to obtaining components from all sorts of different places. A few years ago, cartridge-loaders invariably bought their cases and wads from the same manufacturer, thus ensuring the suitability of the one for the other; and the trouble you refer to has only arisen since loaders took to buying cases from one man and wads from another, thereby making it impossible for them to make sure of a good fit. This shows that the production of what you say are bad cartridges, is due to the neglect of an important technical point, and not in any sense to England's policy of free trade, or, as some prefer to call it, "free imports."

For myself, I have no objection to the term "free imports," because Sir Robert Peel, and other great men, who introduced free trade into this country, expressed the opinion on more than one occasion that the only way to fight hostile tariffs was by free imports. The correctness of their opinion has been proved up to the hilt by the recent Government Blue Book, which shows how marvellously prosperous England has been, as compared with other countries, since she adopted free trade; and this in spite of many disadvantages, such as expensive railways, inadequate canals, inferior education, greater consumption of alcohol per head of the population, &c., &c. I am not speaking of the present bad trade, caused by an expensive war, and bad seasons due to inclement weather.

To return to the particular point raised in your article, I would remind you that Kynoch, Limited, has brought out three cartridges, "Bonax," "Kynoid," and "Opex," of which all the components, except the shot, are made by them, and which are assembled and packed at their Witton works. These cartridges have competed successfully, in quality for price, with all other cartridges made, either in this or any other country in the world. If you, or any of your friends, feel the slightest hesitation in accepting this statement as correct, then I would invite a trial. The cartridges can be obtained in any part of the United Kingdom, and the retail prices are fixed, so that the retailer is assured of a reasonable margin of profit. Kynoch's success in this direction proves conclusively that it is possible in free trade England to supply a thoroughly good cartridge at a very low price, and also to give full value for their money to those English sportsmen who desire damp-resisting, or other special qualities, when the cartridge-loader and the manufacturer of the components are one and the same firm; and, as a matter of fact, this achievement would not have been possible had it not been for England's fiscal policy.

Yours, &c.,

Birmingham, April, 1904. JNO. S. NETTLEFOLD.

CLAY BIRD SHOOTING IN IRELAND.

We have received the official programme of the Clay Pigeon Tournament to be held at Balls' Bridge, Dublin, in connection with the Mirus Fete and Bazaar, in aid of Mercer's Hospital. The tournament will commence on Monday, May 30th, and will continue until June 4th. The management is in the very able hands of Mr. W. R. Lane-Joynt, who has received a large measure of support by way of donations, both in cash and kind. Messrs. Eley Bros. have generously presented the whole of the traps and birds to be used throughout the meeting, free of all cost. Shooting will commence each day at 11 a.m. and continue till 7 p.m., with an interval from 1.30 to 2.30 for luncheon. The meeting will be conducted under the rules of the Clay Bird Shooting Association with a few special conditions to meet the needs of the present tournament. The competitions are of a very varied kind, including double-rise, handicap, and team events. Most of the competitions are for unlimited entries, and we trust that the meeting will be a great success from the point of view of shooting as well as financially.

The directors of the Nobel-Dymanite Trust announce that, having received particulars of the earnings of the subsidiary companies, they recommend the payment of a dividend of 8 per cent. for the past year, carrying forward about £11,000. This compares with a distribution of 7½ per cent. and a balance of £6,340 for the preceding 12 months; but for 1901-1902 the rate was 9 per cent. and for the two previous years 10 per cent.

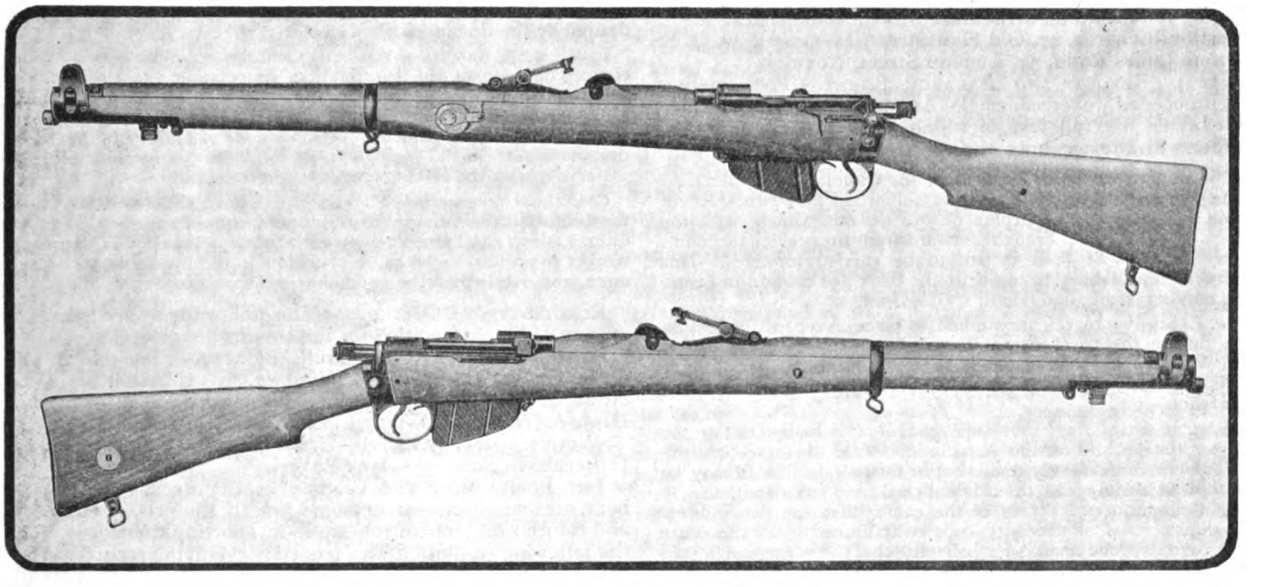
Presiding at the annual meeting of the Iron and Steel Institute, at Westminster recently, Mr. Andrew Carnegie presented the Bessemer Gold Medal to Mr. Hadfield, of Sheffield, for valuable services to metallurgy. Papers of a technical character were then read, special interest attaching to the description by Mr. Cosmo Jones of the practice of Messrs. Vickers, Sons, and Maxim in dealing with masses of steel of from 40 to 100 tons, which were treated and cooled in one operation.

Mr. John Parnell presided at the annual meeting of Messrs. F. Joyce & Co., Ld., and in moving the adoption of the report said that the year which had just closed had been the most disastrous on record to firms in any way connected with outdoor sport. Referring to the accounts, he said that of the £10,000 debentures authorised by the articles of association £6,500 had been issued. They had placed £400 to the reserve, and had reduced the goodwill by a like amount. The profits were £1,856, against £2,104 last year. Mr. Greenwood replying to Sir John Heron Maxwell said that the company primarily concerned in the purchase of Joyce shares was the Dynamite Trust; there was no amalgamation or absorption, but the shares had been acquired by that company, which had no further interest in Joyce's than these shares and the debentures. F. Joyce & Co. had an arrangement by which they supplied the Munitions Co. with goods at certain agreed rates, and *vice versâ*; but beyond that there was no partnership between them.

THE NEW SERVICE RIFLE.

IT is a decidedly unique experience for the War Office to give official permission to a newspaper to publish particulars of a new piece of equipment, and yet they recently granted our contemporary, the *Field*, the permission to write an account of the new service rifle. They placed full particulars at the disposal of the *Field* so that we are now in possession of highly accurate information concerning a very interesting departure in military rifles.

The accompanying illustrations give an excellent idea as to the general appearance of the new weapon, and it will be seen that great efforts have been made to combine military handiness with efficiency. While we all regret the inherent defects of the mechanism of the old weapon which have been allowed to remain unmodified in the new one, our sense of



disappointment must not detract from recognition of the importance of those changes which have been sanctioned. Chief among these is the shortening of the barrel which enables one type of weapon to be used for all classes of troops alike, the infantryman being thus able to use his old weapon when forming part of an improvised troop of horse. The excellent system of sighting which has been finally adopted will be accepted as a great boon. The Krag form of sight combined with a screw adjustment between the fixed elevations provides a means of obtaining the nicest possible fixing of the angle. The presence of a wind gauge enables a similarly exact refinement in side adjustment to be made, so that the wind deflection can be neutralised by altering the alignment of the sights instead of aiming off the bull.

The covered barrel and other details of construction have been too widely discussed for it to be necessary for us to specify them in the present connection. Among gunmakers the chief interest will naturally centre itself around the behaviour of the new barrel which is five inches shorter than that of the old rifle. Various ill-informed persons have endeavoured to condemn this alteration as an example of unsound practice on the part of the Committee. On the other hand there is good reason for believing from various sources of information that the long series of experiments which has been carried out at Enfield is likely to have resulted in the production of a really perfect shooting barrel far ahead of anything that has before been experienced. One well-known gunmaker at least has constructed no less than eight barrels under the new specification, and the results of shooting tests have convinced him that the quality of the work obtained is superior to anything that was previously thought possible even with the greater length of barrel. More than this it is reported that a new brand of steel has been made up into experimental barrels which appears to possess exceptional attributes in the way of minimising the deposits of nickel on the surface of the bore. This, as is well known, is the greatest source of trouble with existing types of military arms, at any rate in this country. Nothing so rapidly deteriorates the shooting properties of a barrel as the metallic ouling which so soon manifests its presence. Once there, it forms a hiding ground for the powder residue, so that corrosion sets in at a place where the cleaning rag cannot scour away the foreign matter.

The opening out of the barrel by deepening the rifling grooves towards the muzzle may quite reasonably be expected to enhance the ballistics of the short barrel so as to make them fully equal to those of the old. If, therefore, this desirable result is obtained during a substantial proportion of the barrel's life there is good reason for supposing that we have gained the advantages of a shortened rifle without sacrificing good qualities in other directions. In so far that rifle shooters and experts in general are possessed of very little accurate information concerning the behaviour of the new length of barrel it is regrettable to see the tendency which exists in so many quarters to condemn the new arrangement without trial. We for our part prefer to adopt an attitude of suspended judgment, which is at least more consistent with scientific enquiry, than condemning a practical contrivance by theoretical speculations which are unsupported by genuine knowledge.

THE GUNMAKERS' ASSOCIATION.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Gunmakers' Association was held at Effingham House on Wednesday, April 27th, at three o'clock in the afternoon, and there were present:—Messrs. H. J. Blanch (in the chair), C. Boswell, H. White, A. H. Gale, C E. Greener, John Rigby, A. E. Cole, J. T. Musgrave, R. T. Woulfe, and Max Baker.

MINUTES.—The minutes of the last Annual General Meeting were duly read and confirmed.

MESSAGES OF REGRET.—Messages of regret for inability to attend from a large number of members, were duly placed on record.

NEW MEMBERS.—The following having duly applied for membership, were elected members of the Association:—

James Herbert Burrow, 116, Fishergate, Preston.
Robert Ramsbottom, 81, Market Street, Manchester.
Westley Richards, 27, Old Hall Street, Liverpool.
Arthur James Rudd, 54, London Street, Norwich.

ANNUAL REPORT AND BALANCE SHEET.—The meeting then proceeded to consider the Annual Report, for the year under review, the full text of which is as follows, and this, together with the accounts was approved and passed:—

"The Report and Balance Sheet of the Gunmakers' Association for the year ended March 31, 1904, is submitted herewith. It will be seen that there is a surplus of £10 9s. 6d., which, with the balance of £97 13s. 7d. brought forward from the previous account, makes a surplus of £108 3s. 1d. to be carried forward. This amount is represented by cash at the bank £98 0s. 9d., in Secretary's hands 13s. 4d., and debtor's £9 9s. 0d.

The Executive regret very much to place on record the loss by death during the past year of three of the most respected and esteemed members of the Association These are Mr. Henry Wilkinson Latham, Mr. Thomas W. Webley and Mr. E. Wilson, of Norwich.

Storage of Mixed Explosives on Registered Premises.—During the past year the demand for the Association's card of storage instructions has been exceedingly small, but in this connection it may be said that so widely has the original card been circulated, and in addition unauthorised copies of the same, that the demand for fresh copies must of necessity be greatly limited. On the other hand there is good reason for believing that the storage of mixed explosives by gunmakers throughout the country is carried out with care and obedience to regulations which is not only recognised by H.M. Inspectors, but has resulted in a virtually complete absence of accidents such as were at one time unduly frequent. Instances of illegal interference with the rights under which mixed explosives are stored have been reported to the Association, and enquiry has shown that these are mostly due to the ignorance of local inspectors as to the interpretation of the rules laid down.

Chamber Sizes for Shot Guns.—The largest individual piece of work which has been carried during the past year to a final conclusion is the settlement of the vexed question of chamber sizes for all calibres between 4 and ·360 bore. So considerable has been the detailed work involved in this question that the Association has recently issued to its members a separate memorandum giving a full account of the task which has been accomplished. The debatable points which prevented the adoption of the earlier set of sizes have been met on the principle of mutual compromise. The result is that gunmakers are now in possession of a complete series of sizes which have been unanimously accepted by the ammunition makers. The dimensions finally agreed upon have been subjected to a system of careful mathematical scrutiny, whereby the practical utility of the sizes is fully assured. The Executive are happy to say that in this matter they have worked throughout in the closest agreement with the Birmingham and Provincial Gunmakers' Association, and this collaboration has been of the greatest mutual advantage. The memorandum concerning the new sizes was accordingly issued in the joint names of the two Associations.

Gun Marking Offences.—During the past year the Association has received extremely little information concerning alleged offences against the Merchandise Marks Act, and there is accordingly good reason for believing that this hurtful class of offence has practically ceased in this country. The Executive have, however, been informed of a very serious fraud of this nature which was perpetrated in India, and which they trust will be severely dealt with in that country.

The New Service Rifle.—The Executive received from the War Office a specimen of the new Lee-Enfield shortened rifle in response to a request they made for facilities to inspect the same. An opportunity was taken to show the rifle to any member of the Association who was personally interested therein, and advantage was extensively taken of this privilege. In returning the rifle the Executive expressed regret on behalf of the Association that the mechanism of the breech has not been re-modelled so as to afford a greater degree of stability. They also communicated the results of tests which were made to establish the influence on the recoil of the altered weight.

St. Louis Exhibition.—Last December the Association received a communication from the Commissioners of the St. Louis Exhibition notifying them of the fact that a representative gun exhibit would be greatly appreciated, the Commissioners offering special facilities to exhibitors by way of free show cases, free delivery and the services of an attendant to show off the goods. Notwithstanding the exceedingly short space of time available, the Association was able to secure exhibits from a considerable number of its members, the guns offered for exhibition being fully up to the level desired by the Commissioners.

Pistols Act.—In spite of the active efforts, not only of this Association, but also of the Birmingham Association, the Pistols Bill submitted at the last Parliament was duly passed into law, and although several important amendments were made at the last moment, the Act, as passed, represents a serious injury to the legitimate interests of the trade, without so far as can be seen, dealing materially with the evils it sought to alleviate.

Conditional Guarantee.—The Executive have under consideration the desirability, or otherwise, of adopting some form of sale conditions which shall protect the trade against unreasonable claims in respect to accidents, the cause of which it is impossible to determine, and over which the gunmaker can have no control."

ELECTION OF OFFICERS.—The following were elected officers of the Association for the coming year:—

Executive.—C. I. Annan, H. J. Blanch, C. Boswell, A. H. Gale, H. W. Gibbs, C. E. Greener, E. Harrison, H. W. Holland, J. T. Musgrave, J. V. Pape, W. L. Powell, J. Rigby, H. A. A. Thorn, H. White, L. B. Taylor. *Solicitor*—Reginald T. Woulfe. *Hon. Treasurer*—H. W. Holland. *Hon. Auditor*—F. Beesley. *Secretary*—Max Baker.

THE POSITION OF THE CARTRIDGE BUSINESS.—The members present discussed at some length the present position and future prospects of the trade in sporting cartridges, and the following resolution was passed:—"Having regard to the fact that the present tendency of the cartridge trade is to depreciate the reputation of best hand-loaded cartridges, the Executive are asked to consider the drafting of recommendations to the trade, defining a policy calculated to ameliorate the present adverse conditions."

THE ANNUAL DINNER.

THE Annual Dinner of the Gunmakers' Association took place at the Trocadero Restaurant on the evening following the Annual General Meeting. For various reasons the party present was decidedly smaller than in any previous year. This, however, did not detract from the pleasantness of the function. The Chair was taken by Mr. H. J. Blanch, who proposed the toast of the evening in a speech which was marked throughout by its good taste and practical grasp of all questions affecting the prosperity of the trade. Mr. Blanch certainly deserved a greater measure of support from those whom he has supported on previous occasions. Mr. A. T. Cocking and Mr. J. C. Irvine spoke in an exceedingly sympathetic tone concerning the aims and ambitions of the Association, and they both powerfully voiced a wish that the Gunmakers' Association should find a way of granting a closer representation to the allied trades, whereby the strength of a none too powerful industry should be better organised for work of a public character.

ROUND THE TRADE.

Mr. R. Wallis, the well-known gunmaker of Waterloo Bridge Road, died last month.

The affairs of Mr. E. G. Buck, lately trading as Buck & Co., have been placed in bankruptcy.

This year's Bisley will commence on the 11th and will terminate on Saturday the 23rd July.

We are pleased to hear that Mr. Charles Hobday is progressing favourably after a severe attack of illness.

Captain Willett, late King's Dragoon Guards, has been appointed secretary and manager of the Gun Club in succession to Mr. Battcock.

We understand that Mr. F. J. Cole of Cole & Son, Windsor, has decided to open on his own account at Cirencester. The district affords every scope for an energetic practical man.

Capt. A. P. H. Desborough has issued his report on the circumstances attending the accident which occurred in the drying house for guncotton at Messrs. Curtis's & Harvey's Cliffe factory.

The directors of Messrs. Holland and Holland, Ld., after placing £2,000 to reserve, recommend a dividend on the ordinary shares at the rate of 12 per cent. per annum for the year ended December 31.

Nobel's Explosives Co., Ld., have just issued their new season's price list for sporting cartridges, and it is interesting to note in this connection the success which has attended the issue of their Empire 33-grain powder.

The *Royal Cornwall Gazette* contained an article in its issue of the 21st ult., regretting the closing down that week of Messrs. Nobel's Perranporth factory near Truro, from the point of view of the loss of employment resulting.

The late Colonel John Lowther Du Plat-Taylor, C.B., a chairman of the Nobel-Dynamite Co., Ld., and vice-chairman of the British South African Explosives Co., Ld., left estate of the value of £15,983, including net personalty of £12,795.

Cotton Powder Ld. is the name of a new company which has been formed to take over the business of the Cotton Powder Co., Ld. The capital is £110,000, of which £50,000 will consist of 7 per cent. cumulative preference shares. There will be no initial public issue.

Mr. Walter Fletcher, for many years the able and inventive chief of S. W. Silver's gun department, has resigned that position and may be found at 46 Wilson Street, Finsbury, where he has started business on his own account. Being a thoroughly practical gunmaker he should receive a large amount of work from the trade in fitting and finishing.

H. M. Chief Inspector of Explosives has issued a circular letter to the trade calling attention to a draft New Order in Council for consolidating and bringing up to date the regulations relating to the packing of explosives. The rules seem to be explicit and to the point, in every way in fact an improvement on the present scattered orders in which the subject matter is just now being dealt with. On the other hand there seems good reason for supposing that the chief inspector will be asked to re-consider the rule that the date of manufacture of explosives consigned shall be stated on the label. The gunmaker would certainly be in a quandary when attempting to state this particular in respect to the contents of a box of cartridges. The powder-maker again would hardly know what date to assign to his product.

The shareholders in the Société Centrale de Dynamite have now sanctioned most of the proposals put forward by the directors for the purpose of disposing of the funds derived from the sale of shares in the Spanish Union Explosives Company. As a consequence, the sum of £20,000 will be applied to the purchase of new shares in the Mexican Dynamite Company, of which the Central Dynamite Company is already interested to the extent of one-third of the share capital. A second sum of from £20,000 to £24,000 is to provide for the purchase of shares in the Belgian Dynamite Company, and a third amount of £12,000 for the acquisition of shares in the Italian Explosives Company. It has also been decided to buy back 12,000 of the company's own shares from the subsidiary Nobel-Dynamite Company, but the question of cancelling this block and reducing the share capital accordingly has been postponed.

THE NEW RULES OF PROOF.

THE *London Gazette* of the 26th ult. contained the full text of the new rules of proof which come into force after the usual three months' notice, viz., with the commencement of August. The following is a complete excerpt of the same, except that we have only reproduced the two most important of the scales of proof. Special attention may appropriately be called to the manner in which the relation of bores to chamber sizes has been shown in Scale No. 4.

RULES, REGULATIONS, AND SCALES made in the Month of April, 1904, by the Gunmakers' Company and the Guardians of the Birmingham Proof House, under Authority of the Gun Barrel Proof Act, 1868.

WHEREAS in and by section 117 of the Gun Barrel Proof Act, 1868, the Gunmakers' Company and the Guardians of the Birmingham Proof House, in such Act and hereinafter referred to as "the Two Companies," are empowered, should they deem the proof or the rules, regulations and scales, stated in Schedule "B" to the said Act annexed, or any of them respectively, insufficient or inapplicable or unsuitable, on application to, and with the approval of, His Majesty's Principal Secretary of State for the War Department, to repeal or alter all or any of the rules and regulations, and all or any part of the scales respectively from time to time in force under the said Act for the proof of small arms, or of any classes of small arms, and to make, repeal, and alter any new rules and regulations, and any new scales in that behalf.

And whereas the rules, regulations and scales now in force under the said Act are the rules and regulations made in the month of February, 1896, and which were approved by the Most Honourable the Marquis of Lansdowne, K.G., Her Majesty's then Principal Secretary of State for the War Department, on the 10th March, 1896. And whereas, since the approval of the last-mentioned rules, regulations, and scales, improvements and alterations have been made in the manufacture of small-arms and of explosives for use in the same, in consequence of which alterations are necessary in such rules, regulations, and scales.

Now, therefore, the Two Companies, with the approval of the Right Honourable Hugh Oakeley Arnold-Forster, M.P., His Majesty's Principal Secretary of State for the War Department, do hereby repeal the said rules, regulations, and scales, made in the month of February, 1896, and in lieu thereof do make the following rules, regulations, and scales:—

SCHEDULE B.

CLASSIFICATION OF SMALL ARMS.

First Class.—Single barrelled muzzle-loading arms of smooth bore.

Second Class.—Double barrelled muzzle-loading arms of smooth bore.

Third Class.—Muzzle-loading rifled arms.

Fourth Class. Breech-loading arms of smooth bore.

Fifth Class.—Breech-loading rifled arms, not being of the Sixth, Seventh, and Eighth Classes.

Sixth Class.—Express breech-loading rifles.

Seventh Class.—Breech-loading rifled arms of a bore not exceeding ·315 of an inch, in which a cartridge capable of containing a full military Service charge of nitro powder is used.

Eighth Class.—Breech-loading rifled arms specially constructed for use with shot and bullet, having the whole, or a portion only, of their bore rifled, and not being of the Fifth Class.

Ninth Class.—Revolving arms and repeating pistols.

RULES OF PROOF.

1. There shall be three kinds of Proof, viz.:—Provisional, Definitive, and Supplementary. Provisional Proof is the first proof applied to barrels which, according to these rules, require two proofs. Definitive Proof is that applied as the second proof to

barrels which require two proofs, also that applied to those which require one proof only. Supplementary Proof is an additional one applied after the Definitive Proof, according to Rules 17, 18, and 19.

2. The descriptions of powder used in proof shall, except as provided in Rule 18, be as follows:—

That known as "Tower Proof," or "T.P.," which shall be of strength equal to Waltham Abbey "R.F.G. 2," and of a grain varying between Nos. 4 and 5; that known as Curtis's and Harvey's "T.S. No. 2"; that known as "Col. Hawker's Duck Gun Powder"; and the Nitro Powder known as "Cordite," or any other description of Nitro Powder which may hereafter, from time to time, be adopted by His Majesty's War Department. Provided, nevertheless, that, if any of the powders for the use of which this rule provides should be considered by the Two Companies unsuitable for the proof of any particular description of barrel, they shall have power to adopt such other Powder as they may consider to be most suitable, having first obtained the approval of His Majesty's Principal Secretary of State for the War Department.

3. The Shot used in proof shall be that known as "Soft Shot," size No. 6.

4. The Bullets used in proof shall be of Pure Lead, except as provided in Rules 13, 14, 16, 19, and 26, and of such forms as are hereinafter defined in the rules relating to the proof of the different classes.

5. The Wads used in proof shall be of Felt or other suitable material, and shall not exceed in thickness one diameter of the bore.

6. Barrels for arms of the First Class shall be proved once Definitively, and for those of the Second, Third, Fourth, Fifth, Sixth, Seventh, and Eighth Classes Provisionally and Definitively, except as provided in Rule 24. Provided, nevertheless, that barrels for arms of the Second and Third Classes, and for single barrelled arms of the Fourth and Fifth Classes, sent in a state for Definitive Proof, may, at the request, in writing, of the sender, be proved once only, according to the scale for Provisional Proof, and they shall receive a special Definitive Proof Mark, denoting that they have been so proved, as hereinafter provided in Rules 39 and 46.

7. Barrels for arms of the First Class shall be proved with T.P. Powder and a spherical bullet, according to Scale No. 1.

8. Barrels for arms of the Second Class shall be Provisionally Proved with T.P. Powder and a spherical bullet, and Definitively Proved with T.P. Powder and shot, according to Scale No. 2, or may be proved once only, as provided in Rule 6.

9. Barrels for arms of the Third Class shall be Provisionally and Definitively Proved with T.P. Powder and a cylindrical flat-ended bullet, according to Scale No. 3, or may be proved once only, as provided in Rule 6.

10. Barrels for Arms of the Fourth Class shall be Provisionally and Definitively Proved with T.P. Powder and shot, according to Scale No. 4. Barrels for single barrelled arms may be proved once only, as may be provided in Rule 6.

11. Barrels of arms of the Fifth Class shall be Provisionally Proved with T.P. Powder and a cylindrical flat-ended bullet. They shall be Definitively Proved with T.P. Powder and a Cylindrical flat-ended, or cylindro-conoidal bullet, according to Scale No. 3. Provided, nevertheless, that, should a barrel be chambered for a cartridge which cannot contain the Service Charge defined in the scale, it may receive a special Definitive Proof with a charge based upon the maximum service charge of such cartridge. Provided also that, should a barrel be intended to be used with a larger charge than the Service Charge defined in the scale, the sender shall declare the same in writing, and a special Definitive Proof based upon such declared Service Charge shall be applied. In each case the proportion of Proof Charge to Service Charge shall be the same as in the scale. Barrels which have received a special Definitive Proof under this Rule shall be marked as hereinafter provided in Rule 52. Barrels for single barrelled arms of this class may be proved once only, as provided in Rule 6.

12. Barrels for arms of the Sixth Class shall be Provisionally Proved with T.P. Powder and a cylindrical flat-ended bullet, according to Scale No. 3. They shall be Definitively Proved with T.S. No. 2 Powder and a flat-ended bullet, or such other form as may be, from time to time considered to be most suitable, according to Scale No. 5. Barrels proved under this rule shall be specially marked as hereinafter provided in Rule 53.

13. Barrels for arms of the Sixth Class, specially constructed for the use of nitro powders, shall be so declared in writing by the sender when presented for Definitive Proof. They shall be Definitively Proved with cordite powder, or such other nitro powder as the Two Companies may, under the provisions of Rule 2, consider to be most suitable, and with a nickel covered bullet, similar in form to that of the Service Cartridge for which the barrels are chambered, or of such other material and form as may be, from time to time, considered to be most suitable. The Service Charge shall be declared in writing by the sender, and the Proof Charge shall be such as shall give a stress not less than thirty per cent over that of the Service Charge, as may be readily ascertainable. Barrels proved under this rule shall be specially marked as hereinafter provided in Rule 54.

14. Barrels for arms of the Seventh Class shall be Provisionally Proved with T.P. Powder and a cylindrical flat-ended bullet, according to Scale No. 3. They shall be Definitively Proved with Cordite Powder, or such other Nitro Powder as the Two Companies may, under the provisions of Rule 2, consider to be most suitable, and a nickel covered bullet, of a similar form to that of the Service Cartridge for which the barrels are chambered, or of such other material and form as may be, from time to time, considered to be most suitable. The Proof Charge shall be such as shall give a stress not less than twenty-five per cent., and not more that forty per cent., over that of the Service Charge, as may be readily ascertainable. Barrels proved under this rule shall be specially marked as hereinafter provided in Rule 55.

15. Barrels for arms of the Eighth Class shall be Provisionally Proved with T.P. Powder and shot, according to Scale No 4 for the Fourth Class. They shall be declared in writing by the sender to be of the Eighth Class when presented for Definitive Proof, and shall be proved with T.P. Powder according to Scale No. 4, with a conical bullet one and three-quarters the weight of the Service Charge of Shot of the said scale, of a diameter suitable to that of the muzzle of the barrels. In case barrels are intended to be used with larger charges of powder than the ordinary Service Charges set forth in the said Scale No. 4, they shall be so declared in writing by the sender, and a Proof Charge proportionate thereto shall be applied. Barrels proved under this rule shall be specially marked as hereinafter provided in Rule 56.

16. Arms of the Ninth Class shall be proved with a cartridge of the maximum size suitable thereto, and containing such a charge of powder, and such a bullet, as, in the opinion of the Two Companies, will cover the Service Charge to be used. Revolving Arms shall be proved once Definitively in each chamber. Repeating Pistols shall be proved Definitively, and be fired with the number of shots the magazine will contain. Arms of the Ninth Class shall be marked as hereinafter provided in Rule 47.

17. Barrels for arms of the Fourth and Eighth Classes, in which Nitro Powders are intended to be used, shall be so declared in writing by the sender, and shall receive a Supplementary Proof, in addition to, and after, the Definitive Proof under Rules 10 and 15, with T.S. No. 2 Powder, according to Scale No. 6, which scale has been based on the ordinary Service Charges of the Nitro Powders now in general use, and which, in the opinion of the Two Companies, do not exert higher pressures than those recognised as Standard. In case barrels are intended to be used with larger charges of Nitro Powders than such ordinary Service Charges, then the quantities of powder and shot so intended to be used, shall be declared in writing by the sender, and a Proof Charge which the Two Companies may decide to be suitable shall be applied. Barrels proved under this rule shall be specially marked as hereinafter provided in Rule 57

18. Barrels for arms of the Fourth Class may, after having been Definitively Proved under Rule 10, and Supplementarily Proved under Rule 17, at the request in writing of the sender, receive a further Supplementary Proof with any particular description of Nitro Powder, in general use, named by him, with a Proof Charge which the Two Companies may decide to be most suitable. Barrels proved under this rule shall be specially marked as hereinafter provided in Rule 58.

19. Barrels for arms of the Fifth and Eighth Classes may, at the request in writing of the sender, receive a Supplementary Proof, in addition to, and after, the Definitive Proof, with Cordite Powder, or such other Nitro Powder as the Two Companies may, under the provisions of Rule 2, consider to be most suitable. The Service Charge shall be declared in writing by the sender, and such a Proof Charge of powder and such a bullet as the Two Companies may decide to be most suitable shall be applied. Barrels proved under this rule shall be specially marked as hereinafter provided in Rule 59.

20. For barrels of all Military Arms, sent for proof, manufactured for the British Government, the method of proof shall be the same as that employed by His Majesty's War Department.

21. Barrels for arms of the Fourth, Fifth and Eighth Classes of 8 Gauge having chambers of 4 inches and longer, those of 10, 12, and 14 Gauge having chambers of 3 inches and longer, and those of 16 to 32 Gauge having chambers of 2¾ inches and longer, shall be so declared in writing by the sender. They shall be Definitively Proved with one-sixth more powder than that used for ordinary Definitive Proof, and shall be marked with a special Chamber Mark, as hereinafter provided in Rule 50.

SCALE No. 4.
For the Proof of Arms of the Fourth Class.
(BREECH-LOADING ARMS OF SMOOTH BORE).
(See Rules 10 and 49.)

Nominal Size of Cartridge.	Gauges marked in Proof.	Diameter of Bore.	Provisional Proof.				Definitive Proof.				Service Charge.			
			Powder, T.P.		Shot.		Powder, T.P.		Shot.		Powder.		Shot.	
			grains.	drs.	grains.	oz.	grains.	drs.	grains.	oz.	grains.	drs.	grains	oz.
4	5-2	1·026	740	27	1421	3¼	492	18	1912	4⅜	246	9	1421	3¼
	5-1	1·001												
	5	·976												
	6-2	·957												
	6-1	**·938**	649	23¾										
	6	·919												
	7-2	·903												
8	7-1	·888	567	20¾	984	2¼	328	12	1312	3	164	6	984	2¼
	7	·873												
	8-2	·860												
	8-1	·847	492	18										
	8	**·835**												
	9-2	·824												
	9·1	·813	417	15¼										
	9	·803												
10	10-2	·793	348	12¾	711	1⅝	232	8½	930	2⅛	116	4⅛	711	1⅝
	10-1	·784												
	10	**·775**												
	11-1	·763	294	10¾										
	11	·751												
12	12-1	·740	266	9¾	547	1¼	178	6½	738	1 11/16	89	3¼	547	1¼
	12	**·729**												
	13-1	·719	260	9½										
	13	·710												
14	14-1	·701	246	9	492	1⅛	164	6	656	1½	82	3	492	1⅛
	14	**·693**												
	15-1	·685	239	8¾										
	15	·677												
16	16-1	·669	226	8¼	437	1	150	5½	574	1 5/16	75	2¾	437	1
	16	**·662**												
	17-1	·655	218	8										
	17	·649												
	18	·637	211	7¾										
20	19	·626	205	7½	383	⅞	136	5	520	1 3/16	68	2½	383	⅞
	20	**·615**	205	7½										
	21	·605	198	7¼										
	22	·596	198	7¼										
24	23	·587	191	7	355	13/16	123	4½	465	1 1/16	62	2¼	355	13/16
	24	**·579**	184	6¾										
	25	·571	184	6¾										
	26	·563	178	6½										
28	27	·556	171	6¼	328	¾	109	4	437	1	55	2	328	¾
	28	**·550**	164	6										
	29	·543	150	5½										
32	30	·537	144	5¼	246	9/16	82	3	328	¾	41	1½	246	9/16
	31	·531												
	32	·526	137	5										
	33	·520												
	34	·515												
	35	·510	130	4¾										
	36	·506												
	37	**·501**	123	4½										
	38	·497												

NOTE.—The Gauges and Diameters in bold type are those to which barrels are usually bored for Definitive Proof for use with the cartridges belonging to the groups in which they are included.

22. Barrels for arms of the Second and Fourth Classes, of a larger Gauge than 4, for which no charges are laid down in the scales applicable to such classes, shall be Provisionally Proved according to Scale No. 1 for the First Class.

23. Barrels for arms of the Second and Fourth Classes, of a larger Gauge that 4, sent for Definitive Proof, for which no charges are laid down in the scales applicable to such classes, shall have the Service Charge declared in writing by the sender, and the Proof Charge shall be twice the weight of powder and one and one-third the weight of shot of such Service Charge. The Service Charge shall be marked upon the barrels, as hereinafter provided in Rule 60.

24. Barrels for arms of the First, Second, and Fourth Classes of not less than 5 feet 6 inches long shall be proved once Definitively with Col. Hawker's Duck Gun Powder, and Shot. The Service Charge shall be declared in writing by the sender, and the Proof Charge shall be twice the weight of powder and one and one-third the weight of shot of such Service Charge. The Service Charge shall be marked upon the barrels, as hereinafter provided in Rule 60.

25. Barrels for arms of the First, Second, Fourth, and Fifth Classes which are Choke-bored shall be declared to be so, in writing, by the sender when presented for Definitive Proof. Choke-bored barrels are such as have the diameter of the bore at the muzzle less than at some point behind the muzzle, other than the chamber, or the cone or the lead in front of the chamber. Barrels which are choked ·004 of an inch may, at the request in writing of the sender, be marked, and those which are choked ·008 of an inch

shall be marked, when proved, as hereinafter provided in Rule 51 Barrels which are choked ·008 of an inch or more, and not marked as provided in Rule 51, are required to be reproved.

26. A barrel of any description for which the Classification and Scales of Proof do not provide, or to which the said scales are, in the opinion of the Two Companies, inapplicable or unsuitable, shall be proved with such a charge of powder, and such a bullet or charge of shot, as in their opinion, is most suitable for such barrel, and they may, if they think fit, require the Service Charge to be declared by the sender. In case a barrel shall not be capable of containing such a Proof Charge, as large a charge as the barrel will contain shall be applied. Barrels proved under this rule shall be marked as hereinafter provided in Rule 61.

27. Whenever a barrel is sent for proof, chambered for a cartridge of unusual size, or of a pattern not in general use, the cartridge case required to prove such barrel shall be provided by the sender.

28. The Two Companies will not be responsible for the proper proof or marking of, and refuse to prove, barrels which, according to Rules 13, 17, 18, 19, 21, 23, 24, and 25, require special Definitive Proof, Supplementary Proof or special marking, unless such barrels are accompanied by the necessary requests or declarations, defined in the said rules, when presented for proof. Provided always that the Two Companies may prove and mark barrels unaccompanied by any request or declaration in such a manner as, in their opinion, such barrels should be proved and marked.

29. Should a barrel be presented for any special or Supplementary Proof, which, though it may belong to a class to which such proof may be applicable, is unsuited to such proof, the Proof Master of the Company to which it is presented may refuse to prove it. He may also refuse to prove a barrel declared to be of a certain class, which is not of such class, except for the class to which it should belong.

30. If a barrel, which has already been proved and marked with the Definitive Proof and View Marks, be again presented for Definitive or Supplementary Proof, and shall fail to stand proof, the person or persons, respectively, who is or are entitled to impress the Proof and View Marks, shall efface the existing marks of Definitive and Supplementary Proof therefrom. Should a barrel which has obviously been weakened after Definitive Proof be brought to the notice of the Proof Master of either of the Two Companies, it may be re-proved Definitively, without the consent of the owner. Should a barrel be brought to the notice of the Proof Master of either the Two Companies which is in such a condition that it would be impossible to re-prove it, or to properly view it, the marks of Definitive and Supplementary Proof may be effaced therefrom by the beforementioned person or persons.

31. Any barrel which may have been enlarged in the bore after Definitive Proof, so that the Bore Mark impressed upon it at proof is not a true representation of the diameter, shall be required to be re-proved Definitively, and if it shall have received a Supplementary Proof, it shall be required to be re-proved Supplementarily; such for example, as an enlargement from $\frac{9}{2}$ to 8 or $\frac{13}{4}$ to 12, as set forth in the Scale No. 4.

32. The various powders used in proof shall, at all times, be open to the inspection, without notice, of any officer authorized for the purpose by the Secretary of State for War, who may take samples of the same for examination or trial.

CONDITIONS PRECEDENT TO PROOF.

33. Barrels for arms of the First Class sent for proof shall be bored and ground, and in a proper state for setting up, with the squares set off, looped, and the proper breeches in, with the thread of the screws sound and full. Barrels for percussioned arms shall be percussioned and have nipples in. Twisted barrels shall be fine bored and struck up.

34. Barrels for arms of the Second, Third, Fourth, Fifth, Sixth, Seventh, and Eight Classes:—

For Provisional Proof.—Barrels of plain metal shall be fine bored and turned or ground, and those of twisted metal shall be struck up in addition. They shall have plugs attached, with touch-holes drilled in the plugs of a diameter not exceeding one-sixteenth of an inch.

For Definitive Proof.—All barrels shall be struck up and smoothed, the insides shall be clean, the ribs fairly struck up, and such as are Muzzle-loading shall have breeches properly percussioned, huts filed up, the proper breeches and nipples attached, with the thread of the screws sound and full. Barrels for rifled arms shall be rifled.

35. Barrels for Breech-loading arms shall be Definitively and Supplementarily Proved with the action attached. The action shall be finished or in the finished filed state.

36. Revolving Arms shall have the cylinder or chambers with the revolving action and firing work complete and in working order. Repeating Pistols shall be complete and in working order, with the magazine attached.

PROOF MARKS.

37. The mark denoting Provisional Proof shall be as follows:—

As to the Gunmakers' Company.
The letters "G P" interlaced in a cypher surmounted by a Lion Rampant, thus:—

As to the Guardians.
The letters "B P" interlaced in a cypher surmounted by a Crown, thus:—

38. The marks denoting Definitive Proof shall be as follows:—

As to the Gunmakers' Company.
The Proof Mark, being the letters "G P" interlaced in a cypher surmounted by a Crown, and the View Mark, being the letter "V" surmounted by a Crown, thus:—

As to the Guardians.
The Proof Mark, being the letters "B P" surmounted by a Crown, and the View Mark, being the letters "B V" surmounted by a Crown, thus:—

39. The mark denoting the special Definitive Proof of barrels proved once only, according to Rule 6, shall be as follows:—

As to the Gunmakers' Company.
The letters "V G P" interlaced in a cypher surmounted by a Lion Rampant, thus:—

As to the Guardians.
The letters "V B P" interlaced in a cypher surmounted by a Crown, thus:—

40. The special Proof Mark applied to barrels proved for use with Nitro Powders, according to Rules 13, 14, 17, 18, and 19, shall be as follows:—

As to the Gunmakers' Company.
The letters "N P" surmounted by an Arm Dexter in Armour, embowed, holding a Scimitar, thus:—

As to the Guardians.
The letters "N P" surmounted by a Crown, thus:—

MODE OF AFFIXING MARKS.

41. On barrels Provisionally Proved the Provisional Proof Mark, as set forth in Rule 37, shall be impressed near the breech end.

42. On barrels for Muzzle-loading arms of the First Class, which, according to Rule 6, require Definitive Proof only, the Definitive Proof Mark and View Mark, as set forth in Rule 38, shall be impressed upon the Round near the breech end, and if a barrel is constructed with a Patent Breech the View Mark shall be impressed thereon.

43. On barrels for Muzzle-loading arms of the Second and Third Classes the Definitive Proof Mark and View Mark, as set forth in Rule 38, shall be impressed above the Provisional Proof Mark, and if a barrel is constructed with a Patent Breech the View Mark shall be impressed thereon.

44. On barrels for single Breech-loading arms of the Fourth, Fifth, Sixth, Seventh, and Eighth Classes the Definitive Proof Mark and View Mark shall be impressed in a convenient position near the Provisional Proof Mark, and the View Mark shall be impressed upon the Action, Body, Shoe, Breech Block, Breech Bolt or Chamber, with which the barrel is connected.

45. On barrels for double Breech-loading arms of the Fourth, Fifth, Sixth, Seventh, and Eighth Classes the Definitive Proof

Mark and View Mark shall be impressed upon the Flat of each barrel at the breech end, or in a corresponding position when there are no Flats, or, at the request in writing of the sender, may be impressed upon the Round of each barrel, and the View Mark shall be impressed upon the Action, Body, Shoe, Breech Block or Blocks, Breech Bolt or Bolts, Chamber or Chambers, with which the barrels are connected.

46. On barrels for arms of the Second and Third Classes, and for single barrelled arms of the Fourth and Fifth Classes, proved once only, according to Rule 6, the special Definitive Proof Mark, as set forth in Rule 39, shall be impressed in the same position as the View Mark occupies according to Rules 43 and 44.

47. On Revolving Arms of the Ninth Class the Definitive Proof Mark and View Mark shall be impressed upon the Barrel and upon the Revolving Cylinder, and the View Mark shall be impressed upon the Frame or Body of the Action. On Repeating Pistols of the same class the Definitive Proof Mark and View Mark shall be impressed upon the Barrel, and the View Mark shall be impressed upon the Action, Body, Shoe, Breech Block or Blocks, Breech Bolt or Bolts, with which the barrel is connected.

SCALE No. 6.

For the Supplementary Proof with "T.S. No. 2" Powder of Arms of the Fourth Class, in which Nitro Powders are intended to be used.

(See Rule 17).

Number of Gauge.	Powder, T.S., No. 2.		Shot.	
	Grains.	Drams.	Grains	Ounces.
4	301	11	1805	$4\frac{1}{8}$
8	218	8	1312	3
10	150	$5\frac{1}{2}$	903	$2\frac{1}{16}$
12	116	$4\frac{1}{4}$	711	$1\frac{5}{8}$
12 extra	137	5	738	$1\frac{11}{16}$
14	109	4	656	$1\frac{1}{2}$
16	102	$3\frac{3}{4}$	602	$1\frac{3}{8}$
20	95	$3\frac{1}{2}$	574	$1\frac{5}{16}$
24	89	$3\frac{1}{4}$	520	$1\frac{3}{16}$
28	82	3	492	$1\frac{1}{8}$
32	62	$2\frac{1}{4}$	355	$\frac{13}{16}$

48. On barrels for all arms, except those of the Ninth Class, the Nominal Size of the Bore shall be impressed at Definitive Proof. This may be indicated by the number of balls to the pound, as 12, 16, 20; by decimal parts of an inch, as ·577, ·450, ·303; or by millimetres, as 8 m/m, 7 m/m, 6·5 m/m, as may be most convenient or most suitable.

49. On barrels for arms of the Fourth and Eighth Classes, from 4 to 10 Gauge inclusive, the gauges shall be divided in three parts, and the barrels shall be marked accordingly; thus the divisions of 8 Gauge would be marked 8, $\frac{8}{1}$, $\frac{8}{2}$. From 11 to 17 Gauge inclusive, the Gauges shall be divided into two parts; thus the divisions of 12 Gauge would be 12, $\frac{12}{1}$; and so on, as provided in Scale No. 4. The Gauge Size of the barrel shall be taken at a point nine inches from the breech end.

50. On barrels for arms of the Fourth, Fifth, and Eighth Classes the Chamber Size, for the Gauges set forth in Scale No. 4, shall be impressed, following the Definitive Proof Mark, enclosed in a device, as for example:—

barrels proved according to Rule 21 shall be impressed with the "L C" signifying Long Chamber, as for example:—

51. On barrels for arms of the First, Second, Fourth, and Fifth Classes, which are Choke-bored, the word

CHOKE

shall be impressed following the Definitive Proof Mark or the Chamber Mark.

52. On barrels for arms of the Fifth Class, which have received a special Definitive Proof as provided in Rule 11, the nominal size of the cartridge for which they are chambered shall be impressed near the Definitive Proof Mark, followed by the weight, in grains, of the powder and bullet of the maximum Service Charge to be used, as for example:—

360 14—134.

53. On barrels for arms of the Sixth Class, Definitively Proved according to Rule 12, the nominal size of the cartridge for which they are chambered shall be impressed, in decimal parts of an inch, near the Definitive Proof Mark, followed by the abbreviation "EX," signifying Express, with the weight, in grains, of the powder and bullet of the maximum Service Charge to be used, as for example:—

577 EX 167—610

54. On barrels for arms of the Sixth Class, Definitively Proved according to Rule 13, the nominal size of the cartridge and the abbreviation "EX" shall be impressed, as provided in Rule 53, followed by the special Proof Mark as set forth in Rule 40, the name of the powder used in proof, or a suitable abbreviation thereof, the weight, in grains, of the powder and bullet of the maximum Service Charge to be used, and an abbreviation of the word "Maximum," as for example:—

CORDITE 75—480 MAX

55. On barrels for arms of the Seventh Class, Definitively Proved according to Rule 14, the Special Proof Mark, as set forth in Rule 40, shall be impressed, in addition to the marks of Provisional and Definitive Proof, followed by the words

NITRO PROVED

56. On Barrels for arms of the Eighth Class, Definitively Proved according to Rule 15, which are Rifled through their full length, the letters "S & B," signifying Shot and Bullet, shall be impressed following the Definitive Proof Mark or Chamber Mark, thus:—

S & B

On barrels which are Choke-bored, the word "Choke," preceded by the letter "R," signifying Rifled Choke, shall be impressed, following the Definitive Proof Mark or Chamber Mark, thus:—

R CHOKE

On barrels which have been proved for larger Service Charges of powder than those set forth in Scale No. 4, the Service Charge shall be impressed, in drams or grains, as may be considered most suitable, following the above-mentioned marks, as for example:—

4 dr or 109 gr

57. On barrels for arms of the Fourth Class, which have received a Supplementary Proof according to Rule 17, the special Proof Mark, as set forth in Rule 40, shall be impressed, in addition to the existing marks of Provisional and Definitive Proof, followed by the words "Nitro Proof," with the weight of the maximum Service Charge of shot to be used, as for example:—

NITRO PROOF $1\frac{1}{8}$

On barrels for arms of the Eighth Class, proved under the same rule, the word "Shot" shall be impressed in addition, as for example:—

NITRO PROOF $1\frac{1}{8}$ SHOT

58. On barrels for arms of the Fourth Class, which have received a Supplementary Proof with a particular description of Nitro Powder, according to Rule 18, the name of the powder used in proof, or a suitable abbreviation thereof, shall be impressed, in addition to the existing marks of Provisional, Definitive, and Supplementary Proof, with the weight of the powder, in grains, and the shot, in ounces, of the maximum Service Charge to be used, as for example for "Schultze" Powder:—

SCH 42—$1\frac{1}{8}$

59. On barrels for arms of the Fifth Class, which have received a Supplementary Proof according to Rule 19, the special Proof Mark, as set forth in Rule 40, shall be impressed, in addition to the existing marks of Provisional and Definitive Proof followed by the name of the powder used in proof, or a suitable abbreviation thereof, with the weight, in grains, of the powder and bullet of the maximum Service Charge to be used, and an abbreviation of the word "Maximum," as for example:—

CORDITE 32—750 MAX

On barrels for arms of the Eighth Class, proved under the same rule, the same Marks of Proof shall be impressed as for the Fifth Class, followed by the name of the powder used in proof, or a

suitable abbreviation thereof, with the maximum weight, in grains, of the bullet of the Service Charge, the word "Bullet," and an abbreviation of the word "Maximum," as for example:—

CORDITE 750 BULLET MAX

60. On barrels proved according to Rules 23 and 24, the Service Charge shall be impressed, in drams and ounces, near the Proof and View Marks.

61 Barrels proved according to Rule 26, shall receive such mark or marks, in addition to the Proof and View Marks, as the Two Companies may consider necessary or most suitable.

TRADE MARKS.

APPLICATIONS ADVERTISED. MAR. 30—APR. 20, 1904.

261,276. A. C. Argles, London. The word "DEDONITE." To apply to Gunpowder. February 23, 1904.

REGISTERED. MARCH 17—APRIL 14, 1904.

260,103. The Webley & Scott Revolver and Arms Co., Ld.
260,142. L. Jeffries.

APPLICATIONS FOR PATENTS.

MARCH 21—APRIL 16, 1904.

27,044D* Torpedo Ejecting Apparatus. G G. M. Hardingham. (Date applied for December 10, 1903.)
6,802. Single-Trigger Mechanism. H. Price.
6,878. Electrical Ignition Apparatus. A. Eckstein and H. J. Coates.
6,916. Percussion Fuse. A. Reichwald (Agent for *Fried. Krupp, Ag.*).
6,943.* Safety Fuse. C. Koch.
7,038.* Bullets. H. Platz.
7,072. Automatic Firearms. S. Sanders and C. Brown.
7,157. Single-Trigger Mechanism. J. Carter.
7,218. Shields for Field Guns B. Behr.
7,219. Ordnance. B. Behr.
7,307. Sight Adjusting Apparatus. G. Forbes.
7,311. Ammunition Belts. A. T. Dawson and G. T. Buckham.
7,336. Sporting Gun Sights. L. G. Fenzi.
7,348. Magazine Rifles. C. Ryland.
7,410. Steering Torpedoes. W. Whitehouse.
7,490.* Explosive. C. J. Rusher and G. W. Baudinet.
7,593. Small-Arms P. T. Godsal.
7,607. Firearms. J. W. Miller and Sir A. J. Compton-Thornhill.
7,616. Range-Finder. C. F. T. Wyndham-Quin.
7,647. Ordnance. W. R. Swain.
7,746. Single-Trigger Mechanism. W. J. Whiting.
7,770. Shot Gun Cartridges and Wads. G. Bathgate.
7,818.* Cooling Gun-Barrels. H. H. Lake (Agent for *Fried. Krupp, Ag*).
7,882. Projectile Caps. R. A Hadfield.
7,961. Projectile Discharge. G. Slater.
7,991. Miniature Rifle Targets C. E. Luard.
8,037. Projectiles. J. R. Hoyle and A. Anderson.
8,041.* Dinitroglycerin Explosive. A. Mikolajczak.
8,061.* Torpedo Steering. F. McD. Leavitt. (Date of application in U.S.A., November 30, 1903.)
8,121. Sighting Apparatus. L. G. Fenzi.
8,181. Rifle Magazine Charger. L. S. Hollings.
8,195. Projectile Fuses. H. Stanbridge and W. Walker.
8,261. Signalling Gun. E. Blakemore.
8,448. Shot Box. J. H. Allcock.
8,518. Destroying Torpedoes. F. S. Pett.
8,678. Explosives T. G. Tulloch.
8,688.* Explosive Projectiles. J. F. Meigs and E. Gathmann. (Date of application in U.S.A., October 29, 1903.)
8,718. Rifle Sights. A. S. B. Steinmetz.
8,742. Rifle Bullet. H. C. Law.
8,759. Small-Arms. H. and C. Gamwell.
8,761.* Air Guns. L. Jeffries.
8,773. Firearms and Ammunition. P. Partridge.
8,811. Small-Arm and Ordnance Sights. L. G. P. Thring.
8,814.* Folding Rifle Support. J. Livtschak.

* These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

MARCH 31—APRIL 21, 1904.

COMPILED BY HENRY TARRANT.

1,462 (1903). **Rangefinders.** A. Barr, Glasgow, and W. Stroud, Leeds. The various parts of rangefinders described in patents Nos. 9,520, 1888; 13,507, 1893; and 3,172, 1901, are modified and combined in an instrument working on the coincidence principle. The reflectors or "optical squares," the prisms which direct the beams of light to the eyepieces, the support of the parts in short base rangefinders, the method of indicating ranges, and the adjusting of these instruments are all dealt with in this specification. Accepted March 21, 1904.

5,091 (1903). **Targets.** J. Chadwick, Fenny Stratford An arrangement of target apparatus on the windmill system in which the targets are placed at right angles one with the other, relatively to a rotative centre. When one target is exposed, the other lies under cover of an embankment or mantlet. A weight placed in an angle of the square frame, upon two sides of which the targets are fixed, acts as a counterpoise and imparts a pendulum motion when the targets are swung from one position to another. Accepted March 5, 1904.

5,679 (1903). **Automatic Gun Mechanism.** A. T. Dawson, and L. Silvermann, London. Several modifications in automatic gun mechanism of the Maxim type are dealt with in this specification. The lock is so constructed as to be capable of removal after the detachment of the sear, the safety sear and the cocking arm, which are mounted upon a transverse axle and are actuated by a common spring. A part prevents the return movement of the lock if it should fail to complete its rearward stroke; and a helical recoil spring may be easily removed and replaced. The firing parts, the ejector spring, and the feed block also fall within the scope of the patent. Accepted March 10, 1904.

5,971 (1903). **Instrument for Sighting from Cover.** W. Youlten, London. A number of improvements in the "hyposcopic" instruments described in patents Nos. 15,273 and 20,896, of 1900, and 24,814, 1901, are set out in this specification. The hyposcope is adapted for use at any range by the provision of a rack and pinion, which elevate the device and cant it simultaneously; or the device may be used as a back sight, being graduated and marked for that purpose Lateral adjustment is also provided for, and the methods of fixing the instrument to a rifle are dealt with. Accepted Mar. 14, 1904.

9,035 (1903). **Disappearing Targets.** D. Gilmore, Belfast. Through the medium of a combination of levers and pulleys arranged principally within a box, a number of figures are actuated in an erratic manner, and are caused to appear one at a time in view of an air-gun shooter. The target remains exposed for a certain predetermined length of time which is alterable. The marks may be caused to move, and when struck by a bullet a bell records the hit. Accepted Mar. 24, 1904.

9,490 (1903). **Working Heavy Ordnance.** A. Dawson, London, and J. Horne, Barrow-in-Furness. A turret gun-mounting having two guns so geared together that they are capable of simultaneous elevation and sighting, by means of either one of three sighting and elevating gears situated one on either side of, and one between, the guns. The guns may be fired separately or simultaneously from either sighting station. Projectile and ammunition hoisting cages are dealt with at length, the modified arrangements tending towards facility of loading the cages and rapidity of ammunition supply at the gun platform. Accepted March 31, 1904.

10,231 (1903). **Automatic Gun Loading.** Sir W. G. Armstrong, Whitworth & Co., Ld., and G. Henderson, Newcastle-on-Tyne. The automatic loading of a cartridge from the hopper into the gun chamber is provided for when the gun is elevated, by an arrangement which compresses the injector spring proportionately as the elevation is increased. The necessary additional power is in this way created. The loading apparatus may be cocked by the pulling of a hand lever in order to allow the first cartridge to be automatically loaded into the gun. Accepted March 10, 1904.

10,364 (1903). **Automatic Firing of Ordnance.** L. Obry, Austria. Automatic firing of ordnance—when the axis of the gun presents the desired angle to the horizon—is provided for by the

device described in patent No. 14,990, 1900. The disadvantage of the mounting of this device is its rigidity, the recoil being communicated directly to the apparatus. The present patent deals with a method of mounting the arrangement on springs, so that it is free to oscillate around its point of suspension. Oppositely acting springs return it after recoil to its normal position. Accepted March 10, 1904.

10,409 (1903). **Rangefinder**. C. A. de la Maza, Chili. A telemeter in which two telescopes are arranged upon a common base. One telescope is fixed at right angles to the base of known length, and the other telescope is movable. When the two telescopes are trained upon one object, the movement of one in focussing is communicated to a gruadated wheel, which indicates the angle formed by the hypothenuse and the base. From the angle and the known length of the base, the distance of the object or the measurement of the other side of the right-angled triangle is discovered. Accepted March 10, 1904.

10,794 (1903). **Field Gun Carriages.** A. T. Dawson and G. T. Buckham, London. A field gun carriage in relation with which the gun can be caused to assume such a position that its weight may be distributed over the wheel-axle of the carriage and of the limber when travelling. The gun, the cradle and the top carriage are so arranged as to be capable of sliding longitudinally on the trail, the cradle being trunnioned in the top carriage. Accepted March 17, 1904.

10,836* (1903). **Blasting Explosive.** A. Brock, Sutton.

10,916 (1903). **Quick-Firing Ordnance**. A. T. Dawson and G. T. Buckham, London. A method of facilitating the sighting and working of quick-firing ordnance, consisting in arranging the elevating and training gear so that the operations may be independently performed by three men. The arrangement of the gear is such that when man No. 1 receives instructions from the officer, he sets the sights; No 2 is caused to elevate the gun; and No. 3 to give lateral direction to it. No. 2 then fires the gun. Accepted March 24, 1904.

10,948* (1903). **Rifle Foresight Protector**. F. Flatman, Erith.

11,191 (1903). **Rifle Rack**. H. Weddall, Carlton R.S.O., and A. E. Hobson, Snarth R.S.O. A rifle rack, adapted principally for stacking rifles round a tent pole or poles consisting of a circular piece of wood divided transversely and hinged at one end. The other end is provided with a thumb-screw by means of which the rack is clamped to a tent pole. Around the periphery a series of recesses are provided to receive the rifle barrels, and inside each recess is a clip adapted to retain the rifle therein. Accepted March 17, 1904.

11,440 (1903). **Blasting Explosive**. W. J. Orsmann, Gathurst. A detonating blasting explosive consisting essentially of powdered aluminium in combination with a highly oxidised compound. Explosives composed as follows are said to be non-sensitive to flame or percussion, but may be readily detonated by fifteen grains or even less of fulminate of mercury:—(1) Aluminium, 7 parts by weight; nitrate of ammonium, 93 parts by weight. (2) Aluminium, 10 parts; nitrate of ammonium, 50 parts; nitrate of potash, or nitrate of soda, 40 parts by weight. Accepted March 17, 1904.

11,819 (1903). **Manipulating Quick-Firing Ordnance.** A. T. Dawson and G. T. Buckham, London, In patent No. 10,916, 1903 (briefly dealt with above) a method of combining sighting, training and elevating gear so that the different operations might be performed by three men from either or both sides of the mounting was described. According to the present patent a complete set of sighting, elevating and training gear is provided on each side of the gun, the elevating gear on one side being thrown out of gear when the elevating gear on the other is to be worked. Graduated drums for indicating range and deflection are also dealt with. Accepted March 24, 1904

12,881 (1903). **Bullet Casting Machine**. F. Wicks, Esher. In patent No. 21,645, 1902, apparatus for casting bullets was described. The device worked on the system of rotary type-casting machines. Such apparatus is provided with a shield around the mould wheel, wherein the bullets are cast. The shield is, according to the present patent, provided with channels through which the air from the moulds can escape as the molten metal enters. Accepted March 31, 1904.

13,548 (1903). **Telescopic Sight Mounting.** L. B. Taylor, Birmingham. A mounting for small-arm telescopic sights adapted to allow of the sight being centrally arranged over the weapon without interfering with the opening of the breech for loading or ejecting. The telescopic carrier is hinged to a fixed bed, so allowing the telescope to partake of an angular motion in a vertical plane. Limited movement in a horizontal plane is also arranged to allow of adjustment. The sight may be dismounted without the aid of tools. Accepted March 24, 1904. *

13,976 (1903). **Wheel Tyre Brakes for Ordnance**. A. Reichwald, London (Agent for *Fried. Krupp, Germany*). In wheel tyre brakes of the Lemoine type for ordnance, a torsionally acting spring is provided between the apparatus for applying the brake and the brake ropes for the purpose of reducing the space taken up by the springs hitherto employed. The torsional spring may be placed in the hollow of the central portion of the axle for compactness, and is in two portions of equal length coiled in opposite directions. Accepted March 10, 1904.

27,430 (1903). **Naval Gun Sighting**. V. J. Pontet, France. A sight for naval purposes in which the correction of mis-pointing in height caused by the ship, is obtained by means of mechanism adapted to preserve a fixed direction in space, is movable on an axis constantly normal to the firing plane, and is adapted to displace the sighting line until the necessary correction is made. Accepted March 17, 1904.

2,837 (1904). **Air Gun Plunger**. J. Lane, London. In air guns generally in use the plunger, when driven by its spring to the end of the cylinder, imparts vibrations to the gun by reason of its solid impact with the cylinder head. The invention described in this patent consists of a yielding plunger head which is attached to a lighter plunger. The vibrations are eliminated and straight holding is not interfered with. Accepted March 10, 1904.

4,493* (1904). **Bullet Mould.** J. W. Anderson, U.S.A.

* These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

BLASTING EXPLOSIVE.

10,836 (1903). A. Brock, of the firm of C. T. Brock & Co., Sutton. A compound primarily intended as a blasting explosive, but which may be used in signal rockets, is dealt with in this specification. The explosive is designed to be safer to handle, and to be less liable to spontaneous combustion or decomposition than other mixtures. It may be ignited by a fuse or a quick match, although a detonator may, if necessary, be used.

The explosive is composed of a mixture of powdered aluminium and any of the oxides of lead in the form of powder; powdered aluminium and nitrate of lead; powdered aluminium and nitrate of baryta; or of powdered aluminium and nitrate of potash. The proportions in which these materials may be mixed vary within wide limits. Good results are obtained by mixing the ingredients together in the proportion of 5 parts of aluminium powder to 25 parts of oxide or nitrate also in powder. The explosive so formed is placed in a cartridge case and is fired through the medium of a quick match or a Bickford fuse.

Although pure aluminium gives the highest ballistic results, a portion of this ingredient may be replaced by zinc or tin if the explosive is to be used for blasting marl or coal. The patentee has discovered that a mixture consisting of half the explosive described, and half of another explosive composed of aluminium and a chlorate (protected by patent No. 2,977, 1903) gives very good results. In some cases a small proportion of carbon is added to the explosive mixture to improve combustion. Accepted March 10, 1904.

A BULLET MOULD.

4493 (1904). J. W. Anderson, Jun., U.S.A. A hand-operated bullet mould is dealt with in this specification. The mould is designed to expedite the operation of moulding bullets. The solidification of the metal within the mould takes place almost immediately, and the removal of the surplus metal from the base of the bullet, and its ejection from the mould may be effected as

soon as the moulding cavity is completely filled. The parts of the mould are designed so that the whole implement shall lie comfortably within the hand of the operator.

The instrument is illustrated in the appended drawings It consists principally of three limbs, *a*, *b* and *c*. The parts *a* and *b* carry mould sections *d* and *e*, and are pivoted together near to their ends. The straight part *a* is recessed at *f*, and in this recess the part *c* is pivotally mounted. The part *b* is held normally in the position indicated by dotted lines in Fig. 1 by the spiral spring *g*,

Fig. 1

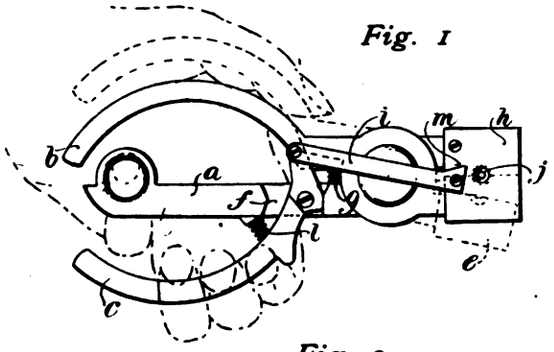


Fig. 2

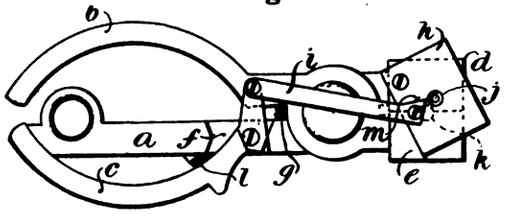


Fig. 3

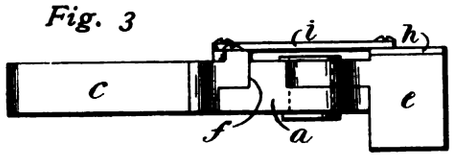
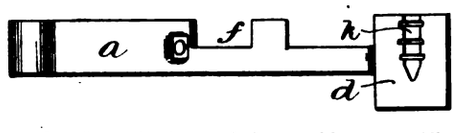


Fig. 4



which is adapted to force the jaws of the mould apart. The plate *h* is pivoted, as is illustrated, upon the top of the mould section *d*, and is of the same area as the two sections when in contact. The plate *h*, which is connected with the lever *c* by the link *i*, is provided with a funnel-shaped opening *j*, through which the metal is poured into the mould *k*. The bottom edge of the opening *j* is sharp, and this edge is caused to shear off the surplus metal from the base of the bullet when the lever *c* is pressed inwards against the action of its spring *l*.

When using the mould the parts are held as is illustrated in Fig. 1. The thumb operates the handle *b*, the little finger is inserted in the circular opening in the end of the limb *a*, and three fingers engage the cutting lever *c*. At the beginning of the moulding operation, the little finger and thumb are contracted so as to bring the mould sections into contact to form a complete mould *k*. The three fingers are relaxed, so that the spring *l* holds the lever *c* at the outward limit of its movement, and draws the opening *j* immediately over the mould cavity *k*. The metal is poured into the mould and it solidifies almost immediately. Still holding the mould jaws together, the three fingers are caused to exert pressure to force the plate *h* through the medium of the link *i* to the position illustrated in Fig. 2. The surplus metal is in this manner cut away from the base of the nearly solid bullet in the mould, and the lug *m* on the link *i*, as the plate *h* turns upon its pivot, dislodges the cut away metal from the top of the plate. The pressure of the hand is entirely relaxed when the position illustrated in Fig. 2 is attained, and the springs *g* and *l* separate the mould jaws and force the part *c* out to its normal position. The bullet is dropped out of the mould into a vessel containing water for cooling. Accepted March 31, 1904.

RIFLE FORESIGHT PROTECTOR.

10,948 (1903). F. Flatman, Erith. The foresight protector dealt with in this specification is designed especially for the latest pattern service rifle—the Lee-Enfield rifle modified—and instead of fitting around the barrel it is constructed to slide between the two wings which project upwards from the barrel upon either side of the sight. The protector is tubular in form. It has one permanently closed end, and the other end is covered by a hinged or pivoted cap. A sort of bayonet fastening locks the protector securely over the foresight, which is completely enclosed.

The device is illustrated in the accompanying drawings. The two protecting wings *a* rise upon either side of the foresight *b* from

Fig. 1

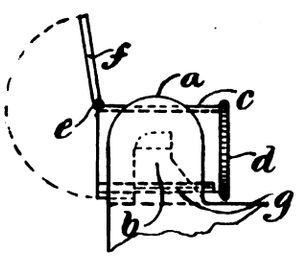


Fig. 2

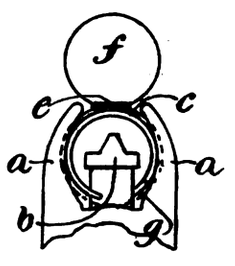


Fig. 3

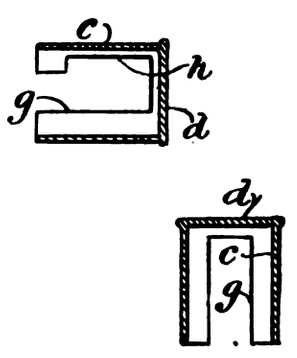
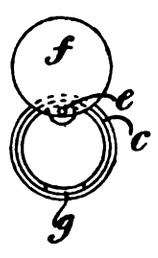


Fig. 4



the rifle barrel (Fig. 2). The tubular protector *c* encloses the sight *b* as is illustrated in Fig. 1. The protector is permanently closed at one end *d* and to its other end the cap *e* is hinged or pivoted at *f* The under side of the cover is cut away as at *g* to receive the sight bed. The circumferential extension *h* (Fig. 3) of this slot *g* is provided for the purpose of locking the cover to the sight bed when in position over the sight. When the cap *f* is dropped over the open end the sight is completely protected. The protector may be entered between the wings from either back or front. Accepted March 17, 1904.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

The Critical Month of the Year.—Those of us who in the ordinary course of things take the weather as we find it, will have good reason to make an exception to the general rule during the present month. The succession of bad game seasons, which has spelt so much loss to the gun trade in general, is invariably traced back to the existence of wild stormy weather in the month of June. With the land in its present water-logged condition, a state of affairs which has only been remedied at the surface by the recent spell of dry weather, any surplus of rain in June will have a more than ordinary effect. For young birds, whether they be partridges, grouse or pheasants, warm mild weather in the month of June is the best possible guarantee of a healthy and vigorous stock. There is already on the ground sufficient moisture to insure an exceptionally good supply of insect food, so that all we now want is warm weather favourable to the gathering of strength by the young birds. June shows signs of opening under wet and unsettled weather conditions. Let us all hope that these will soon give place to an ideal early summer.

The Palma Fiasco.—The National Rifle Association seems to be divided between a desire to accept the victory of their opponents in a sportsmanlike spirit, and the feeling of resentment that the victory in question was obtained by unsportsmanlike attitude on the part of the winners. There could not possibly be any misunderstanding as to the strict reading of the regulations which governed the shooting for the Palma Trophy. These laid down in the clearest possible manner that the rifle to be used in the match must be the service weapon of the country to which the team belonged, as issued to the troops. The American team did not abide by this condition, and it has been repeatedly announced by advertisements in American papers that the team were armed with weapons having special barrels rifled, bored and adjusted for the purposes of the match. These barrels were not of service pattern, and we are not aware that anyone has seriously advanced so untenable a proposition. It seems as though at this time of day nothing can be done beyond making it generally known in this country that the English team were not beaten by opponents competing within either the spirit or the letter of the regulations to which they professed to subscribe. We can, however, refuse to take any future part in competitions for a trophy whose records are thus smirched, and it would appear as though a dignified silence henceforward would be the best line of conduct to pursue.

Technical Instruction in the Gun Trade.—The report of the Technical Instruction Committee of the Birmingham Proof House provides cheerful reading for those whose business activity is wrapt up in the success of the gun trade. Although the beginning that was made in the Proof House buildings was small and unambitious, the wisdom of the founders has been more than proved by the results. The students at these classes may not, in the time at their disposal, have been able to obtain sufficient practice to develop a full measure of the personal skill that is required for accomplishing the best class of work. It must, however, be assumed that the work of the

technical classes is supplemented by daily labour in the workshop. In this way the growing skill of the student apprentices is directed by competent instruction so that the young operatives shall have constantly before them the ideals of high-class workmanship which the teachers have acquired by special aptitude and gradual experience. When a beginner is taught to approach a difficult problem from the standpoint of those who have developed the best methods they are able to obtain double and treble value from their ordinary experiences. Criticism and friendly guidance will in time work a marvellous change in the attitude with which a given piece of work is regarded. The school which teaches the mistaken policy that anything is good enough which will pass the ordinary trade tests, cannot produce the best class of workmanship. On the other hand, competent technical instruction will show that the cultivation of sound ideas produces an instinctive longing for a higher class of workmanship, which finds its appropriate reward in enhanced pay and rapid promotion. It is in the hope that the good work which has been started in Birmingham will extend as years go on, that we so heartily welcome the record of progress which is displayed in the report of the Technical Instuction Committee, which is signed by Mr. W. L. Powell, a member of the trade, whose firm has always been known for a quality of workmanship worthy of the highest praise.

Miniature Target Apparatus.—The fact that the National Rifle Association are offering a prize for the best system of miniature target apparatus exhibited at the coming Bisley Meeting, gives proof that there is a demand for these things. The difficulty of installing suitable apparatus at a miniature rifle club is largely a question of expense, but even granted the money, it is not certain that any existing system is perfect. At the present time there are many miniature clubs where shooting is interrupted while the range officer steps forward, hammer and tin tacks in hand, to nail up fresh targets. This system is, of course, unsatisfactory from many points of view, and what is wanted is certainly some form of mechanical travel between the butts and the firing point, by which the used targets can be replaced. The most satisfactory plan we know of is the provision of rails with a trolly supporting the targets, which can be wound backwards and forwards along the range. This, however, involves a good deal of expense for installation. The Miniature Rifle Society's method consists in the erection of overhead pulleys whereby the targets are carried to the firing point on an endless cord; but it is possible that this device would be too fragile for open-air use where trespassers would always be liable to disarrange the apparatus. A system of mono rail carriage might well be designed which would get rid of a portion at least of the installation expenses, but the problem is mainly one of neat and efficient mechanical design, complying with the requirements of simple installation and small cost.

Our Lecture on Cordite Rifles.—Having dealt in great detail with most of the scientific questions which arise in connection with the shot gun, we have turned our attention to express rifles in the latest of our lectures to young gunmakers. This is a subject on which many lectures might be based, and we have therefore contented ourselves for the time being with dealing with their initiation and the various developments which have arisen as their properties and characteristics become better understood. It would have been a serious blow to the gun trade if its precedence in the sporting rifle business had been permanently destroyed by the competition of the military type of weapon. In the present instance, however, what appeared to promise disaster, has in reality turned out a subject for satisfaction. With a power of adaptation to altered circumstances, rifle makers responded to the competition of the military arm by producing a series of weapons far and away ahead of anything that had previously been thought possible. In fact, Great Britain is as much ahead of the rest of the world in high power sporting rifles as America is, for instance, ahead of us in the production of cheap miniature weapons. While the British officer, by reason of his service in wild countries is the big game hunter of the world, the gun trade is bound to find in him an appreciative customer for sound and efficient rifles. Although our rivals in other countries might be fully capable of turning out thoroughly sound weapons, it is in the nature of things that we should hold our precedence in this particular line of trade. The practical experience of every user of these rifles is unfailingly transmitted to the maker; and he is thus able to introduce one by one the improvements which guarantee a high degree of all-round efficiency and fitness for the purpose in view. We must hope that the extension of miniature rifle shooting in this country will similarly bring our manufacturers into touch with what is required of them in this other direction.

The Service Rifle in the House of Lords.—Lord Tweedmouth deserves the gratitude of all rifle shots for his carefully considered criticisms on the new service rifle. In a dispassionate and well-informed speech he reviewed the arguments for and against the new pattern of rifle which has been adopted on the recommendation of the Small-arms Committee, and it is unfortunate that the Government were unable to put forward a better spokesman in advance of their policy than Lord Donoughmore, The statement he made in doubtful and unconvincing manner to the effect that he believed that the present pattern of mechanism would allow for an increase of 200 or 300 feet per second in the velocity of the service cartridge is likely to be received with ridicule by those who are competent to express an opinion on the subject. The increase in the service pressure of the rifle necessary to produce this improvement on the existing velocity would amount roughly to about three tons, and that would entail a proportionate increase in the stress applied to the rifle in the process of proof, and we know that the War Office dare not sanction such an alteration. The other comments of Lord Tweedmouth, while thoroughly to the point, received no more detailed answer than is involved in the general statement that for better or for worse the new pattern of service rifle has been definitely adopted for future use. Lord Tweedmouth struck the right note when he said that the new rifle was admittedly a good one, but it was not the best, and that it was our duty as a nation to see that we had the best. The country will never be satisfied so long as our service rifle contains objectionable features open to obvious remedy, and although the War Office may be able to live down the effects of its unpopular policy, as it did in the case of the previous pattern of service rifle, the fact remains that well-informed opinion will always be against the rifle.

THE BISLEY PROGRAMME.

IN reading over this year's Bisley programme it will be found that there is very little in the way of specially interesting competitions calling for detailed notice. The most important change in the regulations affecting the shooting is concerned with the size of the 100-yards target. Hitherto there has been a good deal of chopping and changing about in regard to shooting at this distance. The only target at one time used for the 100-yards range was the Martin-Smith with its three-inch bull and two-inch central, together with a number of rings which made the value, of an ordinary bull six points instead of the usual five. When the miniature rifle competition was introduced the ordinary 50-yards revolver target with a plain four-inch bull was utilised. This, however, did not afford a sufficiently fine test of marksmanship for more powerful rifles, and a target was accordingly introduced in connection with the Greener competition having a four-inch bull and a two-inch central. The miniature competition was afterwards shot on the same target as the Greener, which then became standard for all competitions at this distance, except the Martin-Smith. Another variation was, however, produced by the substitution of a target with a two-inch bull for the firing of practice shots, the idea evidently being held that the best way for practising rifle shooting is to do so at a bull half the usual size. The new target, which it seems will be used for all 100-yards shooting, has a 3½-inch bull with a two-inch central carton, the inner ring being 7-inches in diameter and the magpie 10½-inches, the whole target remaining 24-inches square as before.

The Small-Arms Committee section of the Council will not, we must hope, be circumscribed in their verdict as to which is the best automatic rifle by the terms of their appointment. We want them to tell us which is the best automatic rifle, and if they tell us wrongly we must refuse to be put off by the excuse that the terms of their mandate made them recommend something that in their private judgment they know to be bad. The Sherwood rifle contest, which received but scant attention by way of entries last year has dropped out of the programme. The Stevens which is new will doubtless prove a popular substitute. The Greener will appear as in the past, but we do trust that this firm will this year prevent the use of an eight-pound set of match sights on a three-guinea rifle, or else keep a few rifles so fitted in reserve for those who come unprovided.

To those who are interested in the new shortened service rifle the programme will be of special interest. It is absolutely barred from all service rifle contests of the ordinary sort by the clause which forbids any kind of wind-gauge sight, but it is admitted in a few competitions where the ordinary rules give place to special conditions. The addition of a wind-gauge will add a new feature to volunteer marksmanship, and its use must not be sanctioned until all can share alike in its benefits. That the N.R.A. are anxious to afford every scope for the improvement of military ammunition is shown by the fact that any cartridge may be used for match rifle contests which is generally a serviceable one from a military point of view and having regard to the weight to be carried by the soldier. This should afford ample scope for trade knowledge to show wherein improvements may be made.

PROOF HOUSE RETURNS.

THE annual report of work accomplished by the Birmingham Proof House supplies pleasant reading, in so far that while we should have expected a large falling off as a consequence of the bad season, the actual figures show a substantial advance in most of the important classifications. The following table of comparative values makes this fairly clear:—

	1901.	1902.	1903.
Provisional Proofs	**92,909**	**94,039**	**96,674**
Definitive Proofs—			
Muzzle Loaders	13,192	15,799	24,112
African Barrels	77,220	83,640	109,158
Breech Loading Arms	87,777	87,485	100,416
Nitro Proof of Rifle Barrels ..	609	1,571	2,435
Express Rifle Barrels	361	537	619
Military Rifle Barrels	8,094	4,635	4,157
Chambers of Revolvers	62,343	68,674	64,507
Pistols	1,055	923	597
Sundries	882	588	412
Supplementary Proofs—			
Nitro Proof	10,474	18,424	23,492
Proved with Nitros	354	473	895
	262,361	**282,749**	**330,800**

Wherever we look we appear to find a cheering and satisfactory state of affairs. The returns for muzzle loaders and African barrels show an improvement, which, though small, is in agreement with general indications. The breech-loading arms classification which appears to include every sort of shot gun and rifle not mentioned in the other headings, provides the best clue that can be obtained concerning trade activity, and here we see that the total reaches six figures, being materially in advance of the figures attained for many years past. The express barrel proofs are unlikely to supply any truly accurate notion as to the trade done in this line of work, since it is a speciality very intimately connected with the London trade, and therefore the London proof establishment is likely to be favoured with the bulk of the testing. It is surprising to find that the military rifle business has not shown up better in the proofs than is here indicated. We have heard personally of more trade than is here recorded, and must, therefore, again assume that the unpublished returns of London would explain the apparent anomaly. Revolvers and pistols, as was to be expected, have shown a reduction of activity, due, no doubt, to legislative interference with the trade.

The supplementary proofs are rapidly attaining a position which makes the total number of proofs a somewhat misleading test of trade activity. Although the individual items show an increase of weapons submitted for proof, it must be remembered that about one-ninth of the proofs were in respect to weapons proved a third time. In so far that the number of barrels so proved has more than doubled in the past two years, and the number is likely to show still further increases in the future, the careful statistician must base his conclusions rather on the sub-headings into which we have divided the total proof rather than on the gross figures. As regards finance, the Birmingham guardians report the satisfactory balance of £831 on the year's working.

THE ORIGIN OF GUNPOWDER.

To anyone with an historical turn of mind a book which has recently been published by Messrs. Longmans, Green & Co., will appeal with special interest. The author is Lieut.-Col. H. W. L. Hime, late of the Royal Artillery, and the subject he has set himself to discuss is the origin and progress of gunpowder and ammunition. The title chosen hardly gives to the prospective reader a sufficient idea of the research into old records and the logical analysis of ancient evidence which the author has marshalled with such enthusiasm and discretion.

The author commences by enquiring into the origin of saltpetre and the possibilities of its secret use for the manufacture of the Grecian sea-fire. By a most convincing process of connected reasoning Colonel Hime satisfies the reader that the whole balance of probability supports the assumption that quicklime and naphtha were the essential elements of this munition of war, and that gunpowder could not possibly have been used without its constituents becoming well known. In delving into these abstruse historical points the author shows himself a master of languages, and he is consequently on familiar ground when querying various alternative translations from Persian, Greek, Latin, Sanskrit and other original documents which bear upon the origin of gunpowder. The connection of the Arabs with incendiary and explosive substances is very carefully examined, as also is that of the Hindus and the Chinese.

Curiously enough, in speaking of the Chinese claims to have used gunpowder centuries before western civilisation had applied the invention he points out that all evidence to that effect is entirely untrustworthy. In examining the early Chinese practice in dealing with explosive substances he shows an extraordinary number of coincidences, which together form a considerable weight of evidence suggesting that whatever the Chinese knew of gunpowder they acquired from Western nations.

In turning finally to Friar Bacon he appears to find the first really definite evidence of the existence of true gunpowder coupled with a knowledge of its properties and the way to make it. It is, however, necessary to explain why Friar Bacon, instead of clearly stating what he knew on the subject, sought to conceal his knowledge by wrapping it up in the form of an anagram. It seems, however, that the worthy Friar held the view that scientific information was bad for the populace. "The crowd," he says, "is unable to digest scientific facts, which it scorns and misuses to its own detriment and that of the wise. Let not pearls, then, be thrown to swine." Elsewhere he says: "The mob scoff at philosophers and despise scientific truth. If by chance they lay hold upon some great principle, they are sure to misinterpret and misapply it, so that what would have been gain to everyone causes loss to all." However, by infinite diligence and pains, the author shows how the recipe for the manufacture of gunpowder can be extracted from the writings of Roger Bacon. To quote the author's own concluding paragraph it seems that "whether as discoverer or inventor, Roger Bacon made and fired the first gunpowder. It fell to the lot of a persecuted English monk to fulfil the prophecy of Prometheus, that in the latter day there should appear 'a wondrous being, who should call forth flashes brighter than lightning and sounds louder than thunder.'"

Other portions of the book which deal with projectiles and igniters and so forth will be found of great interest, even if of secondary importance to that which relates to the origin of gunpowder.

THE DESTRUCTION OF WASTE PERCUSSION CAPS.

By HENRY W. BROWNSDON, B.Sc., Ph.D.

THE destruction of waste percussion caps has up to the present been a process involving a considerable amount of danger; and not a few accidents (some fatal) have occurred in carrying out the process at one stage or another. The method most in vogue is that of exploding the caps by heat, but as this method can only be economically carried out on large quantities of caps, it leads of necessity to accumulation, the chief source of danger when dealing with defective caps.

The destruction by chemical agents has received little recognition, although it has been suggested to use a solution of hydrochloric acid. This method has found little favour in the trade for reasons which are evident to anyone who has tried the process, and it may be dismissed without further comment as quite unsuitable. That a chemical method for destroying caps has many advantages over an explosive method cannot be denied, and the only difficulty which has prevented its general adoption has been the want of a suitable destroying agent.

After a lengthy inquiry into the destruction of fulminate of mercury, I have been led to the adoption of sodium sulphide for this purpose, which will be found to be at once rapid and effective in its action. For the destruction of waste fulminate and loose composition other chemicals (sodium thiosulphate for instance) may be used with success; but the destruction of loose composition and of the composition in caps is a very different matter. In the one case a reagent is required which will merely destroy the fulminate, in the other, where the composition is compactly pressed and protected by varnish and tin foil, a reagent must be used, which, besides being able to destroy the fulminate, must also possess a permeating disintegrating power. All these properties are embodied in sodium sulphide solution. It rapidly attacks the varnish and loosens the foil, and being in addition, a solvent for antimony sulphide, eats its way into, and disintegrates, the composition.

One pint of 20 per cent. solution is capable of destroying the composition in from two to three thousand caps. A suitable method of carrying out the destruction is to half fill strong glass bottles (Winchester quarts holding about two quarts are suitable) with the solution, and to drop the caps (as they are rejected in course of manufacture) into the bottle. This procedure prevents all possibility of accumulation which has already been referred to as a great source of danger. The caps in the bottle should be shaken once or twice a day; and when complete disintegration of the composition and of the caps has taken place, one may be sure all the fulminate has been destroyed. The caps may then be washed and disposed of by any means with safety. My sincerest thanks are due to the Directors of the King's Norton Metal Co., Ld., and Mr. H. Melville Smith for the facilities they have placed at my disposal for carrying out this work in the Company's laboratory at Abbey Wood.

MINIATURE CLUB RIFLES.

THE continuing development of miniature club rifle practice naturally opens the way for periodically reviewing the trend of opinion in regard to the class of rifle favoured by those desirous of ranking as marksmen. If we exclude from the present discussion the large class of shooters who still hold the fallacious view that the rudiments of military rifle shooting can only be acquired by shooting the service weapon, no matter how unfavourable may be the conditions, the way is clear for dealing solely with those who recognise the need for a special miniature rifle.

There is at present very little sign that things are settling down into anything approaching uniformity of practice. Even those clubs which shoot exclusively at 20 yards show a curious want of appreciation of the fact that ·22 calibre rim-fire ammunition is the best all-round cartridge for such work, bearing in mind cost and accuracy combined. There is no cartridge which is equally suitable for the two distances of 20 and 50 yards. Consequently extremes are bound to meet when the two ranges exist side by side. For our own part we should be inclined to favour the ·22 rifle to the exclusion of all others for the 20 yards distance, leaving perfect freedom of choice in regard to the longer range. A cartridge on the lines of the Greener ·310 is excellently adapted for use at 50 yards, especially since the same ammunition may be used at more distant ranges. Where, however, considerations of economy, noise and safety come into play the long-rifle rim-fire cartridge would no doubt find many advocates with practical knowledge to back their opinions. If miniature rifles are required to shoot at 50 yards in competition with service rifles firing reloaded military cartridges containing reduced bullets and sporting powder charges, then the accuracy of the Greener cartridge places it ahead of most brands of rim-fire ammunition. On the other hand, such a cartridge as the ·25 Stevens has a great deal to recommend it for 50 yards shooting, but it can hardly claim to shoot on a par with the Greener ammunition beyond this distance.

In reviewing rifles it will be seen that the ammunition used must receive a prominent share of attention, since it determines in a great measure the characteristics of the rifle. If we exclude all magazine types of weapon as unsuitable for range practice we shall be taking the course which common sense dictates, but one which is antagonistic to existing practice in many quarters. We, however, prefer to back our own opinion that magazine rifles will lose ground when they come into competition with those of single shot construction. Among the rifles at present available for miniature practice the Greener must occupy the position of honour on account of its English origin. The club type of this weapon possesses in a marked degree the combination of essential qualities which we should be inclined to lay down in such a connection. It is well weighted, conveniently stocked, and has a system of take-down barrel which enables the intelligent shooter to maintain the bore in perfect condition. The greatest rival of the Greener is naturally the Stevens, and it is certain that the new English model of this weapon which will shortly be put on the market will advance at a single bound to a pre-eminent position. The workmanship of the weapon is said to be far in advance of previous patterns. and it combines in weight, balance and other superficial characteristics the advantages of the somewhat heavily weighted "Ideal," and and the lighter handling, but less solidly constructed "Favourite." The Francotte pattern of Martini rifle is an exceedingly graceful and well manufactured type of weapon, which would doubtless command a still greater share of patronage if it was bored for a greater variety of cartridges and was fitted with a detachable barrel. The Certus club rifle is another weapon which has points of considerable interest. It is English made throughout, and the shape of the stock is the most perfect of any miniature weapon with which we are acquainted. It might, however, be improved if it were made to weigh a pound or so more than at present. The Winchester single-shot rifle is a weapon which carries out the best characteristics of American construction, though it is not so well known in this country as it might be, because it is to some extent overshadowed by the alternative pattern fitted with the magazine. Probably several other weapons should be named to make this list include the whole of the representative types, but we must dismiss the others, merely mentioning in passing the "boy sizes" of weapons with military-looking bolts which, though too light for really fine shooting, are nevertheless great favourites among beginners in the early stages of their initiation.

It is, however, a curious fact that notwithstanding the many excellent and workmanlike weapons that are available that a prominent club secretary should recently have publicly stated his preference for a French type of weapon shooting a special cartridge, from which accuracy could hardly be expected beyond the most restricted range. Upon enquiring among the club members for the reason of this preference it seemed that general indications of military type were considered a predominant recommendation overwhelming such disadvantages as the existence of a trigger pull which required a travel of one-eighth of an inch to accomplish the release of the hammer. Altogether it would appear as though the future of club rifles will be largely determined by the views and prejudices of shooters, though accuracy, handiness and good workmanship are nevertheless likely to tell in the long run. There is one point in which all club rifles seem to be equally deficient. That is in the matter of sights. We do not know of a single club rifle in which the back-sight notch can be adjusted vertically and laterally by means of thumb-screws to any desired position, the adjustment to be capable of easy reading by a simple form of scale. The hammer and punch method of adjusting the sights in a lateral direction will never prove satisfactory, and the rifle whose sights comply with the requirements here laid down should soon become popular. The Swiss type of Schuetzen rifle is commonly fitted with this system of sighting, and there is nothing artificial about it which could fairly bar its adoption in this country, now that the new service rifle establishes the military usefulness of the so-called wind gauge. In the latest N.R.A. definitions of the various types of rifle they make an even stronger hit than usual against all forms of wind gauge sight, and yet it is certain that to keep level with the latest developments the Association must admit wind gauge sights for all rifles. The system is nowhere more necessary than in club weapons, where accuracy of aim is the chief thing to accomplish, unfettered as the shooters are by considerations of wind. A permanent adjustment is insufficient, since it can be demonstrated that a change of ammunition will throw the line of fire as much as one inch out on the horizontal at 20 yards.

THE NEW SERVICE RIFLE.

LORD TWEEDMOUTH, speaking in the House of Lords on the 13th ult. about the new service rifle, made some interesting remarks. He called attention to defects apparent in the new service rifle, and asked the Government whether gauges and specifications had yet been sent out to private firms for its manufacture; what was the explanation of the high price—£4 10s. per rifle—which it had been announced such firms were to receive. He admitted that the new rifle was a good one, but did not admit it was the best, and held that not only should we secure the best possible rifle, but one which would afford the best basis for future improvements.

He did not think that the slight increase of recoil would prove to be a practical drawback; the ratchet back-sight was a great improvement, as was also the method adopted of loading with a charger so that five cartridges were put into the magazine by a single movement; different sizes of fore-sight would be to some extent advantageous. That being said, however, he came to the defects. He doubted very much whether the lightening of the rifle by the shortening of the barrel by five inches was altogether an advantage. It was claimed that this shortening, in view of the changes made in the tube, would not decrease the muzzle velocity, but it must be remembered that the same changes in the longer barrel would have produced a greater muzzle velocity, involving at the same time a lower trajectory and a longer range—in fact, a weapon with which it would have been easier for a a soldier to shoot. The shorter weapon might be a convenience for mounted men, though now that the rifle was no longer carried in a bucket on the saddle he doubted even this. But in any case there was no reason why the longer weapon of the infantry should be sacrificed for the convenience of the mounted arm.

While admitting that the back-sight was an improvement, the effect of shortening the barrel had been to reduce the distance between the back-sight and the fore-sight by five inches, and thus render accurate shooting more difficult. The fore-sight, too, was protected by a sort of crescent-shaped projection, which was not so necessary for infantry as cavalry, and which in a bad light would throw a shadow which would interfere with the sighting. Turning to the bolt action, he said that any competent gunmaker would agree that he could not with safety greatly increase the strain that was at the present time thrown on the British bolt. As they were re-arming the British Army the opportunity should be taken of strengthening the bolt, so that, in view of the development of the barrel and the ammunition, they would have stronger action at the back of the rifle.

The foreign bolt, locked into the barrel close up to the breech, and therefore, where the main force of the explosion took place, the bolt was tightly joined to the barrel. In our rifles the whole force of the explosion took effect on the whole length of the bolt, and on the weak part of the action. The magazine of the British rifle was of the old type. It was a bulky and rather flimsy box under the rifle, just in front of the trigger guard. The smallest dent in this box rendered the magazine useless, because the platform on which the cartridges rested would not act. In the Mauser rifle the magazine did not project below the rifle or in front of the trigger guard. It might be said that the Mauser magazine would hold only five cartridges, while the British magazine held ten. But now that the new system of charge loading had been adopted, they could do perfectly well with a smaller magazine. Five cartridges could be placed in the magazine in one motion, but if ten cartridges were used, two motions were required to fill the magazine.

He understood that it had been decided to retain the stock in two pieces. All foreign countries had the woodwork of their rifles in one piece; it was cheaper and stronger. A stock in two pieces was apt to get loose, and a comparatively slight loosening of the screw that fixed the end of the stock to the rest of the rifle altered and destroyed the shooting of the rifle. His contention was that it would be wise for the War Office to hold their hands with regard to the issuing of this rifle. He understood that they had completed arrangements for its manufacture at the Government factories, but that they had not yet entered into complete arrangements with private firms. He thought they should confine themselves to issuing the new pattern of rifle to the mounted troops. With regard to the other forces, he would suggest that the War Office should apply to the existing rifle the new back-sight, and should modify the breech action, in the first place, by removing the dust cover. With a very little alteration the present breech action could be adapted to the new system of charger loading. With these changes they could incorporate in the existing rifle at a small cost two of the greatest improvements in the new rifle. Then they should go fully into other questions, and take the advice of all the professional experts. The British Army would not suffer in the meantime because, even if war were to break out, they would have the new back-sight and the new arrangement of the breech. He had learned upon inquiry that similar rifles to our new service rifles could be produced in Germany for £2 16s. or £2 18s., according to quantity, and the estimate of the British manufacturers—£4 10s.—was somewhat surprising.

The Earl of Donoughmore, in reply, said that an important reason for shortening the rifle was that it would be a handier weapon for use by the cavalry; and he claimed that it would be a great advantage to have the same rifle for all parts of the service, infantry, cavalry, artillery, sailors and marines. It would manifestly be an advantage to have one stock from which to replenish rifles lost in the field. He was informed that the rifle was strong enough to permit of a further velocity of 200 ft. or 300 ft., and that left some margin for improvement in the future. He could not hold out any very strong hope to his noble friend that they would "hold their hand," but what the noble lord had said would be most earnestly considered by his colleagues at the War Office. They were perfectly alive to the importance of the matter, and he could assure his noble friend that if any improvements could be made, even at the last moment, they would be adopted.

The original cost of the long rifle in the ordnance factories was £4 15s. and in the trade £5 10s. But in 1903 the price was £2 11s. 6d. in the ordnance factories and £3 10s. in the trade. They were starting this rifle at £4 10s., and they fully hoped that, as time went on and the machinery charges had been paid off, they might considerably improve on that price. It had been decided to issue the weapon in its present form to all branches of the defence services, but he could not say when the re-armament would be complete.

ROUND THE TRADE.

The estate of the late Mr. T. W. Webley, who died on the 13th February last, has been valued at £35,325 gross, of which £17,356 is net personality.

Mr. V. T. Mitchell, as will be noticed from our advertisement columns, is now in a position to take orders for Tatham's chilled shot in English sizes.

The particulars of the competition for prizes offered for miniature target apparatus exhibited at Bisley are given on page 217 of the Bisley programme.

Sir Richard Audrey, K.C.B., has been appointed Chairman of the British South Africa Explosives Co., Ld., in succession to the late Colonel J. L. Du Plat Taylor, C.B.

It is reported that a communication has been received by the Brazilian legation prohibiting the export of arms and munitions of all kinds to Peru through the River Amazon.

We have received from Messrs. Curtis's and Harvey an excellently turned out waistcoat pocket book containing a number of pages suitable for jotting down casual memoranda.

Air-gun shooting in Birmingham occupies a position of sufficient importance for the Saturday sports edition of the local paper to devote a column to the doings of local shooters of these weapons.

As showing the increased popularity of the rifle club movement it is interesting to note that Mr. Walter Winans is organising a miniature Bisley in connection with an important charity bazaar.

The Shimosé powder of which we hear so much in connection with the war is the invention of Masachika Shimosé of the Shimosé Powder Works of the Imperial Japanese Navy, Takinogawa, near Oji, Tokio, Japan.

A rifle range was opened at Southfields near Wimbledon by Lord Cheylesmore last month, and considering the somewhat dangerous character of the range it is surprising to hear that it has been passed by the War Office.

The Championship Meeting of the Clay Bird Shooting Association will take place at Hendon on the 23, 24 and 25 insts., while the Dougall Memorial Trophy Meeting will be held at Southall, near Ealing on July 22 and 23.

The petition of the Norddeutsche Munitionsfabrick for the compulsory winding-up of the Normal Powder Company having been satisfied by the payment of the petitioners' debts it was agreed that the same should be dismissed without costs.

We have received a copy of the latest issue of the catalogue of Mr. G. E. Lewis of Birmingham. It is a comparatively bulky volume, which is, however largely due to the fact that it contains details of many second-hand weapons which are for sale.

The programme of the Gun Club fixtures for June and July has just been published. The International week will begin on June 20th. The first three days' shooting will take place at Hurlingham, and the remainder of the week at the Notting Hill enclosure.

The Wilkinson Sword Company have on view at their premises in Pall Mall the latest pattern of the so-called "sub-target" apparatus, which is a device for registering the accuracy of one's aim without the shooter being required to fire a cartridge.

Mr. H. Boyd ranks as the vendor to a company registered on May 10th with a capital of £10,000 of an explosive named Herculite, which is stated to be his invention. In the past he has also ranked as the inventor of Ripp-lene and Fumelessite, which in point of fact were one and the same material.

The report of the King's Norton Metal Company for the year ended March 31st last states that the profit made amounts to £18,451 which, with the balance brought forward, makes an available total of £22,883. Of this, £7,000 is set aside for depreciation and the remainder, bar £483 carried forward, is utilised for the payment of an 8 per cent. dividend on the ordinary share capital.

The accounts of the British South African Explosives Co., Ld., for the twelve months ending October 31, 1903, being the first completed year of the new management, show a balance of £52,617, after writing off £20,000 for factory depreciation, and carrying £2,500 to a special accident fund. £38,500 has been appropriated for a 3½ per cent. dividend, leaving £14,117 to be carried forward. It appears from the report that a considerable portion of the existing factory may require to be shut down for an indefinite period, this being due to the altered conditions of trade since the monopoly was cancelled.

We have received an early copy of the Union Metallic Cartridge Company's new price list dated April, 1904, which relates to sporting and military cartridges, primers, wadding and so forth. It is interesting to note in the illustrations of paper cartridges for club use that the Winchester Company's patented system of a ring indentation has been introduced in the form of four circles which are, however, interrupted at intervals. The idea of this stabbing of the sides of the brass head appears to be to introduce a slight longitudinal give to the cartridge, so preventing the paper tube from parting with the head.

Captain Lloyd's report on the explosion of gunpowder at Messrs. Curtis's Faversham factory on the 2nd February last has lately been published. After giving the usual careful consideration to possible causes of accident the conclusion is arrived at that the explosion probably resulted from the introduction of a foreign substance into the ingredients during the mixing process. To avoid all possibility of a repetition of accidents due to this cause the firm have arranged to line the house with sheets of zinc, so as to make an impervious lining calculated to prevent detached fragments of cement from getting amongst the material under treatment.

The balance sheet of the Nobel-Dynamite Trust, Co., Ld., shows that £219,031 is available for distribution. The sum of £25,000 is absorbed by preference dividend, and of the balance the Directors recommend that £182,832 be applied in payment of an 8 per cent. dividend on the ordinary shares, the sum of £11,199 being carried forward. The Directors refer to the fact that during the year under review they have lost Colonel Du Plat Taylor, whose death has been reported in our columns, and Mr. Max von Duttenhofer, who died in August last. Sir Richard D. Audrey, K.C.B., has been appointed a member of the Board.

We have received from Messrs. J. R. Watson & Co. a copy of their new season's price list for sporting and other ammunition. The brands described include the Britannia and other cartridges which were formerly the speciality of the Arms and Ammunition Company, whose goodwill Messrs. Watson have recently acquired. The only criticism we have to make of the price list as a whole is the impossibility of attaching any meaning to the instrumental results said to have been obtained with Cooppal No. 2 which are published on page 15. We are told for instance that the powder has a pressure of 1·2 per square inch. If these are tons the figure condemns the powder as worthless, whereas we believe it to be a satisfactory propellant.

The report of the National Explosives, Co., Ld. shows profits for the year amounting to £6,087 which, with the amount brought forward, gives a total of £9,750 for distribution. A 6 per cent. dividend is declared on preference shares, and 2½ per cent. on the ordinary shares, these appropriations leaving £2,992 which is carried forward. The report explains that the small profits made have been due to an excess of competition both for Government orders and in the general blasting trade. The expectation of doing business in the Transvaal market has been set aside by the imposition of a coast duty of 6s. 3d. per case upon all imported explosives, which the Directors report effectually shuts the Company out of the whole of South Africa. The hope appears to be entertained that competition for this market will be equalised by the imposition of an excise duty upon locally manufactured explosives. The past year's record is the smallest profit the Company has shown for a large number of years, the next smallest since the year 1896 having been registered in 1900, the amount then shown having been £25,453.

LECTURES TO YOUNG GUNMAKERS.

XXVIII.—THE ORIGIN OF CORDITE EXPRESS RIFLES.

THE young gunmaker who aspires to understand his business in all its branches will find that the number of subjects to which he must devote special attention is considerable. Among these are important developments of modern years in the growth of high power express rifles. The origin of these weapons is certainly very interesting. About ten years ago the applicability of the modern military small-bore rifle for sporting purposes began to be recognised, and it was a sore point with gunmakers that their cherished express rifle was outclassed by its inexpensive rival, the sporting adaptation of the military small-bore. Among the reasons which appealed most strongly to the sportsman in causing him to change his favourite weapon was the accuracy of marksmanship attained when shooting over unknown distances this being due to the flatness of trajectory of the new military ammunition. The shooter in wild countries knowing that the useful range of the express rifle with its short lead bullet and comparatively small charge of black powder was greatly circumscribed, appreciated the superiority in this respect of the sporting ·303 and the Mannlicher rifle in so far that mis-estimations of range produced but slight differences in the elevation of the bullet. Two objections were, however, found in the practical use of the new type of sporting rifle, viz.: the want of smashing power in the bullet, and the inevitable delay which arose in firing the second shot, for though the magazine enabled five cartridges to be fired in quick succession the interval between the shots was still very considerable as compared with that of the double-barrel express.

To remedy the difficulties incidental to the want of stopping power of small-bore bullets our leading rifle makers exercised a vast amount of ingenuity in weakening the nose of the nickel-cased bullet in such a way as to cause it to expand on impact. They knew that the striking energy of the bullet if suitably applied was amply sufficient for stopping the biggest game, but notwithstanding the partial success attained it was found impossible to ensure in a small-bore bullet the requisite shock value when the part of the game struck did not offer the kind of resistance that produces mushrooming effects. Instances were too numerous in which game fairly struck by the bullet was merely pierced, its vitality for the moment being so little diminished that it was able to break away into the country beyond where it could not be tracked. The advantages of double-barrel construction were at a very early stage secured for the military type of cartridge, but even so the results were not all that could be desired.

It seems to be generally understood that the firms of Holland, Purdey and Rigby were responsible at or about the same time for the first serious and successful effort to restore to the gun trade the profit it had lost by the success of the military type of sporting rifle. The idea they carried out was to reproduce the essential features of the military cartridge in a larger bore. The bullet was carefully designed on the military pattern, its equality of length, and therefore, density, enabling an appropriate charge of Cordite to be used. This new class of ammunition was thus designed to give the same velocity as the military cartridge. It, therefore, gave the flat trajectory which was the main recommendation of the military bore. For sporting purposes, however, it proved to possess great superiority over the military cartridge. That is to say the excess of diameter and weight gave the requisite shock independently of considerable mushrooming effects.

The characteristics of the new ammunition were of course not fully appreciated at the start, but in a very short time the principles governing its action became better understood. The new style of cartridge was gradually extended to all the remaining express calibres; and it was found that while the striking energy of the bullets was greatly superior to that obtained from black powder express rifles, the energy comparison was not fully borne out in practice. The ·360-bore cartridge, though superior in energy, proved capable only of replacing the ·450 black. The ·400 in like manner appeared able to do the work of the old ·500, and so forth as regards the other sizes. The firm of Jeffery was responsible for the introduction of a ·600-bore cartridge, which was larger than any previous size of express rifle, black or smokeless. This cartridge proved itself the equal for all practical purposes of the 4-bore, thus showing that the Cordite type of cartridge enabled results to be obtained with a small diameter of bore equal to those of much more cumbersome rifles. The special characteristics of Cordite very soon made it apparent that only the magnum cartridge of each bore, with considerable space for the accommodation of the powder charge, was suitable for the new method of loading. Hence, although there were many kinds of black powder express cartridge, those adaptable for use with Cordite were much more limited.

While the new Cordite ammunition was entirely based on the black powder size of cartridge it was, of course, impossible to use this ammunition in rifles constructed for use with black powder. In the first place the pressure set up by Cordite in producing the greatly superior range of ballistics was much higher and, therefore, required greatly increased strength in the breech of the rifle. More than this it was found that the deep grooving of the black powder rifles, while perfectly suitable for the rotation of a lead bullet of low velocity, was ineffective when applied to metal-jacketed bullets moving up the barrel with a superior velocity. The rifling, both as regards the form of the grooves and the amount of twist, was accordingly altered to the military type to fit in with the new conditions. A difficulty then arose which has only recently been satisfactorily dealt with. While the lead bullet was capable of expanding in the barrel so as to fill up the grooves of the rifling the nickel-jacketed bullets required to be made of a diameter equal to the distance across the bore, measuring from the bottom of the grooves instead of across the lands. This involved making the Cordite bullets of a greater diameter than the lead ones intended for black powder rifles. Difficulties then arose in the formation of the neck of the cartridge, since to reduce the brass by the amount that the bullet required to be enlarged was to make it unduly thin. Consequently it was gradually recognised that the nose of the chamber in Cordite express rifles must be made rather larger than was the case for black powder ammunition. While this reform has gradually come into recognition there has been no official re-settling of the sizes of chamber best

suited for the cartridges at present on the market, but it is to be hoped that this desirable procedure will not long be delayed,

Although the new class of ammunition was based on cartridges which had been built up in years gone by on the rule-of-thumb principle a curious harmony of design proved to run through the entire series. It was found that when the bullets were made of equal length, and, therefore, practically of equal density, and the Cordite charges were so adjusted as to give a standard pressure, the resulting velocities were as nearly as possible alike. That is to say the extremes differed about as 2,050 feet per second is to 2,150. This arose from the fact that the powder space in the different cartridges had a uniform relation to the diameter of the bore, the equality of pressure and velocity thus following from the due proportion that was maintained between the bulk of the Cordite charge and the space available in the cartridge for its accommodation.

It followed from the nature of these rifles that their use was almost exclusively confined to tropical countries where the game for which they were intended abounds, and although black powder behaves alike in countries with widely different ranges of temperature, with Cordite this is not so. The high average temperature which obtains in a tropical country affects the behaviour of Cordite in a manner that was not at first appreciated. It soon, however, became apparent that rifles which had been manufactured and adjusted in this country gave trouble abroad, not only because of the increased strain that the higher pressures put upon the mechanism, but also because the resulting increase of velocity altered the elevations for which the sights had been adjusted. It was in fact found that rifles which were sighted and adjusted for certain charges in this country would only reproduce the required level of result if the amount of the powder charge was reduced in proportion to the increased activity of the explosive when used abroad.

It was a long time before this seemingly obvious proposition was practically applied in regard to Cordite rifles. Now that the theory of the subject is fully understood, the ammunition manufacturers are loading Cordite ammunition with two sets of charges, viz., full charges for the sighting and adjustment of the rifles in this country, and reduced charges for reproducing the required standard of result abroad. The amount of reduction in powder charge necessary is arrived at by firing the ammunition in a heated condition, the charge being selected which gives the combination of pressure and velocity which is accepted as standard in this country for full charges fired at the normal temperature of the English climate. A temperature of 120° F. is accepted as representing foreign conditions of service. In this way the gunmaker is fully assured that the sighting and adjustment arrived at in this country will be applicable to the same rifle when fired abroad with reduced charges. He is similarly easy in his mind that the rifle which works well in England will not give trouble abroad by reason of an increase above the level of pressure with which it has been tried and adjusted at home.

Recognising the advantages of producing the requisite velocity with a minimum of pressure, the firm of Eley Bros., Ld., last year introduced a special form of Cordite express cartridge having a greatly increased space for the accommopation of the powder charge, the new combination producing the required level of result in the presence of comparatively low pressures. Even though it has been clearly demonstrated that fully charged cartridges of this kind cannot in tropical countries attain a dangerous level of pressure, reduced charges have still to be adopted for foreign consumption, in order to obviate the difficulties arising from the increased ballistics when used abroad. Unduly high velocity not only nullifies the adjustment of the sights, but it increases the recoil and produces other difficulties, such as the undue depositing of metallic fouling in the bore of the barrel. In dealing, therefore, with Cordite express rifles the gunmaker and ammunition manufacturer have found it necessary to define the most effective combination of pressure and velocity, their joint skill being then exercised in securing as nearly as possible a reproduction of these conditions in the presence of tropical temperatures.

While we have so far spoken solely of high-power Cordite express rifles it must be understood that there is another class which may be designated as low power. That is to say it has been found that Cordite charges can be used to replace the old explosive in ordinary express rifles designed for black powder and lead bullets. The advantage of using Cordite in this connection is that the shooter benefits by a certain measure of reduced recoil and smokelessness. When Cordite is loaded to replace black powder the pressure is singularly low, which shows that the high pressures which are obtained with the high-power cartridges arise not because Cordite *per se* gives high pressures but because of the high ballistics demanded of it. The young gunmaker must, therefore, be quite prepared to find Cordite in express cartridges of the kind which are intended solely for use in rifles of the black powder class. It is undesirable to increase the velocity of these low cartridges to the extent that would be possible in attaining to the black powder level of pressure; and this is not done, first because the rifles would require to be re-sighted, and second, because the rifling would not be effective in the presence of a material increase in the velocity.

The popularity of Cordite for express rifles must be ascribed to the fact that it is a standard nitro explosive which is manufactured according to a strict specification which ensures in every sample of it a very close approximation to the properties that previous experience has led us to anticipate. The sum total of our knowledge of the Government service explosive is necessarily more comprehensive than of any rival product. Hence we know the exact range of results we are likely to obtain with it under any ordinary set of conditions. At any rate Cordite appears to satisfy our requirements in in regard to express rifles at least as well as any alternative explosive.

Sufficient has been said as to the origin of the new class of express ammunition to show the vast amount of scientific detail that has been involved in bringing to the present state of perfection this important departure in sporting firearms. The young gunmaker who aspires to understand the true bearing of these highly technical questions must go very deeply into the numerous debatable points that arise. The enterprise and interest which have been shown by the leading firms in the industry show in the clearest possible manner that when a new problem arises the only means of attaining a satisfactory solution is to reduce the necessary factors to a common-sense basis of scientific explanation. However simple the accomplished results may appear the fact remains that when the essential parts of the problem are wrapt in mystery clear thinking and careful experimentation is necessary to define the lines along which sound practice must be developed.

THE EROSION OF MILITARY BARRELS.

EVER since the introduction of Cordite, we have been faced with the difficulty of finding a scientific explanation for the serious wear and sudden lapses from good shooting which take place in barrels used with it in combination with cupro-nickel jacketed bullets. Although many persons have expressed opinions on the subject, we think that the credit for placing the whole question on a satisfactory basis, must largely rest with Capt. J. H. Hardcastle, R.G.A. This officer, as we have already pointed out in our columns, is not only a practised rifle shot, but also a mathematician and scientist who has analysed a considerable number of intricate ballistic problems. In a paper which he has recently communicated to the Royal Artillery Institution, and which has appeared in their latest proceedings, he sets forth the outcome of several years of careful observation and experiment concerning the action of the military cartridge on the bore of the barrel.

He points out for a start that Col. Gibbs was able to make a world's record for 1,000 yards with a rifle which had fired some 20,000 rounds of black powder ammunition, being still in the best possible condition. No matter what care may be taken with the ·303 rifle, such a result cannot possibly be obtained, the life of the barrel from the point of view of good shooting at long distances being very much restricted by the wear and tear produced by the service cartridge. Capt. Hardcastle seems to be inclined to treat three operations as mutually productive of the destructive process. First of all there is the impact of the gases on the bore, which removes its surface in a progressive fashion. Then there is the deposit of so-called nickel, which is, however, mainly copper, on the surface of the bore, and the creation of rents and fissures, which form a hot bed for rust.

If the deposit of nickel could be entirely prevented, the surface of the bore could probably be kept in comparatively good condition, but the film or plate of copper which is deposited by the bullet in its passage along the barrel covers over large areas which the cleaning rag cannot reach. Capt. Hardcastle has shown most clearly by the use of plug gauges what has of course been previously demonstrated, viz., that the diameter of the bore is reduced by the deposit of copper which accumulates during the active life of the weapon. The back end of the rifled portion of the bore is meanwhile subjected to a purely destructive process, whereby the surface of the rifling is gradually scoured away. Thus we find that the forward end of the bore is constricted by the copper deposit already referred to, while the back end is burnt away by the gases. Upon sectionising a worn barrel and subjecting it to microscopic analysis, it became clear that the centre of the land was untouched by anything but hot gases, and that metallic fouling is not deposited there. The junction of the land and groove on the other hand appears to be the greatest point of wear, the sectionised barrel having shown that a bad state of corrosion and copper deposit existed.

Capt. Hardcastle has introduced a useful method of obtaining original information concerning the characteristic state of the barrel where the copper has been deposited. He has worked out the formula for a solution which he has christened "Cunicide." It has the property of attacking and dissolving the whole of the metallic fouling deposited in the barrel without touching the steel. One end of the barrel is carefully closed and the solution is introduced at the other end. After a certain time, say a couple of days, the solution may be removed, the barrel being then entirely freed from all metallic fouling. Having cleaned a barrel in this manner he subjected it to a very close microscopic survey, with the result that the surface of the bore proved to be cracked and broken up in very much the same way that a bed of clay suffers in the presence of a hot sun. The collection of powder residue in and around these fissures, and therefore under the coating of the copper deposit, provides a harbour for the rusting process which thus proceeds unchecked in spite of the futile cleaning which affects only the outside of the copper deposit.

While the author's researches do not appear to give us any clear indication as to a suitable means for dealing with the scouring of the rifling immediately beyond the chamber the chemical solution which he has prepared for removing the metallic fouling seems to provide a very effective means for restoring the efficiency of badly fouled barrels. A certain amount of expert care is obviously necessary in applying the remedy, for the undoubted presence of ammonia in the solution suggests that it must on no account be allowed to get into the action, since its presence would initiate rapid oxidation. Further practical results arising out of the author's experiments may follow from his efforts to define the points of greatest wear on the lands of the rifling.

In a particular barrel which had been carefully cleaned on every occasion after use the cunicide treatment disclosed a deep ring of rust pits which had unknowingly been allowed to develop under the shelter of a deposit of metallic fouling. Some of these pits were over one-fiftieth of an inch deep, and they were found to contain ferric and partly ferrous oxide, both of which substances when in contact with steel and air are bound to set up a continuous oxidation of the steel. Nitrous acid or copper oxide are capable, with the assistance of a tiny quantity of damp air beneath the grease, and in the case of nitrous acid without any air at all, of oxidising a very considerable quantity of iron by parting with their own oxygen. The first result of this chemical process is to produce a bulky residue which breaks its way through the thin layer of oil or grease above it, so permitting direct contact with the air. The obvious treatment for barrels is, therefore, to use a suitable alkaline jelly capable of finding its way into all crevices and then neutralising all acid residue left in the barrel after cleaning. In order that such a material shall not be unduly hampered in its action by the presence of deposits of metallic fouling, weapons should be occasionally examined by a skilled armourer having a suitable set of gauges. Capt Hardcastle is of opinion that the use of the double pull-through with wire gauze should be limited to the armourer.

Speaking from our own experience we feel inclined to endorse everything that Capt. Hardcastle has said. Conscientious cleaning with a rag is of course absolutely necessary for every rifle, but it is now clear that with modern military ammunition evils arise which the rag cannot stay. Their growth may certainly be minimised by the use of a strong alkaline jelly prepared with suitable reference to the chemical relation of the materials used. An alkali which merely combines with the grease and so forms soap will not neutralise nitrous material in the powder residue; but if the rifle cleaning oil is scientifically prepared with suitably selected materials so that every part of the whole bulk contains a

guaranteed proportion of alkali free to act upon the powder residue, then there can be no doubt that its use will be attended with satisfactory results. Not only will the amount of oxidising agent left in the barrel be reduced, but a good coating of the grease should keep the atmosphere from reaching the steel, thereby depriving the metal of the essential elements for the oxidisation process. Capt. Hardcastle has supplied a prescription for a suitable jelly of this kind to Mr. Steward, the well-known optician and rifle expert. It is sold under the name "Nackanock," and it seems to be an inexpensive and in every way effective cleanser for rifle barrels. To those whose own experiences enable them to to appreciate the sound practice and theory underlying Capt. Hardcastle's views we would recommend the whole-hearted adoption of the advice he so unassumingly puts forward in the interests of his fellow sportmen in the rifle arena.

CORRESPONDENCE.

CARTRIDGE PRICES.

To the Editor of *Arms and Explosives.*

SIR,—On reading through Mr. Nettlefold's somewhat forceful letter, I look in vain at the end for the declaration, usual when anything is strongly recommended, that the writer is in no way connected financially with the article held up for special praise. I think in the absence of this, it is not surprising that a new subscriber to your valuable paper can only attribute that intimate knowledge of the superior excellence of Bonax, Kynoid and Opex (somehow these names always remind me of Shadrack, Meshak and Abednego) to more than a passing interest rather let us say to a "fixed principle." Mr. Nettlefold says these cartridges are only possible under a Free Trade policy, or as he has graciously allowed us to use the term, under a policy of "Free Imports"; but as Sam Weller says, "whether it is worth while going through so much to attain so little" is doubtful.

Anyhow it does not seem an argument that will cause those who used to earn a living by loading cartridges to uphold "Free Imports" (by permission) by which it is only possible for a big firm that make everything themselves to compete with anything like success against the foreigner in the home market, wiping out hundreds of their smaller brethren in the process. Fortunately Bonax, Kynoid and Opex are only loaded with Kynoch Smokeless Powder. This ensures a livelihood for a few people in loading other powders. The pride of the manufacturers in question in making their own powder suggests the story of the Irishman who knew the shilling was good because he had made it himself.

Yours etc.,

WALTER H. BAXTER.

The Wilderness, Sherborne, Dorset.
May 20th. 1904.

To the Editor of *Arms and Explosives.*

SIR,—As a reader of your paper I must state that I am pleased to see that you appear to favour measures to stop the present cutting of prices in sporting cartridges. This I consider ought to have been done years ago, as it would have been beneficial to the ammunition makers and also to gunmakers generally. Sportsmen were willing to pay a fair price for their cartridges until the present cheap trade was started and the question remains to be answered, where is it going to stop. Possibly in the near future we shall have cartridges sold with a coupon entitling the holder to some kind of article as a gift.

It is evident that the manufacturers have not taken into consideration that whilst they are creating the demand for a cheap cartridge it is detrimental to their better qualities. As an instance I may quote the cheap rabbit cartridge loaded with black powder. In years gone by the green and blue qualities were freely sold, but now the cheap smokeless cartridges are being sold in their place. The fault does not lie with the gunmakers and others who retail cartridges, and who naturally expect to make a living profit, but with the firms who first placed the cheap cartridges on the market. Anyone who looks through the advertisement columns of the sporting papers cannot fail to notice that such and such a firm will send 1,000 of the cartridges carriage paid to any station in the United Kingdom, and I have now before me a circular stating that a certain firm will even send 500 cartridges carriage paid. Now where does the gunmaker stand a chance of doing profitable trade when he has probably to wait six or even twelve months for his money. He cannot afford to grant credit on the present prices, and even when he does his own loading he is working at a disadvantage through buying the components in small quantities.

The recommended remedy of stocking factory loaded cartridges does not satisfy the existing conditions of the market, as it is not every customer who requires cartridges with standard loads. The differences specified by the customer may be simple enough in themselves, but the gunmaker must load cartridges if he wishes to execute the orders he receives. The factory loaded cartridge is making this yearly more difficult, by reducing the scale of prices below a level at which it is profitable to pay prompt and individual attention to the needs of the special customer.

Yours, etc.,

ONE IN THE TRADE.

TRADE MARKS.

ADVERTISED. MAY 4—25, 1904.

260,361. A device representing a palm beneath which is the word "PALMA." The displayed matter added is as follows: "King's Norton Palma Cartridges. Specially manufactured for rifle shooting competitions by the King's Norton Metal Co., Ld., nr. Birmingham. Ammunition Works, Abbey Wood, Kent." To apply to military cartridges. Jan. 21, 1904.

REGISTERED, APRIL 21—MAY 18, 1904.

264,670. The Delta Metal Co., Ld.
259,706. } Harrod's Stores, Ld.
259,707. }

APPLICATIONS FOR PATENTS.

APRIL 18—MAY 21, 1904.

8,964. Cartridge Container. F. Dagnall.
8,975. Range Finder. C. F. T. Wyndham-Quin.
8,988. Torpedo Protecting Apparatus. S. J. Prescott.
8,995.* Counteracting Recoil. P. Jensen (Agent for *The McClean Arms and Ordnance Co.*).
9,008. Sectional Targets. G. A. Peters.
9,096. Self-Registering Targets. J. Twaddle.
9,153. Air Guns. F. S. Cox.
9,192. Small-Arm Sights O Imray (Agent for *N. Barratt*).
9,286. Gun Carriages. S. B. Apostoloff.
9,293. Firearm Sights. O. Gergacsevics.
9,296. Pistols. A A Blaker.
9,434. Range Finder. D. C. Davies.

9,452.* Cartridges. W. C. Bush. (Date of application in U.S.A., April 29, 1903.)
9,461. Range Indicator. A. T. Dawson and G. T. Buckham.
9,462. Semi-Automatic Ordnance. A. T. Dawson and G. T. Buckham.
9,519. Double Telescopic Sight. W. Barrett.
9,552. Lance. P. H. Stringer.
9,588.* Automatic Firearms. H. H. Lake (Agent for *Winchester Repeating Arms Co.*).
9,612. Removing Mines or Torpedoes. F. S. Pett.
9,643. Orthoptic Sight. H. McKenzie and W. Tivendale.
9,735. Balanced Targets. E. T. Humphries.
9,782. Ordnance. W. R. Swain.
9,943. Percussion Fuse for Shell. A. Höfner.
9,962. Nitrocellulose. C. D. Abel (Agent for *Ag. für Anilin Fabriken*).
10,072.* Small-Arm Safety Device. J. Tambour.
10,262. Range Finder. G. Forbes.
10,270. Gun Shields. R. A. Hadfield and A. G. McK. Jack.
10,288. Practice Ammunition. W. H. Trask.
10,366. Explosive. N. Guthridge.
10,540. Cartridges. A. Reichwald (Agent for *Fried. Krupp, Ag.*).
10,542. Ammunition Limbers. A. Reichwald (Agent for *Fried. Krupp, Ag.*).
10,565. Gun Carriages. A. T. Dawson and G. T. Buckham.
10,635.* Ammunition Limbers. Fried. Krupp, Ag. (Date of application in Germany, May 13, 1901.)
10,663. Formation of Guncotton Blocks. G. W. Bell.
10,699. Gun Silencers. R. Lucas.
10,837. Fuse Heads. F. Render.
10,946. Bullets. H. Stanbridge and W. Walker.
10,966. Small-Arms. W. Youlten.
11,000.* Explosive. E. Steele.
11,066. W. G. Brodie and the British Moss Litter Co., Ld.
11,314. Range Finder. J. Johnson.
11,344. Small-Arm Lock Mechanism. O. Imray (Agent for *Deutsche Waffen und Munitions-Fabriken*).
11,427. Explosives. A. C. Luck.
11,428. Explosives. A. C. Luck.
11,530. Small-Arm Breech Actions. P. T. Godsal.
11,599. Automatic Small-Arms. T. Southgate.
11,634. Torpedo Nets. W. T. Bullivant and G. M. Selby.
11,700. Firearms. D. Abercrombie.

*These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

APRIL 28th—MAY 19th, 1904.

COMPILED BY HENRY TARRANT.

28,831* (1902). **Bolt Action Rifle Mechanism**. T. R. R. Ashton, London.

8,278* (1903). **Manufacture of Nitrocellulose**. J. M. and W. T. Thompson, Waltham Abbey.

8,937 (1903). **Range Finder for Rifles.** P. R. J. Willis, Kingston-on-Thames (Agent for *A. Kennedy, Canada*). A range finder, consisting of two plates arranged at right-angles to a third plate, which is attached to the side of a rifle. The two plates are so notched that a line passing through any two of the notches forms one side of a triangle whilst the axis of the rifle forms the other. The distant object is situated at the apex of the triangle, and the range is so discovered. Accepted April 14, 1904.

11,889 (1903). **Small-Arm Safety Device**. T. B. Kinder, Leamington. A small-arm sear lock is actuated through the medium of a thin steel rod, which communicates the inward movement of a false butt when the gun is pressed into the shoulder, and so frees the sears. The heel pad is forced outwards by springs when the pressure is removed, thus automatically applying the safety. Accepted April 28, 1904.

12,279 (1903). **Manufacture of Hollow Projectiles**. Cummell, Laird & Co., Ld., F. C. Fairholme, and J. E. Fletcher, Sheffield. In order correctly to centre the core in the moulding of hollow projectiles, an annular space is left between the top of the core stem and upper part of the conical plug through which the core stem passes. A templet is dropped into the mould, and the annular space is filled up with some plastic material. The core is thus held in the exact central position as arranged by the templet. Accepted April 1, 1904.

12,456 (1903). **Automatic Target Apparatus.** G. Hoffmann, Germany. A number of targets are so arranged in combination with an electromotor that they may be turned through an angle of 90 deg. from the firing point. Through the medium of a second switch board and key, detonators may also be fired to represent the counter fire of the enemy whom the targets are intended to represent. Accepted April 21, 1904.

12,676 (1903). **Rifle Breech Opener**. G. T. Richardson, London. By means of a revolving plate provided with a spiral flange, which works in conjunction with a toothed bar, the bolt of a rifle may be actuated to expose or close the breech. The device is intended principally for doors and windows Accepted April 7, 1904.

12,978 (1903). **Sectional Targets**. G. A. Dickie, Leith. The sections of a target are so arranged on different planes that there is no space between them to become clogged by bullet splashes. The edges of the sections are inclined, so that should a bullet hit the outside of one part, it slides off on to the part immediately behind it. When the target is struck the section receiving the impact is caused to complete an electrical circuit, and the current indicates the position of the hit at the firing point. Accepted April 14, 1904.

13,470 (1903). **Breech Mechanism for Ordnance.** A. T. Dawson and G. T. Buckham, London. The type of ordnance breech mechanism in which one continuous movement unlocks the breech screw and withdraws the block from the gun, is so modified that the tendency during the unlocking movement to displace the axis of the breech block laterally is obviated. The friction on the threads is thus decreased by applying the continuous unlocking and swinging out forces in a "couple." Accepted April 21, 1904.

13,531 (1903). **Blasting Explosives.** J. Wetter, London (Agent for *Westfälisch-Anhaltische Sp-Ag., Germany*). Improvements in the composition of explosives described in Patents Nos. 25,884 and 26,617, are set out in this specification. The safety from fire-damp of these explosives may be rendered almost absolute without materially reducing the explosive force, by adding inorganic halogenides, *i.e.*, chlorides, bromides or iodides of metals, such as potassium or sodium chloride. An example of this modified explosive is as follows:—Nitroglycerin, 39 per cent.; collodion cotton, 1 per cent.; paraffinum liquidum, 7 per cent.; ammonium nitrate, 19 per cent.; potash saltpetre, 4 per cent.; sodium chloride, 6 per cent; and rye flour, 14 per cent. Accepted April 21, 1904.

13,659 (1903). **Sporting Cartridge Cases.** E. Jones, Witton. A machine for automatically manufacturing the caulks which are inserted in sporting cartridge cases to strengthen the heads and to receive the cap chambers. The operation is expedited and cheapened. A strip is cut from a roll of paper by the machine, which winds the strip into cylindrical form, compresses a number together, and discharges the caulks of exact size complete. Accepted April 21, 1904.

13,660 (1903). **Capping Cartridge Cases.** E. Jones, Witton. By means of the machine described in this patent cartridges are capped and anvilled in the course of manufacture. The anvils and caps are supplied to hoppers by hand. The cases are placed in a revolving disc forming part of the machine, and they are adapted to receive the caps and anvils delivered from these hoppers. The capping operation is worked upon similar lines to that described in Patent No. 2,629, 1902. Accepted April 21, 1904.

13,671 (1903). **Heavy Ammunition Hoists.** A. T. Dawson, London and J. Horne, Barrow-in-Furness. In order to facilitate the supply of ammunition to the platform of guns of large calibre, two rotating bogies are arranged to receive projectiles from stationary trays, upon which they are deposited by runners from the storage bins. The bogies rotate on the principle described in Patent No. 9,415, 1899. From these bogies the projectiles are delivered to waiting trays on the revolving trunk. From thence the ammunition is deposited in the hoisting cages. Accepted April 14, 1904.

13,752 (1903). **Submarine Torpedo Boat**. A. Watkins, Wolverhampton (Agent for *The Electric Boat Co., U.S.A.*). A submarine torpedo boat, provided with the necessary apparatus for diving and running under water, is described in this Patent. Means for compensating the weight of torpedoes expended consist in an elongation of the torpedo tube, so

that a torpedo shall be held in readiness to take the place of the one to be discharged. Accepted April 28, 1904.

14,567 (1903). **Shooting Glove**. R. Kommer, Austria A shooting or military glove, so designed that when the middle finger is bent to grip the small of the stock, the upper part of the glove on the forefinger is automatically withdrawn. When the hand is relaxed the finger is again covered. The link connecting the two glove fingers may be removed so that the glove may be used in the ordinary way. Accepted April 21, 1904.

14,827 (1903). **Manufacture of Explosives**. J. Y. Johnson, London (Agent for *The Loc. Anonyme des Poudres et Dynamites, France*). A method of decreasing the sensitiveness of dynamite to shocks, consisting in the use in manufacture of solid nitrated derivations of the aromatic series having a melting point below 100 deg. C. A proportion of from 5 to 10 per cent. of dinitro-toluene or trinitrotoluene is dissolved in nitroglycerin to secure the desired results. Accepted April 21, 1904.

20,814 (1903). **Time Fuse for Shell.** A. Reichwald, London (Agent for *Fried, Krupp, Ag., Germany*). The locking of the hand-operated composition ring of a time fuse in the position to which it has been set, is ensured by the provision of a punch and an annular tip. When the projectile is started down the bore of the gun, inertia causes the punch to cut a piece out of the tip and enter the recess so formed. Accepted April 28, 1904.

22,787 (1903). **Prevention of Erosion**. L. Luciana, France. Through the medium of a double cardboard envelope, the burning powder charge is confined when passing through the gun barrel. The two cardboard tubes, one of which is provided with a vent for the gas, follow the projectile down the bore and surround the powder during combustion. Its erosive action is in this way obviated. Accepted April 14, 1904.

2,507 (1904). **Range Finder**. M. Nelson, Bath. A range finder, consisting of a telescope and a base tube, fixed at right-angles one to the other, and forming together the letter L. By means of two right-angled prisms and two object glasses, which work in conjunction with a cross wire in the base tube, the image of an object is indicated upon a micrometer scale from which its range is observed. Accepted April 21, 1904.

3,301 (1904) **Blasting Explosives**. J. Fuhrer. Austria. The patentee has discovered that with the aid of metalloid silicon, explosives of very great power can be obtained. The following is an example of an explosive embodying this powerful gas expander:—Ammonium nitrate, 73 per cent; charcoal, 2·5 per cent.: dinitrotoluene, 14·5 per cent.; silicon, 10 per cent. Sulphur or its compounds may also be added. The detonation of an explosive containing silicon is greatly increased by the admixture of aluminium. Accepted April 21, 1904.

4,729 (1904). **Adaptors for Rifles.** F. Greener, Birmingham. An adaptor for firing reduced ammunition in military rifles, consisting of a tube constructed to fit in the chamber of the rifle, and to take the smaller cartridge. To this tube is secured a shoe, carrying its own bolt and striker. This shoe with its parts is constructed to take the place of the ordinary breech mechanism of the rifle. Accepted April 14, 1904.

5,126 (1904). **Manufacture of Nitrocellulose**. A Voigt, Germany. A process of manufacturing nitrocellulose, consisting in dissolving cellulose at a low temperature in concentrated sulphuric acid and then nitrating the product by adding nitric acid. This process, it is claimed, is considerably more simple than those now in vogue, being less complicated and less expensive. Accepted April 14, 1904.

6,561 (1904). **Indicating Targets.** R. M. V. Bremer, Belgium. A pivoted target, adapted electrically to indicate the reception of shocks. The oscillating support of the target is so mounted and weighted as nominally to lean forward against an abutment situated in front of the centre of rotation of the target. The angle of inclination of the supporting lever forms one of the factors on which depends the force of resistance to the shock of projectiles, which shock may be wholly absorbed. The target may be constructed in sections, and is applicable to practice with small-arms or ordnance. Accepted April 21, 1904.

6,679 (1904). **Fuse for Electric Blasting**. F. Render, Manchester. A method of fixing the electric ignition wires in a fuse, consisting in binding them strongly with a metal ferrule. Rough handling does not derange them. Ignition is insured by flattening the ends of the wires and forming two or more points so as to get a corresponding number of sparks. Accepted April 21, 1904.

6,729 (1904). **Spring Pistol**. W. H. Ell, London. A spring pistol, in which a powerful spring is retained in its compressed state by a pivoted sear. An ordinary trigger releases the spring through the sear, and so ensures more accurate shooting. The whole of the parts are enclosed. Accepted April 21, 1904.

7,038 (1904). **Expanding Projectiles**. H. Platz, Germany. An expanding projectile, so constructed that the ballistic properties are unimpaired, whilst the stopping propensities are up to the level of the old lead bullets. The spirit of the International Agreement is fully complied with. The stopping effect is produced by just weakening the nickel casing at a point at the base of the nose. The nickel casing may be cut away circumferentially at this point, leaving the lead exposed to attain the desired end, Accepted April 28, 1904.

*These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

A STRAIGHT PULL RIFLE BOLT ACTION.

28,831 (1902). T. R. R. Ashton, London. The rifle bolt action mechanism described in this specification is designed to operate the turning and sliding movements of the breech bolt in the straight pull manner dealt with in patent No. 799, 1889. No preliminary turning of the bolt handle is necessary. A straight pull rotates and so unlocks the bolt from the breech and throws out the empty cartridge case.

Fig. 1

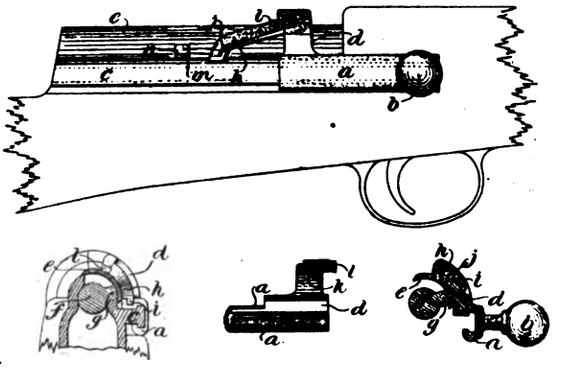


Fig. 2

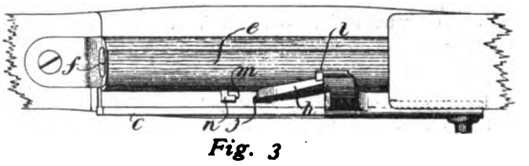
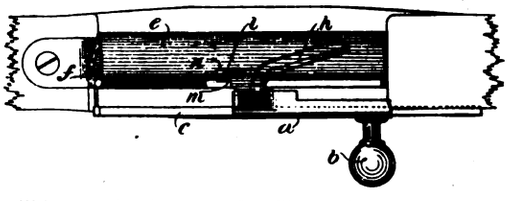


Fig. 3



As will be seen in the appended illustrations of this mechanism, the bolt operating slide *a* carrying the handle *b* is supported by, and works upon, the T-shaped guide rail *c*. Its rear end is provided with the curved arm *d* which extends upwards over the sand

cover *e*. The sand cover encloses the turnbolt *f* carrying the usual guide lug *g* (Fig. 4). An approximately helical guide lug *h* is fixed upon the cover *e*, and along its inclined front face *i* is arranged a flange *j*. The extremity of the arm *d* is grooved upon its under side at *k* (see detailed drawings). This groove is narrower at one end than the other. The straight face of the groove fits the helical face of the lug *h*, whilst the curved face fits the curved lower extremity of the lug. The projection *l* is adapted to take into the flanged portion *m* of the stop abutment *n* fixed behind the lug *h* upon the sand cover *e*.

When the parts are in position illustrated in Figs. 1 and 2 the bolt head is locked within the breech. It is unlocked by pulling upon the handle *b*. The motion imparted by this means to the slide *a* causes the lower end of the groove *k* in the arm *d* to slide over the under edge of the lug *h*, and so to give a rotary motion to the sand cover *e* and to the bolt *f*. The speed of this motion depends upon the pitch of the lug *h*. When the arm *d* reaches the position shown in Fig. 3 the bolt is unlocked. The projection *l* is brought up against the stop *n* and a continued backward pull opens the breech. When the bolt is pushed forwards again the arm *d* presses against the lower end of the lug *h* until the bolt is brought up against the breech as in Fig. 3. The groove *k* is then caused to slide over the lug *h* and to rotate the bolt, so locking it again in the breech. Several modifications of the mechanism are dealt with in the specification, the lug and groove connection being principally attended to. The straight pull system is not claimed broadly, merely the type described in this patent. Accepted March 30, 1904.

THE PREPARATION OF NITROCELLULOSE.

8,278 (1903). J. M. and W. T. Thompson, Waltham Abbey. Apparatus for use in a modified process of preparation of nitrocellulose, is dealt with in this specification. The acids of nitration are removed from the nitrated material after the action has been completed without the aid of moving machinery. The acid extraction and preliminary washing operations are combined in the manufacture of nitrated celluloses by removing the acids of nitration by displacement. Water is run carefully upon the top o the acids which are slowly drawn away at the bottom of vessel described.

The apparatus employed in this process consists of a rectangular lead-lined or earthenwnre tank *a* such as is illustrated in the drawings appended. The tank possesses a false bottom *b* supported by ribs *c* over the real bottom *d*. The bottom slopes down to the the outlet pipe, over which is a perforated strainer *e* to prevent choking. Two troughs *f* with their depending aprons *g* are supported near the top of the tank. These two troughs *f* are supplied by the branches *h* of the tube *i*, either with the sulphuric acid from the tank *j* or with the water from the supply *l*. The nitrating acids are supplied through the pipe *m*.

A charge of mixed nitrating acid is supplied to the tank up to the mark *n*, and the dry cellulose is introduced into the acid in small quantities and is pushed under the surface in the usual manner. About a half-inch layer of sulphuric acid, of a gravity not exceeding that of the waste acid to be produced, is run carefully on top of the nitrating acids by means of the troughs *f*. The troughs are perforated so that the sulphuric acid shall run down the aprons *g*, and float on to the nitrating acids. The whole is allowed to stand until nitration is complete. Water is then supplied to the troughs by way of the pipes *l*, *i* and *h*, and is allowed to float gently over the surface of the sulphuric acid. When a sufficient layer has been formed, the cock *p* is opened and the acids are slowly drawn off, water being supplied to keep the level constant. It is found that the rate of displacement of the acids is a factor which exerts considerable influence on the properties of the resulting nitrocellulose and affords a means of regulating the temperature of displacement. The rate of displacement recommended is about two inches in depth of vessel per hour when treating highly nitrated celluloses. This rate may, however, in some cases be considerably increased. The water gradually and entirely displaces the acids from the interstices of the nitrocellulose, the line of separation between acid and water being fairly sharply defined throughout. The flow of water is sustained

Fig. 1

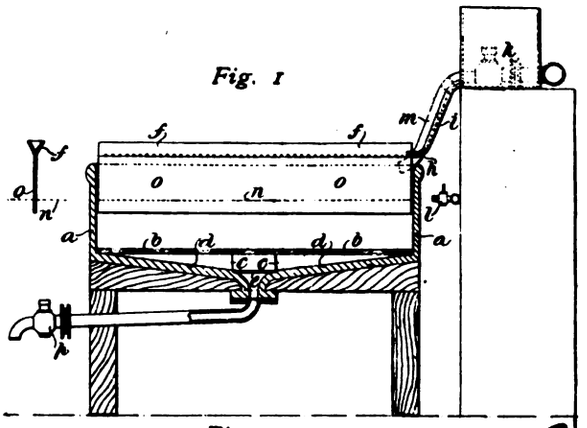
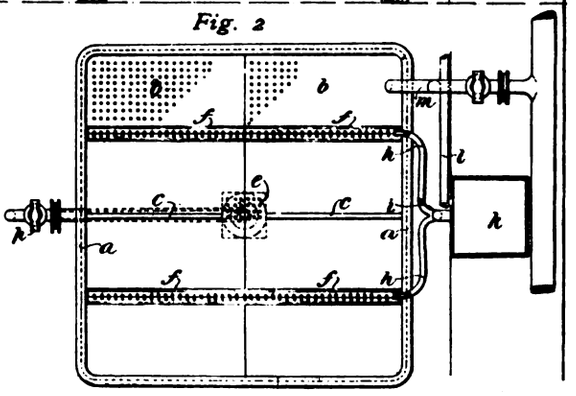


Fig. 2



until that issuing from the cock *p* is found to be free from all trace of acid. The object of introducing a small layer of sulphuric acid is to prevent the fuming which would otherwise take place. It is not essential. The purification of the nitrocellulose is proceeded with as usual.

In order to use the acids in the most economical manner, the waste acid from a previous nitration may be used for a first nitration of the cellulose, being displaced to complete nitration by fresh acid which in turn is displaced by water. Accepted April 7, 1904.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

The Palma Trophy.—Having, in common with the rest of our colleagues on the newspaper press, strongly expressed our feelings in connection with the conditions under which the Palma Trophy was won last year we must equally congratulate the Executive of the American National Rifle Association in having, tardily we admit, taken the right course by returning the trophy. We cannot however blind ourselves to the fact that every possible evasion was adopted until our own Association forced the hands of the American Association by submitting the matter to public judgment. As an Englishman wittily put it, it is like going to buy a pound of butter with a good and bad coin in one's pocket. The transaction is duly completed with the aid of the spurious coin, and when a complaint is subsequently lodged the purchaser defends his action by explaining that he had a good coin in his pocket all the while, and was only delaying its presentation until the badness of the other was objected to. Such action must certainly do a vast amount of harm to American rifle shooting, and for our part we cannot help thinking that the mere returning of the trophy will not set matters right in America so long as the Executive responsible for what has happened remain in office.

Explosives Inspection.—While we regret that the necessity for allocating our space according to the needs of the reader reduces our notice of the annual report of H.M. Inspectors of Explosives to a brief review, it should be understood that this in no way implies any want of appreciation of the excellent public service which is rendered by these gentlemen. We have always held the opinion that the Explosives Department of the Home Office is a model of administration from whatever point of view it may be regarded. All business submitted to the department is promptly dealt with, and the greatest care is exercised to prevent any disproportion arising as between the conflicting claims of safety on the one hand and commercial considerations on the other. H.M. Inspectors have at all times been singularly successful in drawing the happy line between the provision of adequate safeguards and the enforcement of unduly harassing restrictions. To anyone who makes a really careful scrutiny of the annual report, it will be apparent how great is the task which the four inspectors carry through in the course of the year. The fact that their remuneration costs the country so small an amount in proportion to the important and technical character of the services rendered, entitles them to a large measure of public gratitude for their enthusiastic interest in a task which must largely be a labour of love. Their annual publication of a report covering the year's doings is supplemented by a large amount of work in the preparation of special reports. The care with which these are compiled can only be compared with the judicial thoroughness with which a judge sums up the arguments in a highly contentious and technical piece of litigation. The sole excuse which we can make for dealing so inadequately with the very important body of material which emanates from the Explosives Department of the Home Office must, therefore, lie in the assumption that our readers lose no time in possessing themselves of the original documents, the receipt of which is from time to time acknowledged in our columns.

Cartridge Loading Arrangements.—The time has now arrived when our large cartridge loading organisations have awakened from the lethargy of a winter's rest following upon a bad season, in which the accumulated stock was inadequately liquidated. Fortunately for the home trade, orders from the colonies and abroad have been very plentiful of late. This favourable symptom seems in our opinion to arise from the altogether exceptional and widespread interest which is taken in this country in the many technical questions that are involved in the production of first-class sporting ammunition. There is hardly any aspect of the sporting cartridge which has not at one time or another been made the subject of special research and standardisation. The logical consequence of this important original work has naturally been to produce a greatly enhanced quality of output. Whatever may be the condition of other trades, in one at least there can be but little doubt that we stand in the very front rank. It is quite possible that while we have specialised the short game cartridge as adapted for the conditions of sport met with in this country our American cousins have been equally hard at work in improving the heavier charged cartridge of the pigeon variety, this being suited to their own average of work. No matter what may be said concerning openings for improvements in the cartridges which are daily manufactured we feel fairly confident that the output of our leading factories in this country represents a very high average performance, of which we may well be proud.

Manufacturing Developments.—One of the most serious problems which the manufacturer must face is the extraordinary amount of turnover which he is called upon to deal with to earn the profit which was so much more readily compiled in years gone by. No matter what department of manufacture may be considered, the lesson appears to be the same. The customer is far more critical of quality than ever in the past, and he will even reject thoroughly sound and satisfactory goods for minor blemishes of finish. The customer does not, however, appear to be willing to pay for goods of such exceptional quality in proportion to the added cost of manufacture. He assumes that the manufacturer must find his remedy elsewhere, that is by increasing the efficiency of his methods and the amount of his turnover as to be able to supply the article at a reduced rate. While this principle, carried a certain distance, represents a welcome sign of manufacturing progress, there are many trades in which competition seems always tending to reduce profits to the disappearing point, while calling upon the manufacturer to keep his works going for the very nominal consideration of avoiding serious losses of capital. This difficulty is not confined to any one country, since wherever we look we find that the manufacturer is constantly driven in the direction of finding fresh means for effecting economies, thereby postponing to a future date the calamity that always seems to be pending. It is unlikely, in the nature of things, that an absolute crisis will ever be reached; but the effect of the tendency which we are discussing seems likely year by year to increase the stress and anxiety under which manufactured articles are produced. The only remedy that appears to be available is to endeavour at all times to anticipate by a few years the improvements that adversaries will adopt. This battle seems likely to be one amongst giants, the smaller man, unless he is a true specialist, finding it impossible to meet with a small organisation the competition of the large corporations, which are ever developing their resources and constantly on the look out for means whereby they may enlarge their turnover and so spread establishment expenses over a larger area of enterprise.

The Bisley Meeting.—In a few days' time the meeting at Bisley will be in full swing, and reputations will be gained or lost according to the skill of the competitors and the quality of the materials which are supplied for their use. It is very difficult to draw any very close connection between trade interests and the doings at this meeting. Certainly a large number of trade manufactures are used thereat. Consequently the skill or otherwise exercised in their production is subjected to a practical test which is of the greatest use to the maker. There is no fear or favour about a Bisley verdict. The best is bound to come to the front by sheer good quality, whereas no amount of misplaced advocacy will force something which is intrinsically bad into favour. Military rifle shooting with match sights is necessarily allied very closely to the daily work of the firms who act as manufacturers of the ·303 and other military cartridges. Revolver competitions again serve mainly as a test of the latest developments in revolver ammunition, and it is really remarkable to notice how the quality of the scoring increases year by year, the shooter appearing on every occasion to produce results beyond the theoretical accuracy of the cartridge. There can, however, be no doubt that the loading and ignition of Cordite revolver ammunition has so rapidly advanced in quality during the last few years as to account in a great measure for the improved quality of the shooting. This year it is likely that still further advances will be shown, particularly in the behaviour of the revolver over the 50 yards distance. In miniature rifles again we have a very interesting class of contest, which will help to settle our ideas as to which is the most suitable specification of weapon and cartridge for the diverse conditions of shooting which will be represented at the 100 yards range.

Our Lecture on Cordite Rifle Pressures.—The most technical question on which the gunmaker and ammunition manufacturer has been called upon to tackle during recent years is undoubtedly the determination of the best conditions under which Cordite may be used for high velocity express rifles. Various combinations have from time to time been brought forward, and these have been subjected to practical tests in all parts of the globe. A subsequent examination of the results obtained, together with physical experiments based thereon, has gradually evolved a series of laws which appear to govern this particular combination of rifle and cartridge. The most important test, to which all others are subsidiary, is of necessity the estimation of the gas pressure in the chamber. To arrive at accurate results, it has been found necessary to co-ordinate the abstruse researches of such scientists as Sarrau and Vielle concerning the general ductility of copper and its behaviour under pressure, also the relation of copper crushings to the actual pressure within the gun. These and many other problems had to be worked out virtually on first principles, and as a consequence we now have in a most compact form thoroughly sound working laws concerning the pressure evolved by Cordite charges under various conditions of use. In our lecture this month we have sought to enunciate with as little raising of abstruse scientific questions as possible

the theory which underlies the true estimation of pressure in Cordite rifles, and we trust that although our exposition of the subject is of so elementary a character, it will at least represent to the reader a certain amount of sound and definite instruction on a matter of considerable practical interest.

Partridge Prospects for the Coming Year.—At the commencement of the month just passed we spoke with a certain amount of doubt and hesitation concerning the state of the weather in reference to the breeding prospects of our feathered game. We pointed out that if a dry and genial spring could be followed with a mild month of June, free from tempestuous gales and heavy rains, there would be an excellent prospect for the season's head of game. We are now in a position to review the conditions of weather which have marked the interval. For the four weeks ending with the 25th ult. the usual weather reports have given us the measured rainfall at fourteen observation stations throughout the United Kingdom. The collated results disclose the very satisfactory circumstance that the average rainfall of all these stations has been well under half an inch per week during the period under review. Were we to exclude the exceptional districts where the rainfall is generally in excess we should find that the rainfall over the country as a whole has been confined to a few casual showers. This, coupled with the mild air and plenteous sun, ensures so far as anything can be judged a thoroughly satisfactory rearing season, thus giving us every reason for anticipating plenty of sport for the autumn. Even though the financial conditions may not be of the best there is always in this country a large body of sportsmen who will go out with the gun if there is any likelihood of a reasonable return on the expenditure of effort. We may, therefore, regard the anxieties of the shooting season as settled on a most satisfactory basis.

CIVILIANS IN MILITARY POSTS.

THE newspaper press frequently contains references to the argument for and against the appointment of military officers to certain of the more commercial administrative posts of the War Office. The class of person who writes this kind of article cannot in the nature of things be an expert in the actual manufacturing problems, and as a consequence mistaken principles are frequently advanced as though they were incontestable truth. The line of reasoning commonly followed is that if a given position involves the exercise of commercial manufacturing ability, then a man trained in the commercial pursuits is obviously more suited for the position than a military officer who is drawn from his regiment for service of this kind, and returns after five years' service to the old routine. This admittedly is quite true, but unfortunately it fails to appreciate a most significant circumstance. This is that, while the salaries paid to officers holding such positions will compare favourably with any post of equivalent grade in the fighting forces, the remuneration would be beneath the notice of a practical bedstead manufacturer, or a maker of brass fittings. There has admittedly been an attempt to increase the pay attaching to special positions in the manufacturing departments, but even so it must be stated that the profits of manufacture for private concerns provide much better remuneration for the chiefs of industry than anything the Army service can offer. It must necessarily follow that the many types of intellect which embrace those taking up an Army career must include men of sterling commercial ability, the natural bent of whose mind is rather towards commercially applied science than the honour and glory of campaigning in wild countries, which is so quickly shorn of the romance with which youthful dreams surround it.

Among those who attain the more important positions in the manufacturing, the scientific and the testing department, there must necessarily be a certain nu nber of officers of exceptional ability. Those who have graduated in the more scientific branches of the service must necessarily be mathematicians of the highest order, while in addition to this many of them have received a very fair scientific training of the kind that is so valuable when corrected and modified by close connection with practical problems. Out of the many thousands of officers in the British service, it would be a truly remarkable thing if the manufacturing department failed under a proper system of early selection and gradual training in subordinate positions to build up a staff of experts equal to the best that ordinary commercial experience could produce. Government manufacture is certainly not so arduous a task as that which besets the company director having dividends to pay on invested capital. The prime cost of a military made article takes no account of establishment expenses, while in addition, each department is served by a whole host of officials who act in an advisory or other capacity, the cost of which is not charged against the manufacturing grant. It thus happens that the problem of Government manufacturing is relieved of three-quarters of the troubles which represent the anxieties of commercial enterprise. If orders are slack, visions of the annual general meeting do not perturb. Quality of manufacture may always be considered apart from the grosser commercial questions of producing the goods at a profit. Why, therefore, it should be necessary with so large a body of raw material to select from, to look to men of commercial training to run a Government factory it is difficult to see, and yet the fact remains, that the officer is regarded as an incompetent class of person who is incapable of dealing with the foremen and others who are placed under his control.

The sole explanation of the difficulties of personnel which arise in conducting our manufacturing departments, is that the moment an officer proves himself to be worthy of the trust that is placed in his hands, that officer is worth to a commercial organisation twice the salary he receives from the Government. The fettering conditions of the Government service make a post with a contracting company a far more pleasant and permanent occupation. It would be invidious to name the many instances that must rise to one's mind of officers of sterling abilities who have passed into the service of private companies. In fact it is exceedingly difficult to name half-a-dozen men of ripe experience who have remained in the Government service after learning all that Government work could teach them There are of necessity a few exceptions, but certainly the fact that the Government cannot keep its own most efficient officers is proof positive that the positions which they abandon for private employment, will not tempt those already engaged with commercial firms, to take up the responsibilities of a Government post, which are too often unaccompanied by the power of control which makes the responsibility a real one.

A BALL-BEARING RIFLED GUN.

IT is an article of faith among all journalists to recognise the pre-eminence of our national newspaper the *Times* as a somewhat solid but none the less reliable authority on the great variety of subjects which it includes in the scope of its editorial treatment. The extraordinary competition in the newspaper world has apparently caused our august contemporary to unburden its soul concerning its greatness, and the method by which its marvellous influence has been fostered and maintained. In introducing to the public its new scheme of subscription at a reduced rate per copy it has drafted and widely circulated a very large amount of pamphlet matter showing the origin of the journal and explaining how the perfection of its methods has been attained. It appears for instance that the *Times* has at its command an immense staff of experts who are conversant with specialised departments of knowledge, and the articles which are published are revised, edited and qualified according to the acute intellectual vision of these personages in the background. While we are willing to recognise to the full the immense value of the information contained in the ordinary daily issues of our contemporary, we must confess to a certain amount of scepticism as to the unvarying wisdom which underlies the treatment of certain subjects which specially interest our readers. We have for instance still fresh in our minds a highly favourable notice of an instrument known as the hyposcope, and we could not help disagreeing with the comments which were passed on this, to our mind, inconvenient appendage to a military rifle.

In the *Times*, however, of the 18th ult., we find an article which really seems to require detailed attention. It is entitled, "A Ball-bearing Rifled Gun," and the fact that it comes "from a Correspondent" cannot detract from the editorial want of caution that has allowed three-quarters of a column to appear concerning a weapon upon which one line would have been too much. The article opens with a reference to the curious circumstances that the history of firearms contains no instance of a fundamental change in the means of rotating the shot. It seems that it has been left to an American inventor to conserve the heat which is expended in friction between the shot and the rifled bore. His device consists of a series of spirally arranged ball-races following the ordinary line of the rifling. The rolling bed which the projectile may thus traverse gets rid of all friction in the barrel, with the result that recoil is annihilated, the tendency of the bullet being rather to drag the gun after it than to kick it away behind it A more terrible and ignominious error concerning the elementary laws of motion could hardly be imagined than this extraordinary statement. When we read further on, particulars of the gun's velocity and range, and assertions that it is gas-tight we do so with mild surprise, our power of being astonished having already been exhausted. The climax is, however, reached when we find that sand thrown into the weapon and mixed in with the balls seems to act as a lubricant, there being actually an increase of efficiency amounting to four per cent. We must before going further disassociate ourselves from this theoretical explanation, since an increase of velocity from such a cause would be more likely to arise from a greater confining of the gases, and, therefore, more active burning due to the actual friction set up rather than to the supposed easing of the friction by the sand.

Had the correspondent who wrote the article realised the true function of a ball-race he would have known that the balls, if they acted as ordinary balls or rollers, would revolve forwards towards the muzzle with every shot, and that the only way of carrying out the ball-bearing principle would be to complete the circle of each spiral of rifling by a ball race outside the gun, whereby the forward movement of the balls within the gun would be compensated by the delivery of a fresh supply from the back. If the ball race in the gun described contains no outlet at the muzzle end then the principle of ball-bearing disappears, and the weapon should be considered as a somewhat complicated form of smooth bore. More than this we doubt the ability of a spiral of balls to impart rotation to a projectile. It is well-known that the Chinese character is to show contempt for the European by the playing of sundry unpleasant tricks of which the victim is unconscious. In fact the whole essence of the joke is lost if its victim gains knowledge of it. In the same way we cannot help thinking that it is the ambition of the true artist in humour to be taken seriously, and we must, therefore, regard the notice which our contemporary gives of the new ball-bearing gun as an example of successful humour on the part no doubt of the American inventor.

Unfortunately from the joke point of view the new ball-bearing gun will hardly stand the test of originality which may be shown by the following extract from our issue of April, 1900:—"We are frequently indebted to our American contemporaries for particulars of the latest thing in ordnance. The most recent example is the ball-bearing gun described by a Cleveland journal. The ordinary form of rifling is replaced by spiral grooves, in which steel balls are free to move in a longitudinal direction. We can hardly describe the arrangement as simple, because there are a number of practical difficulties in its application which rise to our mind, and the solution of which is by no means obvious. Still, one may forgive a daily paper for avoiding technicalities, and consequently we may devote attention to the results obtained from such guns. Unfortunately our information will be of but little interest to Woolwich officials, who evidently know all about the gun, for we read that negotiations have been nearly completed with the Government of Great Britain, and that 'it is within the range of possibility that actual field tests of the gun will be made in South Africa.' The careful reservation of the writer entitles his statement to every credence. The gun will be an undoubted acquisition to our services, for do we not read that 'so easily does the projectile start on its death-dealing flight that the shock is reduced to a minimum.' Possibly this is a little vague, but we return to definiteness when we hear that after the gun had fired 2,310 rounds its loss of efficiency was only 3 per cent. Velocity results are not quoted, but in their place we hear that the range of the projectile has been increased 80 per cent. The ball-bearing system does not break down when the grooves are filled with sand, for it seems that, like emery on a bicycle chain, the grooves merely had a little better oiling. We do not desire to pose as cycling experts, but even so we must call attention to the use of emery as a lubricant for metal bearings."

THE NEW ELEY CATALOGUE.

WE have received from Messrs. Eley Bros. a copy of their new season's price list, which appears to merit special notice by reason of the many important improvements it registers, both as regards general quality of get-up and increased detail of information. The series of shot-gun cartridges which are described in the opening pages of the catalogue are carefully specified in tabulated form.

CARTRIDGES FOR BLACK POWDER EXPRESS RIFLES.

Description.	Black Powder Charge.	Weight of Bullet.	Pressure.	Muzzle Velocity.	Cordite Charge.	Metal Base Bullet.
	Grains.	Grains.	Tons per sq. in.	Feet per sec.	Grains.	Grains.
·577-3 in.	167	570	10	1725	77	570 express or 610 solid
·577-2¾ in. ...	160	520	10	1775	73	520 ,, or 570 solid
·577-·500-3⅛ in. ...	164	440	11	1880	73	440 ,,
·500-3¼ in. ...	142	440	11	1775	65	440 ,,
·500-3 in.	130	340	11	1925	63	340 express or 380 solid
No. 2 express ·577-·500	130	340	10	1850	60	440 ,,
No. 1 express ·500-·450	110	270	10	1900	50	325 ,,
·500-·450 magnum	140	325	11	1950	60	325 ,,
·450-3¼ in. ...	120	365	13	1775	55	325 ,,
·450-3¼ in. ...	120	270	11	1975	55	270 ,,
·450-·400-3¼ in. ...	110	230	11	2000	48	230 ,,
·450-·400-2⅝ in. ...	80	230	10	1850	38	230 ,,
·360-2 7/16 in. ...	55	190	—	1700	—	—
·360-2¼ in. ...	50	155	—	1700	27	190 ,,

The second portion of the catalogue is devoted to the numerous brands of rifle ammunition which Messrs. Eley regularly manufacture. Black powder and Cordite loaded cartridges are separately dealt with, the propulsive charge being in every instance specified together with the weight and nature of the bullet used. The series of express cartridges is exceptionally representative of all the leading types. So interesting is the information which is given concerning the leading brands of cartridge that we reproduce in an abbreviated form portions of these tables. The first table is particularly interesting, in so far that it contains details of the Cordite loading which has been adopted for use in black powder express rifles. We are informed that these are perfectly safe in black powder rifles of solid construction. They give rather higher velocity than the standard black powder ammunition, and are loaded with metal base bullets. The high power Cordite cartridges are similarly dealt with in another table, the special feature of which is that the tropical loads are specified immediately beneath those which have been worked out for use in temperate climates, the charges having in most instances been so adjusted as to give the same combination of pressure and velocity.

While it is impossible to specify in detail other interesting features of the new catalogue, we can at least find space to refer to two further points of special interest. In the first place we find that the Irvine gun lock tester has been subjected to an important modification of design. The special form of lead crusher indented by a knife has been abandoned in favour of an instrument with a flat-headed anvil and piston adapted for use with the ordinary Eley lead crusher, the strength of the blow being now registered in the same way as pressure, viz., by the shortening of the lead cylinder. It appears that the standard striker blow which produced an indentation with the old instrument of ·035 of an inch is equivalent under the conditions of the new test to a shortening of from ·010 to ·015 of an inch. The other point to which special reference may be made is the Gaudet reloaded military catridge as adopted by the Canadian Government for practice shooting at reduced distances. A new pattern of this cartridge is loaded with smokeless powder and a metal base bullet, the price working out at 3s. 6d. per hundred net cash. The Trask system of cartridge is also described, but we believe that a modified form of this latter is at the present time under consideration.

CARTRIDGES FOR CORDITE HIGH POWER RIFLES.

Ballistics when Bullets of Military Pattern are used in barrels 28 in. long, ordinary charges as fired at 60 deg. F., tropical at 120 deg. F.

Description.	Cordite.	Bullet.	Pressure.	Muzzle Velocity.
	Grains.	Grains.	Tons per sq. in.	Feet per sec.
·600-3 in.	110	900	14·0	1950
do. Tropical ..	100	900	14·0	
·577-3 in.	100	750	14·0	2050
do. Tropical ..	93	750	14·0	
·577-·500-3⅛ in. ..	90	570	13·5	2150
do. Tropical ..	84	570	13·5	
·500-3¼ in.	80	570	14·0	2050
do. Tropical ..	75	570	14·0	
·500-3 in.	80	570	16·0	2150
do. Tropical ..	75	570	16·5	
·500-·450-3¼ in. ..	75	480	15·5	2175
do. Tropical ..	70	480	15·8	
·450 No. 2 Nitro ..	80	480	13·7	2175
do. Tropical ..	75	480	14·0	
·450-3¼ in.	70	480	17·0	2150
do. Tropical ..	65	480	17·5	
·450-·400-3¼ in. ..	60	400	16·5	2150
do. Tropical ..	55	400	17·0	
·450-·400-3 in. ..	60	400	16·0	2125
do. Tropical ..	55	400	16·5	
·450-·400-3⅛ in. ..	42	400	13·5	1700
·375-2½ in.	40	270	14·5	1975
·400-·360-2¾ in. ..	40	300	15·5	1950
·360 No. 2 Nitro ..	55	320	14·7	2200
do. Tropical ..	52	320	15·5	
·360-2¼ in.	30	300.	14·0	1650

EXPLOSIVES REPORT FOR 1903.

THE annual report of H.M. Inspectors of Explosives has just come to hand. It opens with the usual statistical information, from which it is evident that the conditions of manufacture are as carefully supervised as ever from the point of view of the safety of the operative. Deaths from accident in manufacture during the past year are once more below the average for the decade, while as regards accidents in conveyance there have been none. There were five accidents on registered premises. One was a gas explosion, three were due to fire-works, and the last arose from a shop assistant's attempt to repair a powder receptacle with the aid of a lighted candle. The usual complaint appears in the current report concerning the neglect or inability of local authorities to do justice to the administration of so technical a question as the storage of explosives. It seems a pity that this complaint continues unheeded for so many years, the opinion of H.M. Inspectors that local inspection of registered premises should be carried out under their direct control, being apparently so obvious a proposition as to justify the needful alteration of the Act.

The following list shows an abstract of the more important importations of explosives during the year under review :—

Ammonal	2 cases and 154 lbs.
Blasting Gelatine	236,200 ,,
Blasting Matagnite	600 ,,
Carbonite	287,200 ,,
Celtite	16,100 ,,
Cooppal Powder	11,850 ,,
Coronite	15,012 ,,
Detonators	17,313,000 ,,
Dynamite No. 1	422,554 ,,
Fulminate of Mercury	10,000 ,,
Fuze Heads	4,300,000 ,,
Fuzes for Shell	17,770 ,,
Gelatine Dynamite or Gelignite ...	1,148,450 ,,
Matagnite Gelatine	15,000 ,,
Nahnsen's Gelignite	177,450 ,,
Normal Powder No. 2	10,000 ,,
Russell Gelignite	12,000 ,,
Vicker's Powder	7,892 ,,

The following abstract relating to Dr. Dupré's research work during the past year is taken from the report :—"During the past year research was confined to the beginning of an investigation into the various processes which have from time to time been proposed to test the stability of nitro-explosives. Professor Will's test, although it is, in my opinion, the most important process proposed, since the introduction of the heat test for the examination of nitrocellulose, has not as yet been examined. Firstly, because it has already received a good deal of independent investigation; secondly, because it has, to us, the drawback of being applicable to only one kind of explosive, and to that, apparently, in one particular form only. Our confidence in the present heat test, as a guide to safety, based on many years' experience, is unshaken. The Home Office has now controlled, mainly by the heat test, the purity of all nitro-explosives manufactured in, or imported into, this country for a period of over 30 years. During that time many thousands of samples of explosives have been examined, representing a large number of different manufactures, and no case is on record of an explosive having been passed which subsequently turned out to be in an unsafe condition.

"There are, however, some reasons for believing that, under certain conditions, especially if the explosive has been kept for any length of time in a warm place, our best test may be rather more severe than public safety imperatively demands. In such cases some relaxation may be desirable, and it is mainly with a view to meeting such cases that the present research has been undertaken. The application of the test, no doubt, requires a certain degree of skill and knowledge on the part of the operator, and without such knowledge the test will give results of little or no value. Persons not possessed of this requisite skill and knowledge had better leave this test alone.

"I need not give details of all the work done during the year, this will appear in due time, in the full report to be submitted to the department. As, however, two of the processes have never before been described publicly, I should like to put some short account of each on record. The first of these consisted in heating a given weight of dry guncotton (usually 2 to 2·5 grms.), contained in small weighing bottles, to a temperature of 130° C. Two equal portions are taken and heated for ½ hour, the bottles fitting fairly well into copper tubes immersed in an oil bath. Next the bottles are carefully weighed after cooling, and replaced in the tubes. One of the bottles is then reweighed after the lapse of two, the other after the lapse of four hours. The loss in weight will, it is anticipated, give a measure of the stability of the explosive. A third bottle, similar to the other two, is used as a counterpoise, and is always heated with the others.

"In the second test the explosive, 2 to 2·5 grms., is introduced into a glass tube about 12 ins. long, 0·6 in. diameter, and of about 50 c.c. capacity. This tube is connected, air-tight, on the one hand with a receiver which can be kept exhausted down to about 1 m.m. mercury, and, on the other hand, with a barometer tube dipping into mercury. When the oil bath has attained the desired temperature (130° C. usually) the tube is exhausted, cut off from the receiver, and immersed in the oil bath, by raising the latter. Soon the mercury in the barometer tube begins to fall, and, after the lapse of ¼ hour, the vacuum is restored by putting the tube, for a few seconds, into communication with the exhausted receiver. This process is repeated after the lapse of another ¼ hour. The results of the first ½ hour, although always noted, are usually not included in the subsequent records. After this, however, the real test begins, and the number of m.m. the mercury falls every ¼ or ½ hour is carefully measured and recorded, the vacuum being restored after each observation. The time allowed to elapse between the observations is governed by the amount of gas evolved, the object being to retain a moderate vacuum, say from $\frac{1}{100}$ to $\frac{1}{50}$ of an atmosphere, throughout the experiment.

"This test was first applied to guncotton only, but when, by a simple cooling arrangement applied to the upper part of the heating tube, the nitro-glycerine was condensed, and made to run back, it became applicable to nitro-glycerine preparations such as cordite, gelignite, blasting gelatine, etc., and even to nitro-glycerine itself. A similar contrivance could be applied to the weighing bottles.

"It is too early yet to draw any definite conclusions, but, so far, it would appear that both the above tests are capable of distinguishing between samples of guncotton of slightly different degrees of purity at least as definitely as Professor Will's test.

ROUND THE TRADE.

The accompanying engraving represents a sketch of the "Bishop of Bond Street," which was recently unearthed.

The eighth *Concours National de Tir* takes place at Lyons between the 7th and 18th inst.

We have received from the Continent a mourning notice relating to the death of *M.* H. Hilgers, of the Mullerite Powder Company in Belgium.

Mr. J. F. Blair, formerly with Messrs. Holland & Holland, Ld., has been appointed Manager of Messrs. Darlow's gun establishment at Cambridge.

The Robin Hood Safety Range Co., Ld., with a capital of £500 has been registered with a view to establishing a range for shooting practice and so forth.

The King's Norton Metal Company have forwarded to us a copy of an interesting little pamphlet which concerns their Palma cartridge, and contains particulars of the shooting with it in last year's match, together with more recent successes.

A company has been registered under the name of the Standard Explosives Co., Ld., with a capital of £10,000 for the purpose of carrying on the manufacture of explosives. There will be no initial public issue, and the registered office is at 9 Great St. Helen's, E.C.

We understand that Mr. Arthur H. Durnford, of Messrs. Curtis's and Harvey, has been appointed manager of their gunpowder mills in Kames, N.B., where he is now fully established. His many friends in the trade will wish him every success in this important position.

We very much regret that Mr. D. J. Metcalfe was recently taken seriously ill while visiting Glasgow with an attack of appendicitis. Recent accounts state that he is progressing favourably, and we may therefore, hope that he will be able shortly to resume connection with his business.

We have received from Mr. V. T. Mitchell a copy of an interesting pamphlet relating to Tatham's newly issued brands of English dimensions of shot made in accordance with the special processes which have made the name of Tatham a synonym for regularity of manufacture. Mr. Mitchell's first consignment of the English sizes was rapidly absorbed by the trade, but we understand that there will be no difficulty in obtaining fresh supplies.

Major Cooper-Key has reported on the explosion which occurred at the Cliffe factory of Messrs. Curtis's and Harvey on the 18th February last. He sums up a very exhaustive analysis of all possible contingencies by expressing the opinion that the accident was caused by spontaneous decomposition of a charge of nitroglycerin in course of preparation, owing to the presence in one of the ingredients of an impurity undiscoverable by the analysis of a sample. He further finds that the fatal results were due to the failure of those superintending the process to drown the charge when it became apparent that this course was necessary.

Messrs. L. Le Personne & Co. have written asking us to make a note of the fact that in our report of the Francotte pattern of Martini rifle a wrong impression was given, in so far that the weapons in question are fitted with a dismountable barrel, and that they are supplied chambered for any cartridge that may be ordered. At our invitation they have forwarded a sample of their latest pattern of rifle, which we shall have great pleasure in dealing with on a subsequent occasion. Meanwhile, as our information was derived from their advertisement in our columns, we have suggested that they should amplify in future issues the particulars contained therein.

James Baldwin & Sons, Ld. has been registered as a public company with a capital of £75,000 to acquire the business of James Baldwin & Sons, of Birmingham and Upper Thames Street, London, the well-known manufacturers of paper bags, gun wadding, &c. The Company will take over the freehold mills and other property situated at King's Norton, near Birmingham, and will carry on the old business. The first directors are Mr. J. Baldwin (chairman), Mr. H. S. Baldwin and Mr. W. Baldwin. They will receive £15,000 per annum and a share in the profits by way of remuneration. After the termination of the original management the number of directors may be increased to seven.

The Webley and Scott Revolver and Arms Co., Ld., have forwarded to this office their new catalogue. It is handsomely produced and exceptionally well illustrated, the great variety of both Webley and Scott pattern guns showing the comprehensiveness of this firm's manufactures. In so far that these guns are practically a standard throughout the trade the catalogue should prove of special interest to all gunmakers. The rifle section of the catalogue equally includes a large number of representative patterns, cordite high velocity express rifles occupying a position of deserved prominence. These include not only ordinary double-barrel weapons, but also the Webley pattern falling-block system of single-barrel rifle.

The report and balance sheet of the Kynoch Company for the year ended the 31st March last, shows a net profit of £91,358 which, with £53,660 brought forward from last year, makes an available total of £145,018. It is proposed that this sum be utilised for the payment of a five per cent. dividend on the preference shares and ten per cent. on the ordinary shares, leaving £37,749, which the Directors propose to use for writing down the capital expenditure, and a further balance of £40,000 which will be carried forward. The capital expenditure of this Company stands in this balance sheet at £973,816 as against £374,653 in 1898. The additions during the past year stand at £74,775. In moving the adoption of the report at the annual meeting, Mr. Arthur Chamberlain said that for the first time in the history of the Company the shareholders had had an opportunity of inspecting their own works. Looking at the business of the last four years, he said that in 1901 they made a profit of £100,000 and distributed £74,000; in 1902 the profit was £100,000 and they distributed £62,000; in 1903, out of £100,000 profit they distributed £67,000; and last year, with a profit of £91,000 they distributed £67,000. Taking the four years together they showed a profit of £391,000, and of that sum they distributed £271,000 leaving to carry forward or to put to reserve or to write off capital expenditure £120,000. The average profit for the four years had been £98,000 per year, the average distribution £68,000, and the average amount dealt with in some way or another had been £30,000 a year. The average capital employed during the four years had been £750,000, and the average profit on the capital had been 13 per cent. He should not like to say that that was an amount which they could maintain.

THE PALMA CARTRIDGE.

THE surprise of last year's shooting for the Palma Trophy was undoubtedly the fine results which were obtained with the special cartridge manufactured by the King's Norton Metal Company. It would unduly overload our columns if we were to review in any great detail the previous history of the English ·303 cartridge as a performer at the long distance target. It must, therefore, suffice to say that the English cartridge of service pattern had been found by long experience to be incapable of giving the regularity of elevation at the long ranges, which is an absolute essential for high scoring, the more so as the target commonly in use punishes errors of elevation much more severely than those due to wind deflection of the bullet. No one appears to have seriously set himself the task of finding out why the ·303 cartridge was so unsatisfactory for the longer distances, all the while that 6.5 mm. ammunition seemed capable of performing such excellent service.

General theory appeared to indicate that the bullet lost its accuracy over distances beyond 800 yards by reason of the greatly diminished velocity which arose from its comparatively low rate of exit from the muzzle, the bullet seeming to topple in the air and so be deficient in the steadying influence of a well-maintained spin. Other theories seemed to suggest that the error arose mainly from the lowness of pressure of the ordinary service cartridge. A low pressure necessarily implies a somewhat moderated rate of ignition on the part of the explosive. A reduced pressure, due to a low rate of gas evolution, affords a greater margin for variation than is the case when a higher charge produces a more rapid ignition, so that something more closely approaching the full power of the explosive is developed with every shot.

All these matters had been theoretically discussed from time to time, but no one had endeavoured by actual experiment to ascertain whether it would be possible to make a ·303 cartridge suited to the existing conditions of barrel which would compete with the popular Mannlicher. Other things being equal it seems only fair to assume that the greater the dimensions of the bullet the more suited will it be for accurate target work at long distances, and this much being known it became necessary to ascertain wherein lay the difficulties which interfered with the success of the ·303 cartridge. It might for instance happen that the cupro-nickel coating of the bullet might not be in the best physical condition for withstanding the terrible tearing action that accompanies its passage along the barrel. In like manner the Woolwich cap has always rested under the suspicion of not being a model of perfection. In fact, while proofs of its bad behaviour were available in great number no one appears to have hit the right nail on the head.

The exceptional size of the ·303 cap is one of the greatest defects of our service cartridge. It unduly diminishes the metal available for the head of the cartridge, and this introduces serious practical difficulties. It is, however, the composition which is most seriously at fault. This is very deficient in strength, and an effort is made to attain the desired efficiency in its action by using a considerable charge. Hence the large size of the copper dome. In actual practice the cap is an exceedingly bad one, as may be shown by the well-known dislike which riflemen entertain towards cartridges which have been under storage for any length of time, especially in a hot climate. The deterioration that arises undoubtedly results from the condensation inside the cap of the nitroglycerin that distils from the cordite. The presence of this foreign matter in the cap disturbs the regularity of its action, whereas with a better composition the trouble does not arise, and cartridges will retain their efficiency over an indefinite period of storage.

All these things go to show that there were many openings for improving the service cartridge, and while it is not in our power to state the exact changes which the King's Norton Metal Company have made, we can at least recognise that the joint effect of their new specification has produced a good cartridge in place of a bad one. We know that the Cordite charge has been materially increased and also that the bullet is of greater weight, this combination producing a higher pressure and a higher velocity. Just what relation these changes bear to the all-round improvement in the efficiency of the cartridge it is difficult to say, but we are at least assured that without making structural alterations that affect the rifle or the cartridge case we have an improved type of ammunition which appeals to the judgment and satisfies the requirements of all the most prominent exponents of the military rifle, whether used with match sights or ordinary service sights.

That the King's Norton Metal Company have not been content to rest on their laurels we have the most clear assurance, and we may accordingly look forward with very great interest to the coming Bisley Meeting. Last year the new cartridges had not been introduced sufficiently long for more than a select body of riflemen to give them a trial. Moreover, the extra weight of bullet which was allowed under the conditions of the Palma match was barred from the ordinary match rifle competitions. While lighter bullets falling within the rules were substituted last year, and good results were still obtained, the arena has since been thrown open in such a manner as to give every freedom for reasonable variations from the ordinary pattern. In fact, the N.R.A. is now content to specify that match rifle cartridges shall be such as may be considered of a practical military pattern.

Though the Bisley Meeting is the chief rifle shooting gathering of the year it necessarily represents an anti-climax. It gathers from all parts of this country and its dependencies the pick of the riflemen who have been assiduously practising at home. Consequently we have already before us a large number of records of first-class shooting which has been done with this year's issue of the Palma cartridge; and it is obvious to anyone in touch with the subject that it has acquitted itself with great distinction wherever it has been used. Whether or not the Palma cartridge may be used in volunteer competitions where the contestants are firing with Government property rifles is a difficult question which has never been thoroughly threshed out. Admittedly there exists a regulation that none but Government ammunition may be used in Government rifles, but there are those who question the desirability of enforcing this rule against volunteers who are willing to use special target ammunition at their own risk. While it would be a rash man who would assign a definite limit to the strength of our service weapon, there seem at present to be reasonable grounds for the belief that the Palma cartridge at any rate does not put an excessive strain on the mechanism.

LECTURES TO YOUNG GUNMAKERS.

XXIX.—THE PRESSURE OF CORDITE EXPRESS CARTRIDGES.

THE most important factor in the development of Cordite express cartridges has been the determination of their pressure and velocity, combined with an examination of the special characteristics which produce the results obtained. While the testing of shot gun pressures is a comparatively simple matter, because relative measurements are sufficient for practical purposes, with express rifles it is necessary that figures be obtained which shall be as nearly as possible absolute values. We know in the case of the shot gun that the use of lead crushers of a uniform length produces a crushing which is neither truly statical nor truly dynamical. That is to say the resulting shortening of the lead cylinder is partly the result of a squeeze and partly a blow, the blow being caused by the momentum that is imparted to the pressure piston.

In the case of express rifles it is necessary that precautions should be taken to ensure the elimination of blow effects on the copper crusher. If for instance the powder gases attain their maximum pressure at a rate quicker than the copper crusher reduces in length then we have the gases acting at a given moment with a force greater than the sustaining power of the crusher. If it were possible to cause an instantaneous removal of the gases within the chamber the piston would continue to compress the copper by reason of the momentum it had previously obtained. In order to produce theoretically perfect conditions of testing the copper crusher must at all times be in such a condition that if the gases were instantly liberated no further compression would result. This condition of perfection can only be produced by the use of copper which is of such strength as to sustain the pressures put upon it. With a properly proportioned copper crusher a given load will produce a given amount of shortening, beyond which no further movement takes place. This ideal condition does not exist in the case of lead, and consequently copper is necessary if absolute values are to be obtained.

Even with copper there is always the risk that the rise of pressure will take place more quickly than the rate at which the copper can compress, but this is got over by precautions based on an estimate of the average pressure likely to be experienced. The copper to be used then receives a preliminary compression by the gradual application of an imposed weight. The copper ceases to shorten when it has increased its area and hardness so as to be capable of sustaining the amount of load thus put upon it. When a compressed copper is used in a proof rifle it retains its form while the pressure is rising to the amount for which it has been adjusted. Consequently, however rapidly the powder develops its gas the copper crusher shows no response until the pre-determined limit is reached. The amount of subsequent compression experienced affords a means of judging the extent to which the pressure exerted by the gases is in excess of the load previously put upon the crusher. Experience has shown within what limits of the pressure experienced in the gun the crusher should be previously compressed, and in this way we have at hand a suitable means for determining the pressure of Cordite express ammunition.

There are two ways of measuring the pressure in a rifle, which are known respectively as the side pressure and base pressure systems. In measuring pressures at the side of the chamber a hole is first of all drilled in the cartridge which corresponds in position with a piston fitted into the walls of the barrel, the copper crusher being held down on to the top face of this piston by a screw. In the base pressure system on the other hand the cartridge itself constitutes the piston, being supported by a copper cylinder which records the amount of pressure existing in the cartridge. In order that the cartridge shall be capable of free backward movement in the chamber it is previously dipped in oil. An interesting aspect of this experiment consists in determining the relative action which results from firing with the chamber dry on the one hand and greased as an alternative. With a dry cartridge, in other words a clean chamber, the friction of the case on the walls of the chamber is such as to lower the back pressure to an enormous extent. In fact the back pressure tending to blow the breech open is frequently found to be more than twice as great with a greasy chamber as compared with a dry one, thus showing that the chambers of rifles should always be carefully wiped out before use. The special advantage of the base system of pressure is that a single "housing," as it is called, may be used for any number of barrels, whereas with a side pressure gun a specially heavy barrel must be made for receiving the piston and its fittings, the difference of cost between the two being thus considerably in favour of the housing for which a barrel of ordinary dimensions screwed externally to suit the housing may be used.

When comprehensive experiments were first of all carried out with express rifle cartridges it was found to be insufficient merely to measure the amount of pressure, since it might well happen that the cartridge would not be exerting its full power in the proof barrel used. Further investigations showed that slight alterations in the dimensions of the chamber and the form of the rifling and lead caused remarkable differences in the action of the cartridge. As an additional safeguard, therefore, it was found necessary, and has now become usual, for the velocity to be measured simultaneously with the recording of pressure. When, therefore, a pressure gun is proved to be giving the correct velocity there are reasonable grounds for inferring that the pressures recorded are those that will be experienced in an actual rifle producing similar results. On the other hand if the velocity is above or below the usual level the pressure will probably vary in the same direction. Even so, however, it has been found that with an equal velocity in two rifles a substantial difference of pressure may be encountered, this showing that the pressure gun only gives a relative index to the behaviour of the cartridge in another rifle. At the present time we find considerable differences between the published results of cartridges of the same size and charged in the manner, and it is only reasonable to infer that these differences arise from the peculiar characteristics of the proof guns employed.

In view of these circumstances an attempt has been made to obtain by theoretical examination of results a concrete notion as to the behaviour of Cordite under the variety of conditions in which it may be used. A series of *formulæ* have accordingly been produced which show the average behaviour of Cordite in the various calibres and styles of cartridge; and

as the agreement of calculated and observed results so obtained is in most instances exceedingly close it seems reasonable to assume that theory and practice must proceed side by side in the determination of the characteristic combination of velocity and pressure that a given cartridge will produce. Differences in the chamber, the lead, the rifling and the shape of bullet all seem capable of producing a practical difference in the results obtained; and as it is virtually impossible to define the true relative effect of these sources of difference it is probably best in the long run to adopt characteristic values in place of, or in supplement to, those obtained from practical experiments.

It will be interesting at this stage to examine some of the influences which are at work to modify the pressure experienced with a given cartridge. We have in every cartridge case a certain amount of cubical space for the accommodation of the explosive. This is measured by deducting from the total interior capacity of the cartridge case the amount of the neck which is utilised for the accommodation of the bullet and jute wad. This deduction is most conveniently effected by cutting off the cartridge case at a distance corresponding with the position of the under face of the jute wad. The actual mechanical carrying out of the process is effected by measuring the total length of the complete cartridge, which is the distance from the base of the case to the nose of the bullet. The bullet and wad may then be removed and their combined length is similarly measured.

The length of the bullet and wad deducted from the total length of the cartridge is the length to which the cartridge case must be cut down to show the amount of space available for the powder. This can then be measured by weighing the shortened case empty and filled with water, the difference between the two weights being the cubical capacity in terms of the weight of water it will contain. The relation which exists between the grains weight of the powder charge and the number of grains of water necessary to fill the shortened case may be expressed as a percentage relation, this value being known as the density of loading. Other things being equal, high pressures result with a high density of loading and low pressures when the opposite conditions are present. If the bullet were incapable of movement the gas pressure attained would be that known as the closed chamber pressure. This, however, would be beyond the strength of an ordinary rifle, but the values for Cordite have been obtained by Sir Andrew Noble by firing charges in a closed mortar of great strength.

As, however, the combustion of Cordite is of a progressive kind, the bullet moves forward and so increases the amount of space available for the gas which is evolved. Hence we have the evolution of gas on the one side tending to increase the pressure, and the movement of the bullet on the other tending to reduce it. It must, therefore, be clear that the inertia of the bullet, together with the friction it encounters in entering the rifling must exercise a considerable influence on the pressure exerted. The inertia of the bullet is approximately proportional to its length, but a more accurate diagnosis of this characteristic is obtained by determining its sectional density, that is, the relation which exists between its cross sectional area and its weight. A bullet that is heavy in proportion to its diameter will necessarily move forward more slowly than a shorter bullet with a low sectional density.

In practice it has been found that as Cordite is primarily adapted for the military cartridge, it operates under the most favourable circumstances in cartridges which have about the same density of loading and the same sectional density of bullet as the ·303 military pattern. The usual types of express cartridges, although based for the most part on the old black powder sizes, reproduce in a great measure the conditions present in the ·303 cartridge. That is to say, they have about the same density of loading and the same sectional density of bullet. As a result they give about the same combination of pressure and velocity. It will thus be clear that while the Cordite charge may be two or more times that present in the service cartridge the extra charge acts over a proportionately greater area of base of bullet, and therefore produces the same proportional effect. Although express rifle cartridges are thus shown to be in the nature of proportional enlargements of the service cartridge, it has been found desirable to reduce the amount of pressure somewhat below that experienced with the military type of cartridge. While the ·303 gives a very low pressure for a military cartridge, the larger sizes of express cartridge have, where possible, been adjusted for a lower general level of pressure.

The reason why an express rifle cartridge should have a lower level of pressure than the military type will be obvious upon a little consideration, The tenacity of rifle barrel steel is more or less in the nature of a fixed quantity, and the amount of stress put upon the metal varies according to the size of the chamber. Consequently a steel which will be perfectly satisfactory with a small bore cartridge may show signs of distress in the case of a larger cartridge having the same pressure. The balance cannot be re-adjusted by adding to the exterior dimensions of the barrel, since the external layers of metal cannot come into action until the interior surface of the chamber has been sufficiently expanded. This expansion of the interior layers very soon attains the limit of elasticity of the metal. Consequently while there may be an ample amount of metal in the barrel to prevent an actual burst, the interior bulging which occurs with large size cartridges working at full military pressure destroys the homogeneity of the metal by placing the fibres of the interior layer in a state of compression, to say nothing of the ill effects which result from the actual expansion of the chamber. It is only by the making of exhaustive experiments concerning the pressure and velocity of express cartridges that our manufacturers have been able gradually to build up a series of charges which give the sportsman the highest available ballistics in combination with a moderateness of pressure which will guarantee the general stability of the weapon. Not only have our manufacturers worked out a harmoniously proportioned series of Cordite charges and bullets for the leading sizes of express cartridges, but they have also ascertained the exact diminution of explosive which is required for cartridges which are to be shot at an elevated temperature. A table which is published in another portion of this issue in connection with our notice of Messrs. Eley's new catalogue, contains some very interesting figures showing how this has been arranged, and we refer the young gunmaker to the table in question for the most up-to-date information concerning the adjustment of powder charge which is necessary to reproduce in a tropical climate the velocity which is obtained with the full charge when shot in this country.

THE WOOLWICH TESTING STATION.

THE following abstract from Capt. Desborough's report on Woolwich experiments with safety explosives, is taken from the annual report of H.M. Inspectors:—

So far as changes in explosives and their accessories are concerned, the only new departure with the former has been the combination of nitroglycerin with ammonium nitrate. Doubtless there will be less liability to partial explosion so long as the cartridges are used in a plastic condition, but whether this advantage will outweigh the apparently rooted objection of some men to the use of warming pans for thawing nitroglycerin explosives remains to be seen. Moreover, the attention now paid by the makers of ammonium nitrate explosives to the provision of a more durable form of waterproofing for the cartridges appears to have reduced the percentage of failures to attain complete detonation with this class of explosive.

The only notable change with accessories has been the substitution of a coating of wax for a paper wrapper in one of the non-detonating explosives. Experiments were carried out to test whether this form of covering would increase the sensitiveness to ignition from an external spark. For this purpose two cartridges, one with the wax coating the other with the usual so-called spark-proof wrapper, were placed side by side and the sparks from a "golden rain" firework were directed on them. In every case the explosive with the paper wrapper was ignited and communicated explosion to the other cartridge. The wax-coated explosive was then subjected to the shower of sparks by itself, and several times did not ignite, though the coating was pitted with small holes where the sparks had partially melted the wax. Incidentally this form of cartridge prevents the formation of explosive dust, which is generally produced when a non-waterproof paper wrapper is used to contain an explosive of this nature. It also claimed that there is less likelihood of explosive becoming detached when ramming home a charge in a rough bore-hole.

Some experiments were carried out in the early part of the year to gain information as to the physical effect produced on ammonium nitrate explosives by subjecting them to extreme cold. For this purpose cartridges of the various explosives were surrounded with carbonic acid snow for a period of 12 hours. The results obtained shewed that when the explosive was contained in paper wrappers and had been stored in a magazine for some months, it almost invariably became so hard as to render the insertion of a detonator impossible, though previously to the experiment and afterwards, when raised to the normal temperature, it was sufficiently friable for this purpose. Only two samples were contained in metal wrappers and neither of these changed their physical condition, though one of them had been stored for nearly two years. There appears to have been little doubt that with the paper cartridges the hardness was due to the freezing of the moisture absorbed by the explosive. The fact that the metal casing preserved the explosive in a friable state confirms the general experience that this form of wrapper protects these explosives more efficiently than any other casing if the cartridges have to be stored for any length of time before use.

Several manufacturers submitted samples of electric fuzes containing 5 grains of gunpowder to be tested as to their liability to communicate explosion to one another, in order that if the tests were satisfactory the fuzes might be included among the explosives of Class VI., Division I. The tests to which the fuzes were subjected are as follows:—

(1.) Two bundles of fuzes, 20 in each bundle, are placed end to end and fixed in this position, the fuze heads in each bundle being held together by wrapping a length of wire tightly round them. A fuze is then fired in the centre of one bundle. The test is considered satisfactory if no other fuze is ignited. The fired fuze is then removed another inserted in its place; this is repeated five times.

(2.) The second bundle (that used in the first test) is now placed at right angles to the first, so that the flash from the fuze that is fired impinges on the sides of the fuzes in the bundle. This is also repeated five times.

The details of the method of carrying out the test have been given to enable manufacturers to ascertain for themselves the probability of their fuzes passing the tests when submitted officially, so as to obviate the needless delay which must arise when fuzes which are quite unsuitable are sent to the Testing Station. The two defects generally disclosed during the trials were:—(1.) Insufficiency of strength in the fuze body, which caused lateral communication of explosion. (2.) Inadequacy of the material in the end plug, which gave rise to axial communication of explosion.

Several complaints were received during the year of heavy sparking which occurred when firing one of the non-detonating explosives on the Permitted List. This was at first thought to be due to the use of a detonator for igniting the cartridges instead of a 5-grain powder fuze, the means employed at the official test when the explosive was originally submitted. It was reported, however, that even when the authorized 5-grain fuze was used, a considerable number of sparks were still emitted, and that all the shots were carefully and efficiently stemmed. With a view of determining whether the explosive would behave in a similar manner when ignited in a cannon, a series of shots were fired from a vertical gun after dark. The weight of the charge used was 293 grammes (roughly 10½ ozs.), or slightly greater than the heavier charge for the official test. Some of the shots were stemmed with 12 inches and the remainder with 6 inches of well rammed clay. In every case sparks were emitted and a glow appeared at the muzzle of the cannon. With the smaller amount of stemming the sparks were apparently not so bright, but this was probably due to the increased glow. I have purposely used the word glow as implying the light emitted by sufficiently heated gases or material substances, in contra-distinction to the visible effect of the combustion of such gases or substances in contact with air, which is properly designated by the word flame.

The experience of the users having been confirmed, it remained to be seen whether the sparks from this explosive would cause an ignition in the gas gallery. A further series of shots was therefore fired in the gas gallery under the same conditions as regards weight of charge and stemming, and in no case did the gaseous mixture in the gallery explode. It may be pointed out that when only 6 inches of stemming were used, the conditions were considerably more severe than

those which obtain in the official test. In a few cases sparks were projected which fell outside the gallery. I may mention that this is no very unusual occurrence and that the ease with which the sparks can be seen depends solely on the amount of daylight. On one occasion when firing an ammonium nitrate explosive late in the afternoon I observed several bright sparks fall on the concrete floor. They proved to be globules of metal, and evidently had formed part of the metal casing in which the explosive had been originally contained.

The conclusion to be derived from these experiments is that the visibility of sparks or glow is not of necessity any criterion as to the liability to fire gas, and in this connection it may be mentioned that in the experiments carried out by Mr. W. E. Garforth, Mem.Inst.C.E., at Normanton, it was found that the almost invisible sparking which occurs on the commutator of open-type continuous-current motors was always found sufficient to ignite the explosive gas mixture used at the experiments. On the other hand, it is hardly necessary to say that the appearance of flame, as opposed to glow, or of sparks due to the combustion of projected explosive, indicates the existence of a very grave danger; and it must be admitted that it is a matter of some difficulty to decide without actual experiments, whether the sparks arise from combustion of explosive or are due to heated particles of non-explosive substances.

APPLICATIONS FOR PATENTS.

MAY 24—JUNE 25, 1904.

11,856.* Firearms. H. H. Lake (Agent for *Winchester Repeating Arms Co.*).
11,886. Bullet Expander for Air Guns. J. B. Lane.
11,935. Small-Arm Sights. J. T. Peddie.
12,008. Range Finder. W. H. Lock and A. H. Pollen.
12,009. Range Finder. W. H. Lock and A. H. Pollen.
12,121.* Magazines of Firearms. F. Gottardi.
12,130. Automatic Firearms. H. F. Woodgate.
12,238.* Igniting Fuses. W. Reine.
12,508. Ammunition. G. C. Baker.
12,519. Target Practice with Ordnance. J. B. A. Légé.
12,551.* Projectile Percussion Fuse. C. P. Watson.
12,624. Firearms. L. B. Willoughby.
12,637. Explosive. P. and A. Weiller.
12,715. Firing Mechanism of Ordnance. Sir W. G. Armstrong, Whitworth & Co., Ld., and S. M. Murray.
12,735.* Short Base Range Finder. H. D. Taylor.
12,772.* Obturating Pads for Ordnance. H. C. L. Holden.
12,807.* Heavy Projectiles. C. F. and H. E. Cowdrey.
12,871. Ordnance Sights. H. C. Mustin.
12,893. Range Finder. J. T. Dreyer.
12,900. Cartridge Cases. G. H. Herrmann.
12,968. Range Finder. W. H. Harvey.
13,050. Rifle Carrier. W. E. Read.
13,069. Small-Arm Projectiles. C., J. B., E., and H. W. Lane.
13,147. Indicating Loading Position of Firearms G. Luger.
13,201. Range Finder. A. E. Conrady and F. W. W. Baker.
13,325.* Small-Arms. W. Urbanowycz.
13,453.* Ordnance. J. E. Sheriff and F. L. Nichols.
13,562.* Nitroglycerin. R. Moller.
13,618. Small-Arm Projectiles. H. Stanbridge and W. Walker.
13,619. Small-Arm Projectiles. H. Stanbridge and W. Walker.
13,622. Floating Target. W. J. Hunter.
13,649.* Repetition Firing Devices. Fried. Krupp Ag. (Date of application in Germany, June 25, 1903).
13,738. Ordnance Wedge Breech Block Mechanism. A. Reichwald (Agent for *Fried. Krupp Ag.*).
13,840. Bandolier. J. H. Patterson.
13,896. Targets. W. W. G. Webb and J. Hall.
13,901.* Fuse Caps. Fried. Krupp Ag. (Date of application in Germany, August 10, 1903).
13,918. Targets. W. H. Pike.
13,950. Shrapnel. P. D van Essen.
13,959.* Projectiles. O. C. Cullen.
13,960. Gun Barrels. O. C. Cullen.
14,074. Targets. A. Winser.
14,208. Blank Cartridges for Small-Arms. King's Norton Metal Co., Ld., T. A. Bayliss and H. M. Smith.
14,236. Range Finder. G. M. Lawford.

* These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

MAY 26—JUNE 23, 1904.

COMPILED BY HENRY TARRANT.

6,551 (1903). **Cleaning Device for Small-Arms**. E. O. Theile, Germany. A cleaning device for small-arms consisting of a part provided with jags adapted to receive cleaning hemp, and a counterweight forming a handle. These two parts are connected by a cord or wire. The jagged cleaning head consists of a tube through the centre of which runs a spindle. About this spindle the head is free to rotate when passing through the rifling of a barrel. Accepted May 20, 1904.

8,333 (1903). **Automatic Targets and Marker.** R. A. Rogers, Isle of Wight. By means of a compensating beam and a pendulum, clockwork mechanism is arranged at stated intervals to conceal one target and bring another to the view of the shooter. An automatic marker arrangement consists of levers which communicate the movement of sections of the target to air balls. The lifting of these air balls conveys to the shooter information as to which part of the target his shot has struck. Accepted May 11, 1904.

10,607 (1903). **Projectile Time Fuse**. H. T. Ashton, Blackheath. A time fuse which is so constructed that it is impossible for accidental firing to occur. In order to effect detonation a body is rotated at a high speed through the medium of vanes whilst the projectile is passing through the air. When rotated sufficiently a catch is released which allows a member to move under centrifugal force and to bring a detonator into the path of one or more bodies carried by the rotating part. Accepted May 5, 1904.

10,789 (1903). **Explosive Mixture**. A. Fischer, London. A blasting explosive consisting of equal parts of di or trinitrobenzol, or their chloro-compounds, and an alkaline salt of trinitrophenol with 2 per cent. of paraffin wax dissolved in a sufficient quantity of any solvent, preferably benzol, to form a paste. From 5 to 20 per cent. of this mixture is combined with from 95 to 80 per cent. of a mixture consisting 80 per cent. of alkaline nitrate, 4 per cent. of sulphur, and 16 per cent. of any suitable form of carbon. Accepted May 12, 1904.

11,478 (1903). **Smoke and Recoil Reducer**. Eleanor Cuthbert-Keeson. By means of a tube forming a prolongation of the gun barrel, noise, smoke, flash and recoil are subdued. The tube allows the projectile to pass unchecked, but it is perforated and slotted in such a manner that the gases are held and spread into an outer cylinder. The cylinder is packed with wire gauze and asbestos for the purpose of receiving and deadening the gas blast checked by the tube. The gas it is claimed reaches the outer air with subdued concussion. Accepted May 19, 1904.

11,466 (1903). **Cartridge Belt Filling Machine.** J. Ramsey and T. E. Riddle, Erith. When dealing with boxes containing twenty cartridges arranged in two columns of ten, a chute is provided for cartridge belt filling machines which chute is adapted to take both columns of cartridges from the package.

Only one column is allowed to communicate with the hopper at one time, and the cartridges are taken one by one from the column by the action of a pusher. Accepted May 20, 1904.

11,933 (1903). **Small-Arm Trigger Mechanism**. S. Turudija, Austria. The ordinary military rifle has a considerable pull-off. In order to alleviate it, but at the same time to allow of notice being given to the shooter that the striker is about to be released, a bent is formed on either the striker head or sear, which permits the striker to advance a slight amount immediately before the actual firing. The striker is then held again, the final pull being rendered a light one for the purpose of more sharply defining the object. Accepted May 19, 1904.

11,985* (1903). **Single-Trigger Mechanism**. E. H. Stone, London.

12,281 (1903). **Projectile Construction**. Cammell, Laird & Co., Ld., F. C. Fairholme and J. E. Fletcher, Sheffield. A projectile is cast with a solid base. The nose is bored and screwed to receive a hardened point which may carry a fuse at its base. A soft cap of iron is pressed over the nose before insertion in the projectile. The lower portion of the soft cap is squeezed between the top surface of the shell nose and the base of the point when the latter is fixed in the shell. Accepted May 24, 1904.

13,670 (1903). **Firing Mechanism of Ordnance**. A. T. Dawson and G. T. Buckham, London. Improvements in the type of breech and firing mechanism described in Patent No. 10,606, 1896. When it is desired to render the gun capable of being fired either electrically or by percussion two separate locks are provided, one containing the electric needle, and the other the percussion striker. Either of the locks may be applied separately to the same slide box to set and retain the firing needle. The extraction and ejection of the primer is also dealt with. Accepted May 19, 1904.

15,061 (1903). **Projectile Construction.** Major H. W. W. Barlow, R.A., and J. M. Ledingham, Woolwich. A bendable lining, consisting of an alloy of 50 parts of lead, 50 parts of tin, and 1¼ parts of copper, is introduced into the hollow of a projectile and is expanded exactly to fit the cavity. The lining protects the charge in the event of the metal of the projectile cracking. It is reasonably supposed that spontaneous cracking of the shell has been the source of explosions of projectiles in store. Accepted May 5, 1904.

15,110 (1903). **Gun Sighting Device**. A. König, Germany. An improved type of the sighting device described in Patent No. 12,108, 1900. An approximately plain image is obtained by the use of a specially curved diaphragm turning its concave surface towards the collecting lens by which the image is produced. By means of two reflecting surfaces interposed between the diaphragm and the collecting lens a shortening of the dimensions of the device transversely to the direction of sighting is obtained. Accepted May 12, 1904.

15,123 (1903). **Field Gun Recoil Apparatus**. A. Vickers and G. T. Buckham, London. The hydraulic buffer of field guns is weakened by the present method of forming the valve-port by the cutting of a gap in the wall of the liner. The method patented consists in forming internal longitudinal grooves of uniform width but varying depth in the buffer-liner. The greatest depth of each groove is less than the thickness of the wall of the liner. Accepted May 12, 1904.

15,894 (1903). **Rifle Foresight**. T. Breen, Devonport. A rifle foresight consisting of upper and lower parts secured together by a dovetail joint and a screw. When the upper part becomes worn, so disturbing correct aiming, a new sight may be quickly attached. The sight may by this arrangement be replaced by any soldier when in the field. Accepted May 19, 1904.

16,090 (1903). **Disappearing Targets.** C. E. Marks, Wilton. Running figures are attached to a trolley which is run across the range by means of a cord. The figures are balanced so that they will be righted again when struck. They are carried on uprights which can be raised or lowered by a cord operated from the firing point. Accepted May 19, 1904.

16,372 (1903). **Ordnance Breech Mechanism.** Sir W. G. Armstrong, Whitworth & Co., Ld., and R. J. Brankston, Newcastle-on-Tyne. In combination with a gun carried in a cradle is a motor carried on the platform below. The motor is adapted to actuate a series of shafts and friction cones, the motion being conveyed by these parts to a wheel attached to the gun which is caused to open and close the breech. Accepted May 26, 1904.

16,373 (1903). **Ammunition Hoists**. Sir W. G. Armstrong, Whitworth & Co., Ld., Newcastle-on-Tyne, and S. W. A. Noble, London. In relation with a hoist which automatically seizes the ammunition, raises or lowers it, and automatically releases it, a series of semi-cylindrical trays are attached to chains running over sprocket wheels at top and bottom of the hoist. The trays are provided with catches which pick up ammunition at a platform on which it is placed in a vertical position and release it at the depositing station at the top of hoist. Accepted May 26, 1904.

16,814* (1903). **Cartridge Ejecting Mechanism.** W. Baker, Birmingham.

3,127 (1904). **Automatic Small-Arms**. Cæcilie von Mannlicher, Austria. Set out in this patent are a number of improvements in the automatic breech action of small-arms described in Patent No. 26,270, 1902. The modifications are intended to simplify the construction, to facilitate the taking apart and assembling of the parts and to adapt the weapon for use as a military rifle. Accepted May 5, 1904.

6,943 (1904). **Safety Blasting Fuse.** C. Koch, Germany. A fuse consisting of two tubes inserted one within the other. One tube carries a quick-match and an igniting crown. This tube is inserted in the other at the top of which is a plug provided on its inside with a specially prepared frictional ignition substance similar to that used on safety match boxes. To ignite the quick-match the crown and frictional surface are brought into contact by pushing and turning one tube on the other. A soft flame which cannot escape is produced by this means. Accepted May 19, 1904.

8,061 (1904). **Torpedo Steering Mechanism.** F. McD. Leavitt, U.S.A. Steering mechanism for torpedoes adapted normally to swing the rudder between extreme port and extreme starboard and thereby to steer the torpedo in a sinuous path. In case of excessive deviation from the prescribed course the mechanism prolongs the action of the rudder either one way or the other until it has steered the torpedo back to its course. Accepted May 12, 1904.

8,688 (1904). **Explosive Projectiles.** J. F. Meigs and E. Gathmann, U.S.A. In order to insure a maximum penetrating effect while allowing of a maximum volume of cavity to provide for a large explosive charge the inner wall of the shell is reinforced by continuous longitudinal ribs or stiffeners. The metal at the base of the shell is reduced. Accepted June 2, 1904.

8,761 (1904). **Air Guns**. L. Jefferies, Birmingham. An air gun with a fixed barrel permanently attached to the body part is described in this patent. A separate lever for actuating the spring compression link, so cocking the gun, and for simultaneously opening the breech for loading is provided. The wearing of joint in guns where the barrel is used as a lever is by this arrangement obviated. Accepted May 12, 1904.

8,814 (1904). **Folding Support for Rifles.** J. Livtschak, Russia. Two elastic legs are pivotally connected with the underside of a rifle. The legs are adapted to be spread out for the purpose of allowing the shooter when in a lying position to adjust the rifle to any position and direction while making himself comfortable. The legs may be locked in along the underside of the rifle. Accepted May 19, 1904.

8,995 (1904). **Recoil Reducer.** P. Jensen, London. (Agent for *The McClean Arms and Ordnance Co., U.S.A.*). A gun barrel is formed near to its muzzle with a number circumferential grooves from the bottom of which to the outerside of the barrel are bored a number of rearwardly inclined vents The gases impinge upon the surface of the grooves and escape rearwardly through the vents, so exerting a pull in opposition to recoil. Accepted May 19, 1904.

9,452 (1904). **Small-Arm Cartridges**. W. C. Bush, U.S.A. In order to provide for the gradual increase in the rate of combustion in cartridges a series of steps forming substantially a conical powder chamber is provided in the base of the case. The compacting of the grains of the explosive charge is prevented by this formation. Accepted May 26, 1904.

*These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

SINGLE-TRIGGER MECHANISM.

11,985 (1903). E. H. Stone, London. The mechanism described in this specification is intended to nullify the effect of the involuntary pressure following the first discharge of a double-barrelled single-trigger weapon. The trigger blade is momentarily locked in its raised position after the lifting of the first sear.

Referring to the drawings, the trigger blade *a* is shaped so as to permit of the use of any desired type of sear-lifting mechanism. A slot *b* is cut in the back of the trigger blade. Arranged behind the blade is the bar *c*, which is adapted to move transversely on the pivot *d* from one side of the trigger plate to the other. This "check lever" *c* is fully illustrated in the detailed drawing. It is provided with a pivoted nose *e*, which is held hard up against the stop *f* by the spring *g*. The nose is pressed against one side of the trigger blade by the spring *h*. When the trigger is raised to lift the first sear the slot *b* is brought opposite to the nose and the spring *h* switches the check lever from one side to the other, the nose passing through the slot. Until the switching movement is completed and the nose *e* has passed through the slot, the trigger cannot descend. The involuntary pull occurs whilst the trigger is

Fig. 1

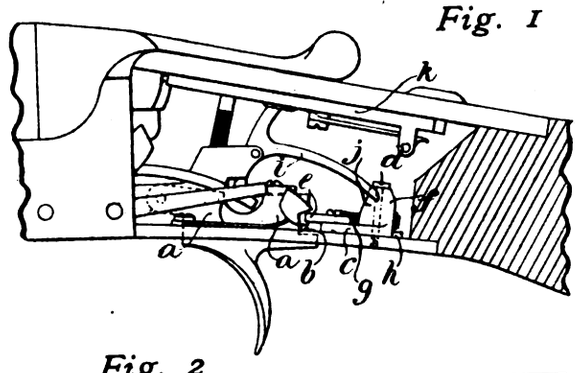
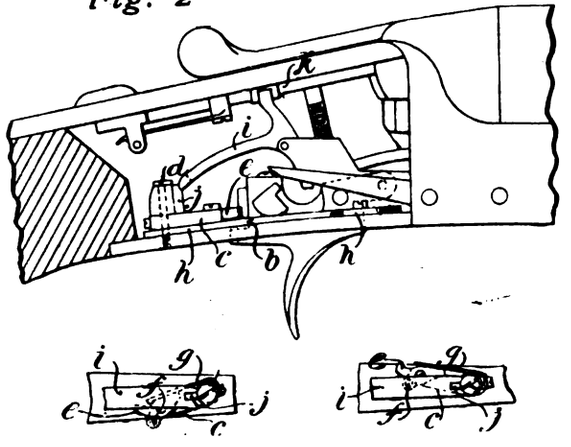


Fig. 2



locked in this raised position. The trigger is unlocked almost immediately, and the sear-lifting device is allowed at once to take up position beneath the second sear tail.

In order to return the check lever *c* to its original position against the pressure of the spring *h*, the arm *i* is slotted at its extremity. The slot is adapted to engage a spiral wing *j*, with which the boss of the check lever is provided. When the safety bolt *k* is actuated, the slot in the arm *i* is caused to descend and to slide over the spiral wing *j*, so forcing the check lever round on its pivot to its original position. The movable nose *e* allows the arm to pass the trigger on its return journey. To secure the momentary arrest of the trigger in its raised position, the width of the portion of the check lever passing through the slot must be adjusted according to the strength of the spring by which it is actuated. Accepted May 26, 1904.

CARTRIDGE EJECTING MECHANISM.

16,814 (1903). W. Baker, Birmingham. An improved method of carrying the kicker springs in ejecting mechanism for small-arms, is dealt with in this patent. Hitherto they have been

Fig. 1

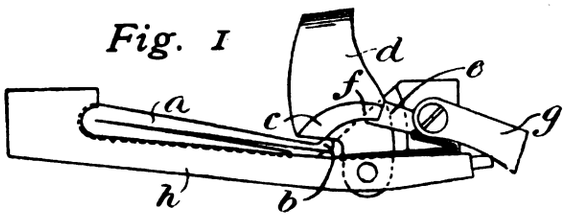


Fig. 2

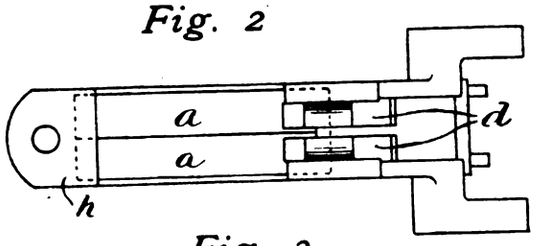


Fig. 3

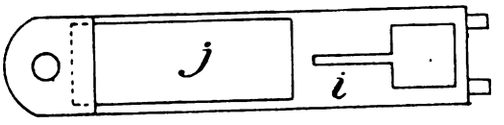
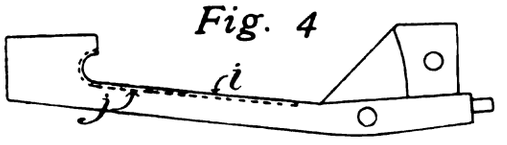


Fig. 4



carried in a box-like frame, having side walls and a dividing partition. The springs were held in position by means of a removable bridge-piece, beneath which the elbow ends of the springs were situated. The box has been broad, and necessitated considerable labour in forming the recesses to accomodate the springs. This construction is simplified.

The mechanism, Figs. 1 and 2, consists of the springs *a*, the arms *b* of which are situated beneath the heels *c* of the kickers *d*. The kickers hold the springs *a* in tension through the locking influence of the sears *e*, the nose *f* of which holds the kickers in the cocked position. Any disturbing medium operating upon the ends *g*, of the sears *e*, releases the kickers, which forcibly throw the spent cartridges out of the chambers by means of the extractors.

The box *h* (Figs, 2 and 3) is adapted to carry the various parts. A clear open space is cut away above the line *i* to receive the springs *a*. The space is very slightly recessed as is set out at *j* in dotted lines. The springs lie in the recesses, and side movement is obviated. The width of the frame is practically only the width of the two springs, and the removal of the metal is a simple matter. The assembling of the parts is also rendered easier. Accepted May 19, 1904.

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CONTENTS.

CURRENT TOPICS.

The New Service Rifle at Bisley.—The classic reference to snakes in Ireland appears to apply to the new service rifle at Bisley. Here and there rumours were heard that somebody had used the new weapon at one or other of the ranges; but whether or not this was true it can certainly be affirmed that the new rifle did not receive anything in the nature of a systematic test. In fact the continued absence of these weapons on the market many months after they were definitely promised leaves us no alternative but to suppose that they have been deliberately withheld. When Parliament is closed and the dead season is upon us it is possible that the veil of secrecy will be lifted. Meanwhile, discussion as to the efficiency or otherwise of the new weapon for the longer ranges must be confined to the region of speculation. It is impossible to state without an actual trial whether a particular design of barrel will prove satisfactory. One is apt to assume that if things had been all right the present state of doubt would not have been allowed to continue; but this kind of negative evidence is very unsatisfactory to those who prefer to base their views upon a more solid foundation.

The Opening of the Shooting Season.—Although the commencement of August necessarily brings with it a certain amount of activity in the trade, gunmakers generally complain that there is an unusual scarcity of orders. Users of guns who frankly admit that additions to their armoury are necessary are unable by reason of bad times to give the requisite orders. This complaint has been recorded in every branch of business. Society has undoubtedly done its best to be gay in spite of depressing financial conditions, but minor economies and the cutting down of superfluous expenses have caused a good deal of disappointment to those anxious to cover the losses of previous bad seasons. It is, however, possible that the promise of an exceptionally good head of game will force along a revival of business as the season proceeds. Cartridges at any rate must be used in large quantities; and it is more than likely that the tempting array of sport will stimulate a fair amount of trade in guns ordered for delivery at short notice. This class of business will probably be encountered when the early reports from the grouse moors and partridge districts convince the sceptic that he is on the threshold of a really fine game shooting season. Disease has undoubtedly been very rare amongst wild bred game; but in the case of pheasants there has been a certain amount of trouble in isolated instances. This may, however, be attributed to the fact that epidemic disease is bound to occur on land that is allowed to become "pheasant sick" for want of the precautions that must accompany the raising of an abnormal head of game on a limited area.

The Gun Marking Controversy.—The Birmingham Gunworkers still continuing their persistent agitation to put a more or less effective stop to the displacement of English by foreign labour in the supply of components for use by the Birmingham gun trade. On general principles we have every sympathy with a movement which appears on the face of it to be intended to discourage the use of foreign materials where those of English make might be employed in their place. The Merchandise Marks Act appears to be relied upon as establishing

the illegality of the practices that are alleged; and if once the law is set in motion either a lot of good or a lot of harm will result. Personally we hold the view that the agitation which is being conducted with such vigour may indirectly produce a remedy for the evils which undoubtedly exist. The manufacturer does not use foreign components by reason of a sneaking sympathy for that which is not British. Where foreign components are extensively used it is because they are cheap, efficient and subject to prompt delivery. If a change were made to British components the trade would probably go, and we should lose the benefit of much of the work which at present assists in keeping many of the shops open. We must hope, therefore, that the constant irritation to which users of foreign components are subjected will gradually bring about its own remedy by stimulating a desire to organise the home output so as to diminish our dependence upon the foreigner.

Our Lecture on Rifle Recoil.—In this month's lecture we are in the fortunate position of being able to introduce to our readers a subject that represents very nearly an original line of enquiry. Some few years ago when Mr. Griffith's figures gave us, for shot guns, absolute recoil values to work upon, we were able by mathematical analysis of the results to show that the mixed conditions under which the blast of powder gas came out of the muzzle could be resolved into an average value of velocity equivalent in recoil effect to what would happen if the whole of the gas came out as one piece with a definite velocity. This mathematical figure for the rate of efflux of the gases forms the basis of our lecture this month on the subject of cordite express recoils. Experimental results have shown that the characteristic rate of exit of the Cordite gases may be stated at 3,000 feet per second. This gets rid of the only doubtful factor in the calculation for recoils for express rifles, and we thus dispense with the need for estimating the muzzle pressure and the resulting rate of efflux. Having, therefore, established a very simple basis of comparison, we have been able to show how gunmakers may calculate the weight of rifle necessary to produce with any cartridge a standard value of recoil. This and other questions raised in the article seem to deal with a number of issues of very apparent interest.

Our American Contemporaries.—While American enterprise is proverbial in almost every department of work there is at least one direction in which our cousins across the Atlantic pay us the very doubtful compliment of robbing us of the fruits of our brains. The sporting periodicals of the United States appear to have so little enterprise and originality of their own, and for that matter so little self-respect, that they live a parasitical existence. A really carefully-written article dealing with one or other of the scientific questions concerning guns and rifles necessitates a considerable amount of hard work, often including a series of experiments which are made to establish the truth or otherwise of the speculations put forward. When a piece of work of this kind has been produced in Great Britain, it passes to the United States in the ordinary course of post, and journals from which one would expect better treatment appear to have no compunction in reproducing the article *in extenso*, subject to the simple acknowledgment of the source whence it has been obtained. The shameful manner in which contributions published in English newspapers are stolen by the American press is a grievance for which no apparent remedy appears to be available. The English output of technical shooting articles, though not large in volume, represents very nearly the world's supply of such material, and it is with unfailing regularity reproduced by the American sporting press. Thus it happens that the fruit of many years of labour and special training is literally stolen without the prospect of a cent by way of compensation. If writers on American sport themselves possessed a sufficiency of original information, a certain amount of free exchange of ideas might be carried on to mutual advantage, but the American tariff exercises no veto on the free importation of intellectual goods, probably because, notwithstanding their undoubted value, no price is paid for them. It frequently happens that the "original" mattter in the leading American sporting papers is almost exclusively made up of politely acknowledged contributions taken from English newspapers.

This Year's Sporting Cartridge Trade—Loading operations for the season's consumption of cartridges are now in full swing, and it is to be hoped that the average quality of the output will prove satisfactory to the shooter. While it is difficult in a trade where progress is registered by the adoption of various minor alterations of method and manipulation to say just how things are going, we think it must be clear that the trade in English sporting cartridges is developing on the right lines. The ventilation of many technical questions concerning the use of modern types of nitro powder has shown that the quality of the cartridge is mainly concerned with the skill of the powder maker on the one hand, and accuracy of method in the loading on the other. The case maker supplies us with an article of highly specialised excellence, the properties of the cap being adjusted upon the basis of accumulated experience. The manufacture of a successful powder is almost entirely concerned with the striking of a midway course between extremes, and it is only by the exercise of matured judgment, guided by previous successes and failures, that the powder maker has learned exactly what combination of chemical and physical properties the powder he issues must possess Having produced a powder which thus satisfies his ideals, he entrusts it to the loader in the hope that its latent good properties will be brought out by satisfactory workmanship in this department. While the theory underlying the production of a perfect cartridge is by this time well understood, it is of course necessary that commercial considerations should receive due attention. The specification controlling the loading of first-class qualities of cartridge has been widely published, but where price makes it difficult strictly to follow on the lines laid down, it is still open to the loader to reproduce as nearly as possible in second quality loading the more important of the virtues which make the best quality cartridge a source of pleasure and satisfaction to the shooter. Generally speaking, it is as easy to insert accurately measured powder charges as to leave the precise amount to chance. Again, as regards the card wadding there is little or no difference between the best and the cheapest. Second quality or even an inferior felt may still perform excellent service if the other portions of the cartridge where quality is not affected by expense are properly dealt with. Really bad cartridges are mostly those in which serious mistakes in manipulation have been made, though of

course the use of an inferior and badly standardised nitro power may cause trouble involving the most serious results. Our advice, therefore, to loaders, wherever they may carry on business and whatever may be the commercial difficulties that beset them, is to confine their attention to those powders which are known to be regulated with every possible care, and to load them as closely as circumstances will permit to the specification laid down by the maker.

POST MORTEMS ON BURST GUNS.

As a general rule the public hears exceedingly little about the instances of burst guns which are bound to arise so long as shooting remains a popular sport in this country. There are, however, a certain number of persons who gain an exceptional amount of experience in dealing with the burst guns that are from time to time thrown up as wreckage from the world of sport. The greatest difficulty which faces the person who endeavours to make a careful enquiry into the circumstances of an accident is the almost complete absence of reliable statistics upon which to base a sound opinion. The cartridge which causes the accident is necessarily lost, the shell only remaining for examination.

There is as a rule very little difficulty in obtaining samples of the batch of cartridges in use at the time of the accident, and it necessarily follows that these must be subjected to careful test and scrutiny. Unless there happens to be proof positive that some serious error of loading has been committed it is unwise to lay the blame on the cartridge. An examination of the pressure obtained from a certain number of them may show a few individual high records, but even then it is exceedingly difficult to lay down the dividing line between what is reasonably safe in a sound gun and what may be considered as dangerous. We know that ordinary well loaded sporting cartridges give pressures between three and three and a half tons during the warmer months of the year. There are however, many instances of commercial cartridges which appear to give thorough satisfaction to the shooter in which individual records of over four tons are encountered. In interpreting results of this kind it is necessary to bear in mind that the actual charge in the cartridge which gives a high pressure cannot be ascertained beforehand. Consequently it is impossible to say whether a relatively high pressure is produced when all the circumstances of the loading tend to produce excessive results, or whether only one or two of them have been in active operation. This means that an even higher pressure than the maximum obtained in taking a series may have existed in the particular cartridge that caused the accident. If the general characteristics of the ammunition suggest the presence of faults that ought not to occur then of course the ammunition must be regarded as under suspicion; but even so it very seldom happens that a clear case is made out against the cartridge.

There is, however, a very satisfactory piece of general experience which appears to characterise investigations of this sort. It is that accidents very seldom occur with the better known varieties of English nitro powder. These, as is well known, are carefully regulated by the manufacturers so as to produce a reliable level of result when reasonably well loaded. They are bulked in such a manner that overcharges are promptly evidenced by the undue space occupied by the contents of the cartridge. Such powders are specially manufactured to suit the requirements of the English market, with the result that they mostly receive fair and intelligent treatment from the cartridge loader. It is, therefore, the little known and exceptionally bulked powders that are liable to be so loaded as to produce doubtful results. A powder which occupies so small a space that it may easily be over-charged without the fact being apparent to the loader necessarily opens the way to accidents of manipulation; and if it be badly regulated so that an ordinary charge puts an unusually high strain on the gun then two possibilities at least exist for the production of unduly severe pressures. If combined with these is stiff and resisting wadding and hard turnovers there is no obvious limit to the pressure that may be experienced. Consequently when dealing with burst guns a large amount of valuable but still indirect evidence may be obtained from a careful examination of the cartridges submitted by the user, such experiments as are made necessarily including a systematic analysis of the characteristics of the powder itself.

When we look to the gun for further information it generally happens that a fresh vista of doubtful possibilities is opened up. Burst guns frequently disclose slight defects of shape and workmanship which may or may not have assisted in bringing about the destruction. There are few rents in a gunbarrel that do not disclose to the observer of an imaginative turn of mind slight evidences of flaws or other interruptions in the homogeneity of the metal. These must be duly balanced against the apparent past history of the weapon, the observer being thus informed as to the probability or otherwise of the weapon having stood the test of a course of hard practical service.

The nature of the injury to the weapon must also be carefully considered. If the breech end of an apparently sound barrel is blown away it must be assumed that a pressure existed which metal of ordinary tenacity could not be expected to withstand. The nature of the burst gives some slight indication to those who have had experience in such matters as to whether an obstruction has been the cause of the high pressure. If an obstruction lies immediately in front of the chamber, say a 20-bore cartridge dropped by accident into a 12-bore barrel, then the effect is to increase the pressure in the chamber without evidence of special strain where the obstruction exists. On the other hand if the obstruction lies a little more forward so as to be struck by the shot after it has been set in motion the seat of greatest strain is removed from the chamber to that portion of the barrel where the obstruction lies. The greater the distance between the breech and the obstruction the more powerful is the rending action that is exercised, so that obstructions existing near the muzzle blow the barrel into pieces.

Another class of injury to which barrels are subject is the formation of rents or tears in the thinner forward parts of the tube. When these exist it is necessary to pay very careful attention to the thickness of the barrel walls and the concentricity of the exterior and the interior. An entirely different class of injury that is frequently encountered consists in strains on the action which cause an opening of the fastenings of the breech. These generally arise from the use of violent cartridges working as often as not in combination with a gun of

doubtful antecedents, the design and workmanship of which is not of the best. Barrels which are set too close together to allow proper space for the insertion of the extractor leg frequently break away along the obvious line of least resistance. Considering that many weapons which give way in this manner have evidently received many years of constant wear it is difficult to lay down with any precision just why the structure breaks down under the strain of the particular cartridge that causes the accident. In such instances, and in fact in many others, the burst seems to arise from accidental combination of a somewhat over powerful cartridge and a gun which possesses an insufficient margin of strength for present-day commercial cartridges. It may, therefore, fairly be said in speaking of most gun accidents that of many possible causes it is very difficult to pick out the probable one. In fact the verdict of found burst seems very often to be the only logical conclusion to which a jury of experts can come.

SOME IMPRESSIONS OF THE BISLEY MEETING.

IT is only a portion of the gun trade in Great Britain that is interested in the happenings at the Bisley Meeting. The maker of sporting guns and rifles finds very little that specially attracts his sympathies, although some of the most respected names in the business have become known to the sporting world by reason of successes attained at the ranges. In fact a reputation for the turning out of good rifles carries with it evidence that the maker has devoted considerable time and trouble to experimentation and practical shooting. In the making of shot guns on the other hand there is more mechanism and workmanship, but less mathematics and science than with the rifle. However, there are still many gunmakers whose business has gained greatly from association with Bisley. The firms of Gibbs and Rigby stand very high in this connection; while those of Fraser of Edinburgh, Martin of Glasgow, and Greener of Birmingham stand as a positive proof that daily intercourse with rifle shots of the highest repute tends to favour the production of weapons of the most refined accuracy.

In regard again to ammunition it must be recognised that the name of Eley has become permanently associated with the output of first-class revolver cartridges in a manner that would hardly have been possible without the testimonials that are gained by the making of Bisley possibles. Then again we have fresh in mind the knowledge that Kynoch miniature cartridges containing cordite first became widely known from their performances at the Martin-Smith range. It was for a while a subject for regret that they were mostly shot in American rifles, but Messrs. Webley showed that rifles of their make were capable of sweeping the board. The King's Norton Metal Company represent a firm who were unknown to fame, notwithstanding the possession of one of the best equipped cartridge factories in the country, but when they introduced their Palma cartridge to the notice of the Bisley marksman it would have required a very large bushel to hide the light they set shining. In a similar way we find Messrs. Eley making known this year their Gaudet reduced-charge cartridge of military rifles. The complaints against the Morris tube system of practice firing are all got rid of by the use of a re-charged service cartridge containing smokeless powder and a nickel base bullet. The ordinary operation of the rifle is not interfered with, no added tube or adapter is required, and the ballistics of the cartridge are such that it may be used at any range from 25 to 200 or 300 yards with a high degree of accuracy accompanied by a recoil that lets the shooter know there is something in his rifle. It seems probable that at some future date the applicability of this cartridge for practice purposes at miniature and medium ranges will be more widely recognised than at present.

Whether the Bisley Meeting of this year will prove to have been the early forcing house of the automatic rifle the future only can show. The committee do not appear to have taken a very enthusiastic view of the performance of the two models that were under trial, and the general interest of the proceedings has been largely discounted by the uninformed comments which have been passed by the representatives of the daily press who were present at the trials. An automatic rifle can only show an improvement on the behaviour of the ordinary magazine rifle in respect to the time occupied in firing the five shots in the magazine. In the double-barrel single-trigger shot gun we have a piece of semi-automatic mechanism in which two shots may be fired as quickly as the finger can operate the trigger. In actual practice the time elapsing between the shots is the time taken by the shooter in perfecting his aim. The automatic rifle may be described as a single-trigger multi-barrel weapon, and although it may not show any marvellous properties as regards rapidity of fire say over a period of one minute as compared with the magazine rifle the fact remains that its military usefulness is established by the rate at which the magazine supply can be utilised. The view of the Committee that of the arms submitted none was of sufficient mechanical stability to justify the award of the full prize shows that, while automatic rifles have had a good show, their mechanical form has not yet attained what is considered perfection.

The Thorneycroft rifle is another weapon which has been freely examined and used at the Bisley Meeting. The small compass into which the essentials of a military weapon have been condensed is a wonderful tribute to the ingenuity of its mechanical design, though of course we must bear in mind that for a time at any rate we are committed to the new pattern shortened Lee-Enfield rifle. Of sights and other sundry details, also on show, the Peddie combination must stand very high as a serviceable type of military sight which is also capable of bringing out the scientific skill of our volunteer marksmen.

At the revolver ranges the Colt revolver won its usual quota of first-class honours. The Webley revolver on the other hand earned the remarkable distinction of making a highest possible score at 50 yards, a proceeding for which there are exceedingly few precedents. At the 100-yards range the shooting seems to have produced a certain number of most interesting results. In a recent issue we queried the possibility of the ·25 Stevens rifle competing with more powerful cartridges of the central fire variety at the distance named. The competition for this combination of rifle and ammunition which was initiated this year has, however, considerably modified our view, since it really appears that this simple and inexpensive combination of rifle and cartridge is capable of performing the most remarkable feats of rifle shooting at 100 yards, granting of course the favourable conditions of weather

and range which prevail for the most part at Bisley. The Greener rifle has again repeated its previous successes; but the popularity of the competition established by the firm interested was somewhat marred by a decision permitting the use of undue refinements of sighting such as could not be considered within the means of the ordinary competitor. The Webley ·32-40 rifle achieved the success we expected of it by reason of its performance last year; but on the other hand a Greener and a Stevens rifle also made scores tying with the first position. A Sherwood rifle accomplished an equal score in another competition, but the shooter in question did not succeed in attaining the object of his desires in regard to the Martin-Smith event.

This year's Bisley Meeting can as a whole, be pronounced a thorough success from every point of view; the beautiful weather experienced throughout the fortnight, the total of entries recorded in the leading competitions, and the exceptionally fine scores made with the ·303 rifle in the long-range competitions have all combined to make the rifle shooting world pleased with this year's work. Bisley is a great school treat for most of those who take up their quarters in the camp, but the pleasant social aspects of the gathering can never obliterate the enormous influence which this purely self-supported organisation exerts upon the fortunes of rifle and revolver shooting in this country and its dependencies.

THE BALLISTIC PENDULUM.

A VERY interesting aspect of the Bisley Meeting was open to the inspection of certain favoured individuals of a more or less scientific turn of mind. Under the main tank which supplies water to the various standpipes, stands a building in which was fitted a ballistic pendulum. Although there were many trade experts on the ground, few, if any of them, had ever seen such an instrument in practical working order. It seems, however, that Mr. Metford many years ago devoted a good deal of attention to the testing of bullet velocities as fired from various types of rifle. The ballistic pendulum was the instrument employed by him for a variety of reasons, including its independence of electrical apparatus. Major the Hon. T. F. Fremantle, as a disciple of Mr. Metford, long ago mastered the importance of this very simple means of comparing the striking power of different bullets. As a man of very wide information in all that appertains to the rifle, he has a thorough grasp of the mathematical principles underlying the ballistic pendulum, and he secured the collaboration of the National Rifle Association in getting an improved form of instrument, as made by Mr. Gibbs, of Bristol, installed at Bisley.

To the technical man who holds the view that velocity can only be measured with the electric chronograph, it comes as a surprise to find that anything approaching consistent readings can be obtained by a process of registering the momentum of the bullet. The instrument itself consists of an iron casting weighing about 50 lbs. It is suspended by parallel wires from the ceiling, the length of the pendulum motion being accurately determined by timing the number of complete oscillations during the period of observation. The head of the instrument is made very solid and substantial, so as to withstand the shock of a high-power bullet. The front of the head is faced with a block of hard wood, so ensuring the catching of the bullet and the prevention of fragments striking back, which would mar the accuracy of the results obtained. To take due account of the increasing weight of the pendulum during the course of a series of experiments, a little box is provided in a suitable location, into which are put as many bullets as will be fired. Each time a shot is discharged into the pendulum a bullet is removed from the receptacle so that its weight remains constant.

To the rear of the instrument is a projecting finger, which operates the slide of a delicate Vernier scale. Previous to firing, the pendulum is brought to a state of absolute rest, and the zero of the recoil scale is carefully set in contact with the finger. The actual taking of a velocity consists in firing a shot at the pendulum when so set, and marking to the nearest thousandth of an inch the distance it recoils as a result of the impact of the bullet. In so far that an ordinary distance of recoil is three inches, it will be seen that each thousandth of an inch of recoil represents less than one foot of velocity. Consequently, if the instrument could be relied upon to the extent of the absolute measurements recorded on the scale, something more accurate even than the chronograph might exist in this instrument, but as a matter of fact it is probably doubtful whether the amount of movement could be relied upon to nearer than ·005 of an inch. This arises from the fact that it is by no means certain that the whole of the momentum imparted to the pendulum will be converted into true backward movement. We know, for instance, that however many precautions may be taken in the mounting of a pendulum, a certain number of sources of error must necessarily exist. While fractional resistance can be reduced to an insignificant item, the same cannot be said of the side rock which may arise from a number of different causes. In the design of pendulum used at Bisley the supports are not symmetrically disposed round the centre of gravity. Consequently a slight tendency to a rocking movement is liable to occur. Then, again, whatever may be urged to the contrary, and however small the resulting errors may be, it is certain that the bullets must strike what is commonly known as the centre of percussion. While an elaborate explanation would be necessary to describe its exact application to the principle of the ballistic pendulum, it will be sufficiently clear if we point out that the bullet should strike a point on the head of the pendulum as near as possible to its longitudinal axis. When the bullet strikes at any other part some such effect must arise, as is experienced when a stump of wood is used for driving a stake into the ground. If the true centre of percussion of the driving piece is used, the full value of each blow is imparted to the stake. If on the other hand the blow is given by any other part than the centre of percussion, a vibration runs through the block, which is characterised by a stinging sensation with which batsmen are familiar.

Turning to the more theoretical aspect of the subject, it is very interesting to analyse a few of the considerations that are involved in the use of the ballistic pendulum. The bullet, whose velocity is measured, has a given weight and a given rate of movement. These may be expressed either as energy or as momentum. If we deal with the foot-pounds energy of the bullet we know for certain that the pendulum will not receive the full value of the bullet's energy. Part of it will be represented by the rebound of the bullet and a large additional proportion by the conversion of the energy of movement into heat. In the case of momentum, however,

there is no denying the fact that if the whole of the bullet is caught in the pendulum the momentum of the pendulum and bullet combined have the same value as the momentum of the bullet before impact. The momentum of the pendulum and arrested bullet is measured by noting the distance of recoil and taking due note of its weight and the length of the vertical arc. The following formula represents the calculation that must be made to translate the observations derived from each experiment into the actual velocity of the bullet.

The following factors are necessary for the formula :—

W = Weight of pendulum.
w = Weight of bullet.
g = Value for gravity, viz., 32·2.
l = Length of pendulum.
a = Movement backwards.

Having these before us we may now reproduce the formula that is required, viz. :—

$$v = \frac{W + w}{w} \sqrt{2g\,(l - \sqrt{l^2 - a^2})}$$

The obviously complex mathematical processes involved in determining the simplest velocities from the readings obtained from the pendulum probably explain the fact that it has not been widely adopted for commercial use. There seems to be good reason for believing that the actual readings obtained from a suitable instrument would be very close to what exists in actual fact. But it would hardly suit the convenience of a commercial laboratory to carry out an arithmetical sum for the average of every series of results. Scales and ready-reckoner tables could hardly be used for such a purpose in view of the variety of factors that influence the answer. With the chronograph, notwithstanding the electrical difficulties, the readings can be obtained directly in terms of velocity by the use of a simple form of sliding scale. It is, however, possible that the ballistic pendulum might serve a useful purpose for testing the conformity of batches of ammunition with a pre-determined standard. At any rate, the instrument erected at Bisley appears to be of sufficient interest to merit the special attention which we have here devoted to its installation and general characteristiccs. The actual tests made in our presence seem to conform very closely to the results obtained with the ordinary chronograph, and the differences of reading from shot to shot fell very closely within the limits of the probable variation of the cartridges used.

TATHAM'S CHILLED SHOT.—Although the Tatham brand of chilled shot has been introduced in this country so short a time it has already secured a large number of valuable adherents. The hard hitting and good patterning properties which it displays to so marked a degree especially fit it for all kinds of trap shooting. A large number of well-known pigeon shots have already adopted it as a regular item in their specification of loading. Clay bird shooters have similarly shown their appreciation of its exceptional merits, so much so that Mr. V. T. Mitchell is in the enviable position of being able to advertise that the first four places in the championship competition, together with first places in other events, were won by shooters using "Tatham chilled." While it would of course be a mistake to suggest that the shot was responsible for the success of the shooters, it is nevertheless clear that they elected to use it because they had faith in its good quality.

SPORTING CHARGES FOR THE SEASON.

A LARGE number of gunmakers will have been considering for some time past their arrangements for the coming shooting season, as regards the specification of loads they must adopt in their cartridge department. We are in the fortunate position of having enjoyed the confidence of many of our best known cartridge loaders in different parts of the country, and the interchange of ideas which has taken place from time to time has given us the most interesting insight into the difficulties and trials of this most complex business. So far as our experience has gone it appears to be evident that the full shot charge of 1⅛ ozs. is very seldom required from the loader, the odd $\frac{1}{16}$ of shot over the ounce appearing to satisfy all ordinary requirements. The particular advantage of this charge consists in the fact that it is equally suitable for 33 and 42-grain powders. That is to say, it represents the minimum charge for a 42-grain powder, and, while not exactly the maximum charge of a 33-grain powder, at any rate the largest charge which is likely to give results of all-round excellence in every variety of gun.

It must, however, be remembered that the ordinary 2½ inch nominal length of sporting cartridge is adapted for containing the full 1⅛ oz. charge of shot in combination with the ordinary specification of wadding. In order to make a perfectly tight and well-filled cartridge the gunmaker who adopts the 1$\frac{1}{16}$ oz. charge for his standard loading will do well to combine it for both classes of powder with a felt wad having a thickness of $\frac{7}{16}$ in. This size of felt wad with card wads $\frac{1}{32}$ in. thick on either side may be nicely rammed so as to solidify the powder to the correct extent, still leaving a space of one inch between the over-felt wad and the mouth of the cartridge. This distance is just sufficient to contain a 1$\frac{1}{16}$ oz. charge of ordinary No. 6 shot, the remaining space being enough for the insertion of a $\frac{1}{16}$-in. top wad and the formation of a nicely shaped turnover. While the fancifully coloured "Field" card was till a year or so ago considered a necessary adjunct to a well-loaded cartridge it may now be safely affirmed that the trade has adopted the highly common-sense reasoning that colouring material does not affect the efficiency of a card wad. The admission of this truism has opened the way to a highly appreciated reform in cartridge loading whereby the two wads which are placed on either side of the felt are of a precisely similar character, being plain white cards of such a thickness that a pile of twelve will make a column one inch high and of an average diameter of ·738 in. This diameter of wadding is that known as true 12-bore, and gunmakers must realise that they must never depart from this size, even when the powder maker specifies an 11¾ bore wad. The size of the latter is ·745 in diameter, which is far too large to get into the ordinary 12-bore paper cartridge without bulging the sides and generally destroying the good quality of the loading. The 11¾-bore dimension may, therefore, be regarded as impossible for card wads of ordinary thickness, though it may be used for cloth and other soft wads, as also for card wads of exceptional thinness. Gunmakers who desire to impart an extra finish to the components of their cartridges may adopt for the plain white card on either side of the felt those having a glazed surface.

ROUND THE TRADE.

The board of directors of Eley Bros., Ld., have declared an interim dividend of 5s. per share free of income-tax, payable on the 28th ult.

We have received from Nobel's Explosives Company two card notices relating to the merits of the Company's sporting powders, Ballistite and Empire.

Colonel Hopton, the Chief Inspector of Musketry, was successful in winning the match rifle aggregate at the recent Bisley Meeting, using Palma cartridges.

The German Emperor was so far interested in the automatic rifle tests at Bisley that he sent a special officer to witness the firing experiments that were carried out.

We are very pleased to report that Mr. D. J. Metcalfe has resumed work at the office, having fortunately made satisfactory progress in the illness which lately overtook him.

The Kynoch Company have forwarded to this office a handsomely illustrated sectional catalogue dealing with their leading brands of sporting ammunition and cartridge cases, which they supply for gunmakers' loading.

Messrs. Eley Bros., Ld., had on exhibition at Bisley a new form of clay bird trap, which is set and sprung by means of a lever situated behind the firing line, the duties of the trapper being limited to placing fresh birds in the hand of the traps.

Messrs. Vickers, Sons and Maxim have declared interim dividends for the half-year ending June 30th, at the rate of 2½ per cent., less income-tax on the 5 per cent. stock, and 5 per cent. preference shares, and 1s. per share, tax free, on the ordinary shares.

A few days ago Messrs. Colt's ever-courteous and considerate manager was the recipient of a handsome travelling clock bearing the following inscription:—"Presented to Mr. James Goodbody by a few naval revolver shots in recognition of the courtesy and the invaluable help he has always accorded to the R.N. revolver team."

It is reported from Birmingham that the Natal Government has recently passed a law to the effect that only firearms bearing English proof marks would be admitted into that country, and that firearms not so marked would be destroyed by the Customs authority on arrival. Whether this rather drastic treatment is really intended we should be inclined to doubt.

Messrs. Baldwin have written to us concerning our notice of their registration as a company, asking us to correct the obvious misprint by which the directors' fees were stated at the somewhat abnormal sum of £15,000, whereas the correct value should have been one-tenth of this amount. They also point out that the concern is not a public, but a private company.

Among new exhibitors at Bisley this year, the Eley tent was a prominent feature, this firm having elected to take a site adjoining the revolver ranges instead of in the alternative location of the bazaar lines. Among familiar stallholders of previous years who were absent on this occasion, the Kynoch Company and Messrs. Webley Richards may be specially mentioned.

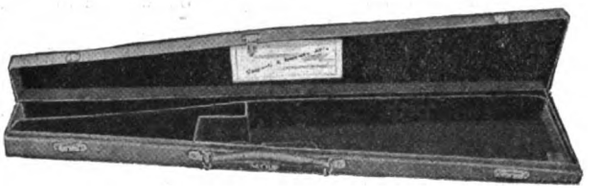
We very much regret to hear of the death of Mr. Harry Rayment from an attack of appendicitis. Mr. Rayment, as a nephew to the late Mr. Joyce, was connected as long as many of us can remember with the cartridge firm of that name; and we feel sure that the news of his death will be received with the keenest regret by all those who have had relations with the firm.

Readers of the *Field* will no doubt have been struck by the ingenious advertisement of the Schultze Company, which consists of a series of drawings illustrating various types of the fair sex, the cast of whose countenance or the items of whose dress are arranged to indicate the properties of waterproof, hard grained, perfect pattern, high velocity and safe, the last lady being an excellent representative of the chaperone type.

We have received from the Western Cartridge Company of East Alton, Ill., U.S.A., a copy of their cartridge catalogue. It is interesting to note that they have followed the lead of the Winchester and U.M.C. companies by crimping the tube of the brass head. The first named company made a series of circular rings, the second a series of interrupted rings, and the Western Company have made their indentations longitudinal and a short distance apart, the idea in all instances being to impart a give to the brass head calculated to facilitate the extraction of the empty shell intact. The Company's brand of ·22 rim-fire ammunition is characterised by a maltese cross on the base.

The Wilkinson Sword Company are exhibiting at their premises in Pall Mall a properly set up model of the sub-target gun machine, which is an ingenious apparatus, whereby the alignment of a rifle at a target some 20 yards distant is automatically reproduced by an index pointer. The pulling of the trigger instead of discharging a cartridge, operates an electrical contact, whereby a dot punch is made on a dummy target indicating the line of aim at the moment of fire. It is generally believed that this ingenious piece of apparatus will be found of great use in giving soldiers shooting instruction under conditions where the firing of reduced charges may appear disadvantageous. A feature of the new apparatus which specially took our fancy was the extraordinary power which it gives to the instructor of noticing whether at the moment of pulling the trigger the alignment of the gun is disturbed by a jerk unconsciously perpetrated by the shooter.

Mr. Robert Bryant, of 24, Drury Lane, Holborn, has left with us for examination and report, an exceedingly well-designed gun case which he has introduced for the purpose of getting rid of certain objections that arise in connection with the ordinary leg-of-mutton case. The details of the new case will be made clear to the reader by examining the accompanying illustrations. It will be seen that the new case, which is to be known as the "Featherweight," consists of a long box having the shape of an isosceles triangle with the apex cut off. It opens longitudinally, and so enables the gun to be inserted flat in the case. The interior divisions and lining have been very carefully designed, so as to be readily adjustable for a great variety of shapes and lengths of gun. The barrels are laid edgewise with the fore-end attached, and the stock lies in the wider end of the case. It is made in



several styles, that which has been submitted to us being of best leather, which has been blocked to the required shape. It is exceedingly stiff, and will protect a gun from the knocks and injuries incidental to its carriage from one place to another, though of course it should be understood that like the leg-of-mutton case, it does not profess to be capable of

withstanding rough treatment in a luggage van and on the platform. The closing of the case is effected by a very neat double-acting lock, supplemented by clasps at either end. The case submitted to us weighs about 3 lbs, and as Mr. Bryant has turned it out at a very cheap price, there seems every reason for anticipating a ready sale amongst all sorts and conditions of shooter.

THE NEW PROOF REGULATIONS.

SECTION 117 of the Gun Barrel Proof Act, 1868, lays down that alterations in the rules, regulations and scales controlling the process of proof shall not come into force before the expiration of three calendar months after the publication of the last of the advertisements announcing the same. The full notice of the new rules appeared in the *London Gazette* of the 26th April, and the various supplementary advertisements were so timed that the new rules of proof should come into force with the opening of the month of August. We may, therefore, now regard the new rules of proof as definitely in force, and it will behove gunmakers to pay very careful attention to the various modifications of practice which are now in operation. The proof marks themselves have been altered in several important respects, the chief being the addition of a special nitro proof mark where nitro powder or its equivalent has been used in proof.

The most important change in the classification of the various arms submitted for proof will be found in the eighth class, which now includes every type of ball and shot gun, instead of guns of the paradox type only. Hitherto ball and shot guns which were rifled throughout the whole length of the barrel were proved in the fifth class as breech-loading rifles. Now, however, ball and shot guns, whatever may be their method of boring, have a class to themselves, and are all proved according to the same scale. The nitro proof of these weapons is divided into two sections, according to whether it is intended to cover the use of nitro powders for shot charges or for ball. Each requires a separate nitro proof, and the markings have been carefully laid down so that the shooter shall be in no doubt as to whether the nitro proof relates to the use of nitro powder with shot, or with Cordite working in combination with a bullet. Ball and shot guns which are rifled throughout the whole length of the barrel will be marked S and B, whereas those which are rifled at the muzzle in the manner of the paradox will be marked R CHOKE, signifying rifled choke.

The classification of shot gun calibres will also be found worthy of very careful consideration. The particulars in question are set forth in Scale No. 4. The old difficulty of finding out from the large assortment of sizes specified which was in reality to be regarded as the typical diameter for a given bore of gun has now disappeared. The various series of dimensions are subdivided into groups, showing the nominal size of cartridge to which they belong. We thus find that the 4-bore sizes range from 1·026 to ·903 in. diameter of barrel. The size ·938 is picked out in extra black type, as showing the true diameter of a standard 4-bore gun, the nominal proof size of this calibre being a size smaller than true 6-bore. Hitherto there has been a good deal of misunderstanding by reason of this apparent anomaly, but in future there should be no difficulty in appreciating the purely nominal relation that exists between the so-called 4-bore and the barrel which is appropriate to cartridges of that size.

The 8-bore is true to the calculated diameter of a leaden sphere running this number to the pound, as also are other calibres, till we come to the 32-bore. Gunmakers will be interested to receive this definite assurance that all intermediate sizes of weapon should be bored true to the theoretical dimensions laid down in the scale of proof. We have heard doubts expressed in many quarters as to what is the true calibre of a 10-bore barrel. The proof scale now fixes this definitely at ·775 of an inch, and as all the figures published in the table have been carefully compared with the diameter of the card wadding commonly issued for the filling of cartridges, no future doubt need exist on the subject. In so far that the two Gunmakers' Associations and the ammunition manufacturers have recently published a parallel confirmation of gun and wad diameters for all calibres commonly in use, a question of considerable doubt and uncertainty in the past seems to be once and for all settled on a satisfactory basis.

Concerning the diameter to which the barrels of sporting guns should be adjusted it seems to be fairly clear that the standard dimensions laid down are intended to rank as minimum values. Not only does the tabulated scale of proof indicate this rendering of the rules, but an examination of their previous history confirms the same argument. That is to say a true 12-bore gun should have a calibre of ·729 of an inch to qualify it for marking with this calibre. If it is less than this diameter when submitted for proof it will be marked as a large size 13-bore. This might create difficulties should the maker of the gun at any future period claim that the weapon has been properly proved. The proof authorities are quite entitled in such connection to point out that as the weapon was proved as a large size 13-bore, and the barrel has subsequently been opened out to a 12-bore, there is a possibility that its diameter has been enlarged since proof by something in excess of ·010 of an inch. On the other hand if the gunmaker, who is wise in his generation, submits the gun for definitive proof with a diameter of ·729 in. the subsequent polishing out and regulation for shooting will probably enlarge the calibre to ·731 or ·732 in. diameter, this still remaining 12-bore size, and showing quite clearly that the weapon has not been unduly enlarged since proof, and therefore that the guarantee of the proof test has not been destroyed by subsequent enlargement of the bore.

That the proof authorities intend to lay special stress on this question of enlarging a barrel after proof is shown by the following regulation which now appears in the rules of proof for the first time:—"Any barrel which may have been enlarged in the bore after definitive proof, so that the bore mark impressed upon it at proof is not a true representation of the diameter, shall be required to be re-proved definitively, and if it shall have received a supplementary proof it shall be required to be reproved supplementarily." While we believe that there were special reasons which prompted the proof authorities to avoid definitively laying down that a gun so treated should be regarded as an unproved weapon, their intention so to regard barrels is none the less perfectly clear. This means that if the rules absolutely lay down that a gun enlarged after proof as above must be re-proved, such a gun must meanwhile be considered as an unproved weapon. This may appear to be a somewhat drastic regulation to adopt; but in actual practice it should not introduce serious difficulties, the trade having merely to make sure that all guns submitted for definitive proof shall take a plug having the dimensions laid down in black type in Scale No. 4, subsequent polishing and regulating thus making the standard diameter of a gun delivered to a customer some two or three thousandths larger than the minimum sizes specified in the scale already referred to.

LECTURES TO YOUNG GUNMAKERS.

XXX.—THE RECOIL OF CORDITE EXPRESS RIFLES.

THERE is probably no question connected with Cordite express rifles which is at the present time in so uncertain a state as the fixing of their weight with reference to the value of recoil. It must be remembered that the recoil of an express rifle must be regarded in a totally different aspect from that of a military rifle, shot gun or other weapon from which many shots are fired in the course of a short time. In the case of the express rifle the number of shots fired during a day's sport must of necessity be very small, and at the actual moment of firing the attention of the shooter is so concentrated upon the work in hand that he is unlikely to appreciate the full effects of the recoil even if it is considerable in quantity. On the other hand the shooter is painfully aware of every ounce in the weight of his rifle, since the conditions under which wild game is pursued necessarily make a great tax upon the energies of the most robust shooter if he has to carry the rifle any distance.

In endeavouring to fix some kind of practical relation between the recoil of different cartridges fired in various weights of rifle it is advisable to pay careful attention to the weight of recognised patterns of rifle such as have received the endorsement of practical use. In endeavouring to arrive at a reasonable theory it is useful to bear in mind the knowledge that has been obtained concerning the relations of weight and recoil in regard to shot guns. Hitherto it has been reckoned that the energy of a gun's recoil gave a very fair index of the physiological effects on the shooter. Experiments, and calculations based thereon, have, however, shown that the punishing effects of a given energy of recoil are greater when obtained with a light gun than a heavy one. This means that a given energy of recoil will be represented by a lower rate of travel in a heavy gun and a comparatively sharp movement in a light gun. This suggests that the physiological effect on the shooter is more a question of the velocity of the blow which the gun imparts to the shoulder than of the actual amount of energy in that movement. The blow produces a shock having local effects, whereas the energy of a heavier but slower moving weapon is taken up by the gradual resistance of the shooter's body as it is brought into play. From this it would appear that the appropriate weight of any given class of rifle is better found by standardising the recoil in terms of its velocity of backward movement than by the actual energy equivalent. This means that while a shooter may perfectly well withstand a 40 ft.-lbs. recoil from a heavy duck gun his distress would be acute were the same recoil experienced with a light sporting gun.

The theoretical examination of the various problems of recoil as applied to express rifles affords material for some very interesting discoveries; and although the arithmetical processes involved may appear somewhat alarming to the lay reader they involve nothing more complicated than the simple rules of arithmetic. For instance it has already been made clear in previous lectures on recoil that the momentum of a moving body is expressed by the product of its mass or weight and its velocity of movement. This is written mathematically as MV. In the matter of recoil it has also been made perfectly clear that the momentum of the gun is exactly the same as the momentum of the various bodies which are projected forwards in the action of firing. In the movement of the bullet and wads we have an MV which balances a portion of the momentum shown by the gun. In the powder gases we have another momentum which must be taken into account. It is, however, necessary to divide the momentum of the powder gases into two portions. That is their rate of movement at the moment when the shot leaves the muzzle, and secondly their movement in the act of rushing out of the muzzle after the bullet has unsealed the muzzle. The momentum of the powder gases at the moment when the shot leaves the muzzle represents a mixed value for which an average must be taken. The gases being equally spread over the whole length of the barrel the net forward movement of the mass of the gases must represent an average between extremes. In other words while the bullet has moved the whole length of the barrel the centre of gravity of the gases has passed from the cartridge to the centre of the barrel. Thus we find that the momentum of the gases at the moment when the shot leaves the muzzle is equal to their weight multiplied by half the muzzle velocity of the bullet, this because they have covered half the distance in the same time.

When we come to examine the momentum imparted to the gun by the efflux of the gases after the bullet is gone we find that special experiments and calculations are necessary to obtain satisfactory figures to deal with. We know, however, as a theoretical certainty that the momentum of the gun is for all the stages of recoil equal to that of the parts moving forward. By measuring the velocity of the bullet we can find how much of this momentum is balanced by the movement of the bullet, and also the amount that corresponds with the movement of the gases up to the time when the shot leaves the muzzle. We may, therefore, feel certain that the momentum still unaccounted for in the total measurement of recoil must be that of the gases passing out of the muzzle. Knowing the weight of the powder charge, and, therefore, of the gases we can obtain their average rate of emission by dividing the unexplained momentum by the weight of the gases. This then becomes the average velocity of the efflux of the gases. We thus account in the bullet and the powder gases for the whole of the momentum which is found by direct measurement to exist in the gun at the time of its greatest velocity of recoil. It should be understood that the total recoil is measured by freely suspending the gun from two cords, and providing means for judging the rate of its backward movement immediately after the gases have escaped from the muzzle.

To return now to the purely mathematical treatment we may lay down in the following formula the equality of the momentum of the gun to that of the ejected materials at the moment when the bullet leaves the muzzle:—

$$MV = v\,(m + \text{weight of wads} + \tfrac{w}{2})$$

Where M = weight of gun
V = velocity of gun
v = velocity of bullet
m = weight of bullet
w = weight of powder. ... ... (1)

Having shown that after the bullet has gone there is extra

momentum added to the gun by the emergence of the gases, we may express this extra momentum by the weight of the powder gases multiplied by x, the unknown value of their velocity. The formula for the total momentum of the gun, that is, after the gases have gone thus becomes:—

$$MV = v\ (m + \text{weight of wads} + \tfrac{w}{2}) + xw \qquad (2)$$

It will be self-evident that we can find out, either by measurement or experimentation, the value of every factor on both sides of this formula bar the unknown quantity x. It must be understood that the formula introduces no theories as regards the efflux of gases under pressure. It merely states in algebraical language what really occurs. This is to say, the true momentum of the gun is equal to the joint momentum of the materials ejected, and we can resolve all these into their respective weights and velocities with the single exception of the value x.

For the purpose of ascertaining the average value of x in Cordite express rifles, a series of experiments was undertaken which consisted in measuring the actual recoil of a series of typical rifles, the velocity of the bullet being also ascertained. These experiments showed quite conclusively that the average velocity of exit of the powder gases may be stated with very fair accuracy at the round value of 3,000 feet per second. If, therefore, we substitute this value for x in the formula, we can obtain the recoil value for any given combination of rifle and cartridge. The velocity of the recoil is obtained from the following formula, which represents a slight transposition of the values shown in formula No. 2.:—

$$V = \frac{v}{M}\ (m + \text{weight of wads} + \frac{w}{2}) + \frac{w}{M}\ 3{,}000$$

or adding weight of wads to bullet =

$$\frac{m}{M}\ v + \frac{w}{M}\ (3{,}000 + \frac{v}{2}) \qquad \ldots \qquad (3)$$

and the energy of recoil

$$\frac{M\ V^2}{2g} = \frac{M}{2g}\left(\frac{mv}{M} + \frac{w}{M}\ (3{,}000 + \frac{v}{2})\right)^2$$

$$= \frac{1}{2gM}\left(mv + w\ (3{,}000 + \frac{v}{2})\right)^2 \qquad (4)$$

The following digest of the series of experiments already alluded to will justify our adoption of 3,000 feet per second as the average velocity of efflux of the gases:—

(1) New service ·303 rifle. Weight of rifle and fittings, 8 lbs. Average muzzle velocity of bullet, 2,112 feet per second. Average velocity of recoil, 10·37 feet per second. This gives an average velocity of efflux of gases (x) of 2,900 feet per second.

(2) Present pattern of ·303 service rifle. Weight of rifle and fittings, 9 lbs. Average muzzle velocity, 2,096 feet per second. Average velocity of recoil, 9·19 feet per second. This gives an average velocity of efflux of gases equal to 2,989 feet per second.

(3) Express rifle firing a ·450-3¼ in. cartridge containing 70 grains of Cordite and a 480-grain bullet. Weight of rifle and fittings, 15·3 lbs. Average muzzle velocity firing at a temperature of 78° F., 2,250 feet per second. Average velocity of recoil, 13·06 feet per second. This gives an average velocity of efflux of gases of 3,275 feet per second.

(4) Cordite rifle firing ·360 No. 2 cartridge containing 55 grains of Cordite and a 320-grain bullet. Weight of rifle and fittings, 13·1 lbs. Average muzzle velocity of bullet firing at 70° F., 2,255 feet per second. Average velocity of recoil, 10·31 feet per second. This gives an average velocity of gas efflux equal to 2,920 feet per second.

(5) Express rifle ·577-3 in. cartridge containing 100 grains of Cordite and a 750-grain bullet. Weight of rifle and fittings, 16·5 lbs. Average muzzle velocity of bullet firing at a temperature of 75° F., 2,094 feet per second. Average velocity of recoil, 17·24 feet per second. This gives an average velocity of gas efflux equal to 3,260 feet per second.

The average of these values seem to be close enough to 3,000 feet per second to justify us in taking this as the correct value, or at any rate near enough for practical purposes. It is more than probable that the correct value of x ought to take some account of the velecity of the gases just before the bullet leaves the barrel, but as this would involve a considerable amount of extra calculation, the idea of further refining the accuracy of our value for x may be dismissed. The above experiments show that 3,000 feet per second is accurate to within 250 feet per second, and this difference means less than 3 per cent. on the energy of recoil. In the meantime, therefore, the formulæ above given may be accepted until further experiments demonstrate whether the velocity of the bullet or any other circumstance affects the value of x

Adopting the statistics of express rifle cartridges which were published in our last issue as an abstract from Messrs. Eley Bros. catalogue, we have calculated the following table of values showing the weight of rifle necessary to produce a velocity of recoil equal to 17 feet per second, which we take as a fair average of existing weapons. That is to say we have used 3,000 as the value of x, and by a simple calculation we found out the appropriate weight of rifle which would produce the recoil velocity which practical experience of existing types of express rifle have shown to be standard:—

Cartridge.	Powder Charge and Weight of Bullet in grs.	Weight of gun having recoil velocity 17·00 ft. sec.	Energy of Recoil with weight found *i.e.* 17·00 ft. sec. recoil.
600/3 in.	110/900	18·42 lbs.	82·63 ft. lbs.
577/3 in.	100/750	16·30 ,,	73·15 ,,
577/500/3⅛ in. ..	90/570	13·35 ,,	60·03 ,,
500/3¼ in.	80/570	12·53 ,,	56·21 ,,
500/3 in.	80/570	13·04 ,,	58·49 ,,
500/450/3¼ in. ..	75/480	11·35 ,,	50·93 ,,
450/No. 2	80/480	11·52 ,,	51·69 ,,
450/3¼ in.	70/480	11·07 ,,	49·66 ,,
450/400/3¼ in. ..	60/400	9·28 ,,	41·64 ,,
450/400/3 in. ..	60/400	9·19 ,,	41·24 ,,
·375	40/270	5·82 ,,	26·13 ,,
·400/360	40/300	6·25 ,,	28·05 ,,
360 No. 2	55/320	7·81 ,,	35·05 ,,

It rests with our readers to examine the weights of the rifles thus calculated, and compare them with those adopted in actual practice.

It will be seen that there is nothing in the nature of a constant energy of recoil for the different bores of rifle. A 26 or 28 ft.-lb. recoil is all that the shooter of the shot gun finds himself able to withstand, but 35 ft. lbs. seems to be a quite reasonable recoil for the smaller sizes of express rifle. As the size of bore and weight of rifle are seen to increase the allowable recoil runs into remarkably high figures. Sixty

foot-lbs seems to represent a prohibitive recoil value to the shooter who is familiar with the range of figures that apply to the shot gun; but the figures in the table before us make it clear that the heavy rifle moves back at the same pace for 60 foot-lbs. as the light one for a little more than half that value.

In fact, a very interesting aspect of the problem of recoil is opened up by the figures which are supplied as a result of the series of five experiments which are quoted above. They show that the translation of recoil into units of energy gives no index of the effect on the shooter. If they did we should be obliged to lay down that a ·600 bore rifle should weigh little short of 40 lbs., which would of course show a disconformity between theory and practice that would condemn the theory as absurd. But when we estimate recoil in relation to the rate of movement of a freely suspended rifle we find that calculated weights agree very closely with those adopted in practice. . Given two rifles having an equal velocity of recoil, one of which is half the weight of the other, we know that the energy of recoil of the heavy weapon is twice that of the light one. Now it seems reasonable to suppose, and practice confirms the view, that the sensations of the shooter will be mainly affected by the velocity of the blow struck by the butt on his shoulder. The heavier rifle will certainly push him further back, but the value of a blow is not in the weight so much as in the sting produced by the sharpness of the impact.

It may well happen that another practical aspect of recoil arises from a consideration of the class of work for which a rifle is to be used. The smaller bores of express rifle are frequently used upon game at which quite a large number of shots are fired in the course of a day; whereas with the larger bores the shots that present themselves are few and far between. Therefore the larger the bore of the rifle the less is the need for adapting its weight to a low level of recoil, whereas with the smaller bores the necessary weight is well within the carrying capacity of the shooter, so that an extra pound or two will diminish the effects of recoil without producing an unduly heavy weapon. From this it will be apparent that weights of rifle shown in the table must be used rather to guide practice than to dictate what that practice shall be. They can, however, show approximately within what limits the weight of a given rifle should lie.

In support of the view that sportsmen are unconscious of recoil when firing, but an occasional shot an interesting aspect of shooting ground work may be quoted. Gunmakers who supply rifles to shooters of unquestioned skill and proved capability, will affirm that seldom or never in their experience has a well-known big game shot succeeded in making a first-class seven-shot diagram at the target. The first two or three shots are delivered with a degree of accuracy, leaving little or nothing to be desired, but after that they go all to pieces, acknowledging that with each shot the punishing effects of the recoil seem to be more marked. Hence when using the rifle on actual game the rifle is fired under conditions that distract the shooter's mind from the punishment he suffers, and he is not called upon to fire sufficient shots to bring the recoil problem into unpleasant prominence. These few words of comment may serve to enable those who read this lecture to young gunmakers to interpret in a broad spirit the purely theoretical values which experiments of great material value have enabled us to put before them.

RECENT MATCH RIFLE DEVELOPMENTS.

If we adopt towards the match rifle the point of view that it is an ordinary military arm so selected and specially sighted as to bring out its highest capabilities of shooting we can see in it a very important subject for the study of many obscure problems of gunnery. The delicacy of shooting required of a man who is expected to place the large majority of his shots in a 36-inch bull shooting at any distance between 800 and 1,100 yards will be appreciated when it is realised that a three-foot bull at 1,000 yards has the same proportional area as a 3·6 inch bull at 100 yards. At the latter distance the shooter has a clear view of his target unobstructed by atmosphere, mirage or other optical disturbances that are apparent at considerable ranges. More than this the windage of the bullet shooting at 100 yards is so small as to be scarcely appreciable, whereas when shooting at the greater distance the deflection of the bullet by wind is frequently as great as 30 feet. Then again the presence of the so-called fish-tail wind blowing up and down the range with variable strength and variable angle introduces a source of disturbance which materially affects the elevation which must be given to the rifle.

With all these and many other difficulties to contend with it is really remarkable that such an extraordinary high level of shooting should be experienced at the long ranges which are so popular a feature of Bisley camp. The match rifle shooter must of necessity be a man of great powers of observation. No miss must be allowed to pass without the most careful enquiry into all possible explanations. He must study the weather with the skill of an experienced yachtsman, and no alteration in the force or direction of the wind must be allowed to pass unnoticed. When a shooter hears the gusts of wind come rushing up from behind he must not jump to the conclusion that his sights must be adjusted to correct the extra strength; for he must first of all satisfy himself that when the wind gets stronger it does not simultaneously alter its direction, so as to neutralise the apparent adjustment of the sights that is called for. When skill in the estimation of wind and other disturbing influences has been carried to the pitch of perfection here indicated it is not surprising to find that the shooter develops a wonderful power of distinguishing faults in the rifle and cartridge. The nickelling of the barrel, the existence of irregular elevation, and the peculiarities of jump and flip which are brought out by using different cartridges are all carefully recorded in his note-book, and it must follow that the rifle and ammunition which are found to give the best average results at the long ranges are those which, other things being equal, represent the highest development of manufacturing skill.

The most crucial test which the match rifle shot is capable of applying to his rifle and ammunition is to denote the degree of success attained in maintaining a constant elevation on the target. The errors right and left of the bull may generally be ascribed to mis-estimation of the effects of the wind, whereas vertical divergence is very largely a question of irregularity in the action of the cartridge. Whether this irregularity arises entirely from a change of velocity, and to what extent the velocity influences the jump of the rifle has not yet been definitely determined, but we do know that the ammunition which gives a constant elevation on the target must of necessity

be more regular in its action than the sort which leaves the shooter in doubt whether the bullet will pitch on the top edge of the target or hit it near the lower margin.

Recent observations have shown that faults of this kind must not be attributed solely to the quality of the ammunition. Rifles themselves are liable to go off their shooting without any apparent just cause, and the shooter must be excused if he attributes this failure to a sudden loss of quality in the ammunition. Captain Hardcastle is responsible for clearing away a large number of misconceptions which are based upon experiences of this kind. Whatever we may say in favour of the match rifle shot as a patient observer very few of them have received a truly scientific training. Consequently they are at all times apt to adopt some imaginary explanation for the difficulties, which to their way of thinking fits in with their observations. One of these views is that a rifle barrel will seldom stand more than 300 rounds and still retain its powers of imparting a perfect elevation to the bullet. It seems, however, that it is not so much due to actual wear of the barrel as to the deposit of metallic fouling in the bore, which, while invisible to the naked eye, is made apparent by the use of an accurate gauge. When this is removed by chemical treatment the rifle appears to regain its lost efficiency. At any rate, Capt. Hardcastle possesses a rifle which fell off after firing a few hundred rounds. A set of barrel gauges disclosed the existence of metallic fouling in the bore. This was chemically removed, and subject to occasional repetition of the treatment, the barrel which has fired thousands of rounds is the best he possesses.

TRADE MARKS.

TRADE MARK REGISTERED. JUNE 23—JULY 20, 1904.

257,530. Lindener Zündhütchen—und Thonwaaren—Fabrik.

There were no trade marks of interest to our readers advertised during the last month.

APPLICATIONS FOR PATENTS.

JUNE 27—JULY 23, 1904.

14,468.* Automatic Guns. C. Lohse.
14,480. Explosives. N. Ceipek.
14,558.* Cleaning and Cooling Guns after Firing F. L. Sawyer. (Date of application in U.S.A., May 26, 1904).
14,636.* Targets. H. H. Cummings. (Date of application in U.S.A., July 10, 1903).
14,685. Projectiles J. Jackson.
14,694. Telemeter. J. W. A. Rule and C. F. Liles.
14,753.* Breech Adapter. J. W. Reid.
14,789. Range Finder. J. J. Guest.
14,887. Projectiles. A. and H. Normanton.
14,916.* Telemeter. V. Saporetti.
15,028.* Ammunition Wagons. A. Reichwald (Agent for *Fried. Krupp Ag.*).
15,044. Projectile Fuses. F. Wigley and P. R. Embury.
15,053. Smokeless Powder. A. T. Cocking and Kynoch, Ld.
15,133. Miniature Rifle Range. C. E. Luard.
15,167. Range and Targets. D. Macrostic.
15,189. Travelling Targets. T. B. Ralston.
15,219. Projectiles. R. A. Hadfield.
15,322.* Automatic Targets. C. Chevallier and E. Cadet. (Date of application in France, August 14, 1903).
15,357.* Ammunition Carrier. H. T. Bru-de-Wold.
15,420. Targets. J. Lane.
15,441.* Automatic Firing Apparatus. H. von Péchy and V. Rea.
15,464. Firing Mechanism. G. Mackworth.
15,531. Sighting from Cover. W. Youlten.
15,595. Targets. A. Astles.
15,707.* Projectile. E. Roth.
15,777. Range Finder. T. R. Dallmeyer and H. Hill.
15,786.* Magazine Firearms. W. M. Vandegrift.
15,788.* Swabbing and Cooling Gun Barrels. A. G. Winter and E. G. Buckner.
15,945. Explosive Mine. T. G. Fitz, G. McCombie, J. B. S. MacIlwaine, and G. F. Strawson.
16,000. Projectile Fuse. Colonel H. C. Seddon.
16,046. Torpedo. R. H. Quine.
16,058. Quick Firing Cartridge Bag. W. Prain.
16,079. Automatic Small-Arms. T. R. R. Ashton.
16,127. Ordnance Sighting Gear. Sir W. G. Armstrong, Whitworth & Co., Ld., and S. W. A. Noble.
16,217. Resizing Air Gun Pellets. G. L. Jeffries.
16,224. Rifle Cartridge Refill. W. Murray.
16,239.* Manufacture of Spherical Shot. A. G. Baker.
16,252.* Automatic Small-Arms. P. Mauser.
16,280.* Breech Loading Ordnance. A. H. Emery.
16,335. Automatic Targets. P. R. J. Willis (Agent for *T. F. Oetjen*).

*These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

JUNE 30th—JULY 21st, 1904.

COMPILED BY HENRY TARRANT.

14,059 (1903). **Cartridge Carrier.** Captain A. R. Burrowes, Ireland. A cartridge carrier consisting of two pieces of leather cut to shapes to adapt themselves to either side of the shooter's body. The underside has arranged thereon pouches adapted to contain slips of cartridges and loops to receive single cartridges. The braces, haversack and belt hold the carriers on the soldier's body. Accepted June 23, 1904.

14,671 (1903). **Electrical Shot Firing.** R. C. W. Wood, Eastwood, and 9 Clifton, Newthorpe. Improvements in electrical shot firing apparatus of the type described in Patent No. 1,137, 1902. The arrangement is such that accidental discharge is checked, binding screws are dispensed with, and the generator terminals along with the wire ends of a separate cable constitute an automatically disconnecting double pole firing key. Accepted June 16, 1904.

14,825 (1903). **Explosives.** H. H. Lake, London. (Agent for *Dynamit-Ag., Germany*). A process for giving to the poorer nitroglycerin explosives containing about 30 to 40 per cent. of nitroglycerin and collodion cotton, such plasticity as is necessary for forming them into cartridges to be placed in the blast hole. It consists of adding to the gelatinized nitroglycerin during manufacture carbohydrates entirely or partly soluble in water such as sugar, starch or dextrine. An example of such an explosive follows:—nitroglycerin 32 per cent., collodion cotton 0·7 per cent., dextrine 15·5 per cent., vegetable oil 1·0 per cent., nitrate of ammonia 35·8 per cent., oxalate of ammonia 3·0 per cent., sawdust 2·0 per cent, sodium chloride 2·0 per cent. and alum 8·0 per cent. Accepted June 30, 1904.

17,509 (1903). **Ordnance Sighting Apparatus.** A. Vickers and G. T. Buckham, London. In connection with sighting apparatus of the type dealt with in Patents Nos. 10,916 and 11,819, 1903, a method is described of enabling such apparatus in which large range and deflection dials are employed to be applied to existing service devices so that the dials may be accessible to separate sight setters. Right and left hand service sighting apparatus is also arranged so as to be worked simultaneously for elevation and deflection after the method set out in the above quoted patents. Accepted June 23, 1904.

17,654 (1903). **Ammunition Carrier.** Captain W. J. Seton, London. In a recent specification, No. 8,674, 1903, the patentee described a loading device for double-barrelled guns. A carrier is now invented to take a number of these loaders. The carrier consists of a trough-shaped frame of rigid but

light material provided with grooves which receive the ends of the loaders and allow them to slide in the frame. Accepted June 16, 1904.

18,312 (1903). **Sporting Cartridge Wad.** F. Garrett, Stratford-on-Avon. In order to reduce recoil an overshot wad is described which is driven in a direct line from the cartridge case. The innerside of the wad is cupped or hollowed, so that the shot shall have an equal and central bearing upon it when the gun is discharged. The wad may be composed of leather or of some substance which will break up after leaving the gun. Accepted June 23, 1904.

18,414 (1903). **Armour Piercing Projectile.** J. R. Hoyle, Sheffield and A. Anderson, Dore. A construction of armour piercing projectile characterized by the transference of a quantity of metal from the base of the shell to the nose. The base is semi-spherical, so that the thickness of the walls is about the same throughout. If necessary a rearward prolongation of the side walls is formed to take the driving band. Accepted June 30, 1904.

18,476 (1903). **Gun Cover.** H. Holmes, London. A gun case so designed as to be easily portable at the same time affording protection for the barrel of the gun. The barrel covering portion is for this purpose formed of stiff material whilst the stock covering portion is made of limp canvas. Both stock and barrel parts may be stiff but a limp junction piece is provided to allow of the folding of the cover when not in use. Accepted June 23, 1904.

18,744 (1903). **Automobile Torpedoes.** F. McD. Leavitt, U.S.A. A method of propelling torpedoes of the Whitehead type, consisting in providing a fluid pressure turbine on the central axis of the torpedo. Motion is communicated to the central screw shaft through the medium of two or more reducing gears symmetrically arranged around the axis so as to equalize the propulsive strains, and reduce friction and vibration to the lowest possible point. The mechanism it is claimed is less complicated than that in which an engine driving the propeller screws is itself driven by fluid under pressure. Accepted June 16, 1904.

19,032 (1903). **Automatic Pistol Mechanism.** The Webley and Scott Revolver and Arms Co., Ld., and W. J. Whiting, Birmingham. An automatic pistol is described in this specification. A combined breech-block and carriage are adapted to move backwards and forwards upon the frame. The barrel is stationary relative to the breech-block and carriage. The parts are designed so as to be capable of easy dismounting; and the breech locking device has received special attention. A novel ejecting device is combined with the parts. Accepted June 30, 1904.

19,763 (1903). **Torpedo Steering.** F. McD. Leavitt, U.S.A. In gyroscopic apparatus applicable in the steering of automobile torpedoes compressed air is utilized for spinning up the gyroscopic fly-wheel. At the end of a sufficient interval, to insure that the fly-wheel shall be spun up to the requisite velocity, a time valve is caused to cut off the flow. The compressed air at this point immediately operates unlocking mechanism which releases gimbals and sets the gyroscope free. Accepted June 16, 1904.

20,380 (1903). **Ordnance Construction.** G. C. J. Topp, Isle-of-Wight. A method of increasing the life of long and costly guns, consisting in the use of stays of sufficient strength to counteract the tendency to deflection due to concussion when fired. The stays run from beneath the breech, over a bridge on the top of the barrel at its centre, and down under the muzzle. The bridge may be raised so as to support the front end of the bore. Accepted June 30, 1904.

20,965* (1903). **Blasting Explosive.** C. H. Curtis, C. L. W. Smith, D. J. Metcalfe and A C Pearcy, London, and A. F. Hargreaves, Midlothian.

23,085 (1903). **Rifle Sight.** F. E. Heinrich, Germany. A back leaf sight so designed that there is no possibility of jamming at any point between the slide and the leaf. The leaf is so constructed that the under surface presented to the slide working along the bed is cam shaped. By this arrangement it is rendered easy to lift the leaf to its most upright position. Accepted June 16, 1904.

27,044D (1903). **Torpedo Ejecting Apparatus.** G. G. M. Hardingham, London. (Agent for *The Electric Boat Co., U.S.A.*). A method of ejecting torpedoes from submerged tubes. adapted principally for submarine boats. Instead of employing compressed air as is usual, the disadvantages of that system are obviated by using water from outside the boat under pressure to expel the torpedo. Accepted June 9, 1904.

27,609 (1903). **Percussion Time Fuse.** C. Puff, Germany. A percussion fuse designed to explode the shell either upon striking or after penetration. Two or more caps are provided either of which may be brought into action according to desire. One ignites the exploding charge directly upon impact, whilst the other ignites a slow burning composition, first which must be burned out before the explosive is affected. Accepted June 30, 1904.

9,588* (1904). **Automatic Small-Arm Mechanism.** H. H. Lake, London. (*The Winchester Repeating Arms Co., U.S.A.*).

10,072 (1904). **Safety Device for Small-Arms.** J. Tambour, France. A safety block is so arranged in conjunction with the firing pins that when not firing the block is slid into a position in which it is in the path of the hammers. Should the hammers be accidentally thrown forward they are arrested by the block before reaching the strikers. A bar, situated under the grip, is caused to remove the block when the gun is grasped by the shooter. Accepted June 30, 1904.

11,856 (1904). **Automatic Small-Arm Mechanism.** H. H. Lake, London (Agent for *The Winchester Repeating Arms Co., U.S.A.*). In a selected patent in this issue we fully describe a method of operating the recoiling barrel and breech block in order to allow the barrel to be loaded with the first cartridge. In the present patent the inventors describe a device for unlocking the breech block and withdrawing it without actuating the barrel or its extension. The device consists of an outside handle which is caused when pulled to remove the locking block from its locked position and so to allow of the rearward movement of the breech block to which it is pivoted. Accepted June 30, 1904.

12,121 (1904). **Magazine Mechanism.** Dr. F. Gottardi, Austria. A method of indicating how many cartridges are at any time in the magazine of a rifle consisting of a number of spring controlled studs. These studs correspond in number with the cartridges held by the magazine. As each cartridge passes out of the magazine one of the studs which project when the magazine is full from its wall, is moved inwards by its spring. Accepted June 30, 1904.

12,238 (1904). **Fuse Igniter.** W. Reine, U.S.A. A blasting fuse igniter consisting of a cap adapted to fit the end of the fuse and having an outer closed chamber containing a substance which will ignite by exposure to moisture. This fuse is designed particularly for use in damp mines. Accepted June 30, 1904.

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* These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

A BLASTING EXPLOSIVE.

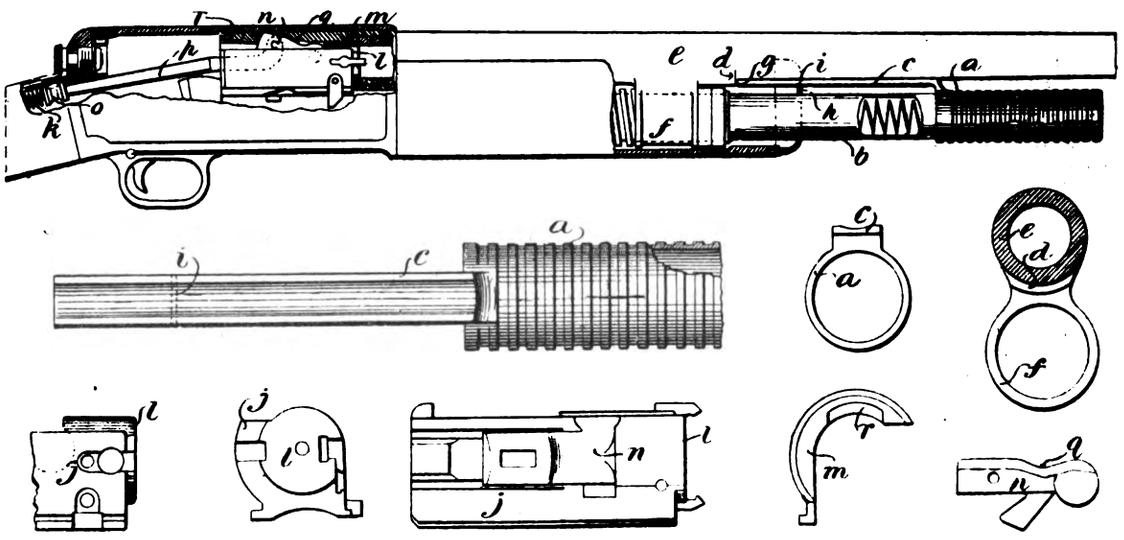
20,965 (1903). C. H. Curtis, C. L. W. Smith, D. J. Metcalfe, and A. C. Pearcy, London; and A. F. Hargreaves, Midlothian. The class of non-detonating explosive suitable for use in dusty and gaseous coal mines forms the subject of this patent. Such explosives of the kind dealt with in Patent No. 24,943, 1903, yield upon combustion a proportion of carbon monoxide together with other gases which do not support combustion such as carbon dioxide, nitrogen, ammonia, and water vapour. The presence of these inert gases protects the inflammible carbon monoxide from premature contact with the oxygen of the atmosphere. The present patent consists in the employment in such an explosive composition of a new mixture.

Two mixtures are taken. Mixture No. 1 consists of 75 per cent. saltpetre, 22½ per cent. charcoal (about 75 per cent. carbon) and 2½ per cent. sulphur. These ingredients are incorporated together in the ordinary way of gunpowder making by milling and granulating. This mixture is the same as No. 1, described in the patent the number of which is quoted above Mixture No. 2 consists of 23 per cent. paraffin wax and 77 per cent. starch—preferably rice or maize starch. Instead of paraffin wax stearic acid, palm oil,

mineral wax, or other solid or liquid fat may be used. The paraffin wax is first melted in a steam jacketted pan, and the starch after being mechanically granulated to the required size is added to the molten wax which is absorbed by the starch granules. The addition of starch is continued until the entire charge of wax is absorbed. A given weight of starch will carry 30 per cent. of paraffin wax and will form a powder in a state of granulation, the granules being slightly larger than the granules of raw starch. The function of the paraffin wax is to render the granules coherent and somewhat harder than they otherwise would be to protect them against the influence of the atmosphere. The proportion above mentioned is not essential. It has been found possible to use starch alone, and for some purposes this form of the new explosive is a useful modification.

In completing the explosive about 85 to 87½ parts by weight of mixture No. 1 are mixed with about 15 to 12½ parts by weight of mixture No. 2. The compound is pressed into a compact pellet. These proportions may be varied to some extent. Instead of making up the charge in the form of a pellet the grains after complete and intimate intermingling may be filled into an ordinary miner's cartridge, or may be put into any other form suitable for coal mining. Accepted June 23, 1904.

Fig. 1



WINCHESTER AUTOMATIC ARM.

9,588 (1904). H. H. Lake, London (Agent for *The Wincheste Repeating Arms Co., U.S.A.*). Improvements in automatic firearms of the type possessing recoiling barrels are set out in this Specification. The improvements consist of a new method of manually operating the recoiling barrel in order to feed the first cartridge into the chamber; in supporting the forward end of the breech block solidly within the barrel extension at the moment of firing; and of a modified breech block locking device.

The weapon is illustrated in the accompanying drawings. From these it may be seen that a tubular sliding barrel-operating handle *a* is employed and that it is formed with annular grooves to afford a grip for the hand of the shooter. This handle is mounted so as to move freely backwards and forwards upon the end of the tubular magazine *b*. Secured to the rear end of the handle is a bar *c*. The rear end of the bar is adapted to engage with the shoulder *d* formed on the underside of the recoiling barrel *e* The heavy guide ring *f* (Fig. 1) depending from the barrel receives the tubular magazine *b*. When in the normal position there is a clearance space *g* between the rear end of the bar *c* and the shoulder *d*. This is provided so that during the automatic operation of the weapon, the shoulder shall not impinge against the bar when the barrel is returned to its closed position. The handle is held in the retired position shown in Fig. 1 by the upper portion of the forestock tip *h* which engages with the groove *i* cut in the bar *c*.

When the bar is pulled rearwardly by grasping the handle, the bar springs sufficiently to disengage the groove and the forestock tip. Almost immediately after starting the bar end contacts with the shoulder *d* and carries the barrel and thus the breech block *j* back against the pressure of the spring *k*. At the end of the backward travel the barrel is carried forward again by its spring, the bar and handle being forced back with it to the normal position. The breech block carries a cartridge into the chamber as it is pushed forward after the barrel. The handle is used for manually operating the gun when it is desired to feed the first cartridge from the tubular magazine into the chamber; but it may of course be used in case of emergency.

At its forward end, the breech block *j* is furnished with the circular centering and supporting projection *l*, which is designed to enter a corresponding recess cut in the extension *m* of the barrel *e*. The part *l* helps not only to centre the breech block as it moves into the closed position, but also supports the forward end of the block when the gun is discharged. In consequence of the position of the locking part *n* which is pivoted in the breech block the recoil is caused to exert a downward thrust upon the forward end of the breech block. This thrust is resisted by the extension *l*. The desire for a supplemental support of this description is particularly necessary because the right-hand wall of the barrel extension is cut away to allow of the ejection of the spent cartridges.

The spring *k* acts, as is well known, through the follower *o* and the rod *p*, which rod is connected with the part *n* to move the breech block back to the closed position. The rod *p* is caused also to operate the locking part *n*, lifting it directly the breech block and barrel are separated at the end of the rearward combined movement into an elevated position. When, after its momentary pause, the breech block is moved forward and again enters the barrel, the cam surface *q* upon the locking part slides over the surface *r* upon the barrel extension, and at the completion of the closing movement is elevated by the spring into the locking position illustrated in Fig. 1. By this arrangement a dog previously used for holding the locking part down is done away with. Accepted June 23, 1904.

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CONTENTS.

CURRENT TOPICS.

A Jacketless Bullet.—One of our most highly esteemed engineering contemporaries announces that a New York firm are manufacturing a powder which is said to be capable of firing lead instead of jacketed bullets in the Krag and other high-power rifles, so exercising a saving of 20 dollars per 1000 rounds. This announcement may be taken in two ways. Either it relates to a remarkable scientific discovery or else it is the dream of an unpractical amateur. On the face of it the information seems to rest under suspicion in so far that it is made to appear that the jacket on the bullet represents some 80 per cent. of the total cost of the cartridge. Judging by the rate at which rifle clubs are at times supplied with cartridges one might almost assume they could get them for nothing if only they could dispense with nickel jackets. Hitherto we have always believed that the object of the jacket on a bullet was to provide it with a hard enough surface to take the drive of the abrupt turn of the rifling in the modern military small bore. In fact we might just as well try to skate on soft mud as expect a lead bullet to take a ten-inch spiral of rifling. That is to say that we cannot see how in practice we can impart to a lead bullet a rotation of some 2600 turns per second during the period of its passage from chamber to muzzle unless it has a sufficiently tough surface to withstand the shearing effects of the beads of the rifling. An engineer correspondent of ours, in calling attention to the notice of the new powder, explains that perfectly obturated lead bullets simply rush through the barrel like a smooth bore, the rifling acting as a milling cutter, and just shaving off so much of the bullet's diameter To us the use of a jacket seems to have nothing to do with the powder, being simply a question of so much inertia to overcome and giving to the bullet a surface that will not deform under the strain that is of necessity put upon it.

Short Range Cartridges.—It is a curious illustration of the fickleness of fashion that efforts should now be made to increase the scattering of shot charges whereas we have hitherto been most concerned in concentrating the pellets over the smallest possible area. Messrs. Eley Bros. have, as will be seen from another column, introduced a new cartridge primarily intended to reduce recoil, but the secondary effect of which is to diminish the bunching of the pellets at the shorter distances at which game is ordinarily encountered. By thinning out the charge so that 7-8ths of an ounce of shot takes the place of the ordinary 1 and 1-16th oz. load they introduce a set of conditions that enable game to be shot at closer ranges than ever before. While it is a tradition that high-class shooting over estates where driving is mostly done necessitates the use of open shooting guns, and that rough shoots require the use of choke-bored guns, experience seems frequently to indicate that even the roughest marshland shoots show the game at a shorter average distance than is commonly supposed. At any rate we all recognise that sport in the wild unpreserved tracts of the United States carries out our idea of a rough shoot; and it is not, therefore, surprising to find choke guns are so largely used in that country. On the other hand it cannot be denied that the so called brush gun with its short barrel and cylinder boring is becoming increasingly popular. The Union Metallic Cartridge Company, has recently carried the idea of

the "scatter" gun a stage further by introducing a cartridge which allows the powder gas to escape amongst the shot and so give a wide spread to the pellets even in the presence of choke boring. This is known as the 25-yards cartridge, and it will not be surprising if something of the same kind would not be useful over here. At any rate the diagrams of pattern contained in the newspaper advertisements of the new cartridge seem to suggest a singularly attractive departure from old methods.

The Shooting Season.—Now that the shooting season is fully opened, and we are upon the threshold of the partridge month, it is possible to review the prospects for the coming six months or thereabouts. There can be no denying the certainty of a good stock of game, notwithstanding the fact that last year's misfortunes have in places made it exceedingly difficult to recover the loss of breeding stock that inevitably resulted. Partridges appear to have thriven well in all parts of the country, and there can be no doubt that the bread and butter business of the cartridge vendor is likely to develop healthy symptoms. On the other hand it cannot be denied that shootings have not let with the activity of ordinary years, and it must be remembered that even though the birds may be shot, it is the visitor from London or other large industrial centres who represents the best customer to the trade. The local resident will no doubt take over any surplus shooting which has not been let, but cheap cartridges and old guns are good enough for him. It is the wealthy sportsman who purchases best guns and lays in a liberal stock of ammunition as a necessary part of his sporting outfit. However, pending the time when the present stagnation of trade will have given place to more active conditions, it must be admitted that everything promises well as regards the actual amount of sport available. In fact it may be reckoned that good sporting conditions are more favourable in the long run than the possession of ample surplus funds in the hands of those who patronise the partridge lands and game coverts of this country.

Our Knowledge of Explosion Temperatures.—One of the greatest advantages of a thorough scientific training consists in the fact that it enables the consciencious student to assimilate the published work of original investigators. In Mr. F. W. Jones we have a man whose wide scientific information is such as to enable him to appreciate every branch of applied science which relates to the behaviour of explosives. Scientific investigation in these days is not wholly a question either of mathematics, physics or chemistry, but a blending of the three. The proper interpretation of experimental results necessitates a clear insight into these three departments of knowledge. The power to appreciate technical work as expressed in foreign languages is a further essential to the process of bringing one's self up to date in every section of ballistic science. When all the available material is thus co ordinated, the result may be set forth in a clearly reasoned summary of up-to-date knowledge. This Mr. Jones has given to us in regard to the very important question of the temperature of combustion of explosives in general. His analysis of existing information on the subject has been assembled in the form of two papers, the first of which is given in our present issue. With such clearness and simplicity of treatment as is possible in dealing with so difficult a subject, he has shown us the relation that exists between the temperature of explosion and the two factors of chemical constitution and closed chamber pressure. While these articles are complete in so far that they adequately summarise existing knowledge, it must of course be understood that their application to present day commercial problems can only be apparent to those whose daily work brings them into contact with the vast field of unsystematised practice.

Explosives on the Rand.—The *Times* financial supplement of the 22nd ult. contained a very interesting review of the labour and general commercial conditions which have obtained in the Transvaal since the re-organization which took place at the conclusion of the war. In referring to the modified cost of explosives, our contemporary points out that the abolition of the dynamite monopoly has resulted in a notable diminution of the cost of explosives. In 1899 the price per case fluctuated between 87s. 6d. and 98s. 3d., while in December 1902, when the statistics for presentation to Mr. Chamberlain at Johannesburg were prepared, the cost to the mines of the same explosives had fallen to between 58s. 9d. and 71s. 5d. The saving effect is shown to be even more conspicuous if the expenditure of £1,148,701 during the complete year 1898 on 7,308,413 tons of ore crushed is contrasted with the outlay of only £713,103 in 1903 on 6,105,016 tons. The cost of the explosives has, therefore, been reduced from 3s. 1·7d. per ton of ore crushed to 2s. 4d. These figures appear to promise well for the future prospects of the Rand, so soon as a proper supply of labour is established. Consequently there is good reason for hoping that the actual turnover in explosives will surpass the old figures. Meanwhile it will be interesting to observe how the total consumption of explosives is divided between the amounts produced locally, viz. at the Nobel factory at Modderfontein and the De Beers Somerset West Factory, and the quantities imported from outside sources.

Census Returns.—It appears from the general report on the census of England and Wales in 1901, which has only just been published that there were 10,001 men and 188 women gunsmiths and gunmakers in the country. These include 138 boys and ten girls under fifteen years of age. Sword and bayonet makers appear to include 402 men and six women. The manufacture of gunpowder, guncotton and other explosive substances absorbs the services of 3,084 men and 506 women, including 76 boys and 34 girls under fifteen years of age. The making of cartridges, fireworks and other explosive articles of a kindred kind accounts for a further 3,613 men and 3,766 women. It is of course impossible to distinguish the relative number of persons so employed who are engaged in what may be termed danger operations, since many sections of cartridge manufacture are represented by plain metal stamping work which is quite disassociated from the handling of explosives. It is possible, however, from the figures here given to assume that the number of employees who are engaged in one way and another in the manufacture of explosive substances must approach very closely to a total of 5,000, and even this total cannot include many who are employed in cartridge filling work on registered premises in different parts of the country. While, therefore, we see that the actual number of persons regularly engaged in the explosives industry represents quite a considerable total, it is interesting to turn to the annual report of H. M. Inspectors of Explosives. On the first page of the last report we find that the number of deaths from accident

by fire or explosion in the manufacture of explosives is 6·4 per annum. This of course does not include the deaths due to the handling of explosives in mines and elsewhere, but as cartridge loading is regarded as manufacture, this branch of the industry must be included in the total above given. While there is a regular increase in the number of persons employed in the manufacture of explosives, such increase is accompanied by a diminution in the deaths from accident, the average for the decade proceeding the year 1891 being seven, whereas it is now reduced to the figure 6·4 already quoted.

THE UNEMPLOYED AT SMALL HEATH.

IT is a very curious aspect of our manufacture of munitions of war that political pressure should be so frequently exerted upon the Government on behalf of those that are employed by the large contracting companies. During the past month the Birmingham newspapers have contained references to the exceedingly sad effects on the workpeople which have been brought about by the curtailment of deliveries of the new service rifle. In the ordinary way when work is scarce the operative must seek fresh fields for the exercise of his talent; but when the giver of the orders is the British Government it appears to be the accepted practice to petition the War Office to order more rifles than it actually wants. This is because a certain group of workpeople have run up more credit with the local tradespeople than they can see their way to liquidate in the presence of scant employment and short hours of work. We cannot deny that the extraordinary delays which have arisen in connection with the turning out of the new rifle have upset the arrangements of the commercial concerns interested therein. Although we have every sympathy for the misfortune which has overtaken so many deserving citizens, to say nothing of the shareholder who remains somewhat in the background, we must still as British subjects express surprise at the extraordinary course of stimulating Government business by political agitation. Unfortunately the interchangeable system of manufacture is so little practised in this country as to deprive those who work for the Government factories of alternative employment in the event of temporary slackness of orders. Were we to manufacture in this country the typewriters, the sewing machines, the cash register appliances, and all the other thousand and one infinitely duplicated articles which come to us from abroad a new era in our commercial existence would at once be apparent.

To earn a satisfactory living it is better to do one thing really well than to do a dozen things with a moderate degree of success. Our young mechanics find that the struggles of their early career are materially relieved if they devote their whole time and energy to the drilling of a particular hole or the fashioning of some special surface on a given piece of mechanism. Under piece work conditions the specialist mechanic who can be trained to do one kind of work makes good money and becomes the self-respecting owner of a modest establishment; but if employment slacks in his own particular field of activity, his misfortunes begin. It is not to be expected that the whole of our artisan population will qualify as all-round mechanics and so be capable of earning a living in any line of manufacture. If only our patent law were modified so that exclusive rights over an invention could only be retained under the proviso that the goods made under it were manufactured in this country, we should find at once that many large factories would be established in our midst. At present we tie our hands in exchange for nominal patent office charges, and our industry is thereby subjected to dislocation of the kind which is now so prevalent in Birmingham. Were our manufacture of interchangeable articles to cover a greater variety of goods, there would be less difficulty in absorbing the temporary surplus of labour which is created by fluctuations of demand in any given section of Government work.

MERCHANDISE MARKS ON GUNS.

THE agitation which is proceeding in Birmingham with reference to the use of foreign components in the manufacture of English firearms is more or less directly related to the working of the Merchandise Marks Act. Having failed to secure the application of a distinctive foreign mark at the time of proof, to weapons of foreign make, the gunworkers of Birmingham appear to be disposed to test the applicability of the Merchandise Marks Act to the practice of which they complain. In the first place it must be remembered that the Act in question, while stating that certain things are punishable offences, provides no machinery for prosecuting offenders at the public expense. At any rate, this general interpretation appears to apply in so far that prosecutions for marking offences have hitherto been conducted at the expense of private persons, the sovereign of the realm acting merely as the nominal plaintiff. The gunworkers appear to be of opinion that the Board of Trade might take up a case on their behalf; but it is open to very serious question whether such a thing is within the realms of possibility. To fight a case under the Merchandise Marks Act, where the offence is clear, and the defendant practically admits that he is guilty, involves a very small expenditure of money; but where the issue involves more complicated points there is practically no limit to the the cost of the case. The reports of the well-known watch case show what an enormous amount of fees must be paid in the retaining of first-rate advocates and expert witnesses. Under such circumstances it is unlikely that any serious challenge of existing trade customs can be made by a comparatively poor body, such as the Birmingham barrel makers, when they would have against them the combined wealth of the firms with whom they seek to do battle.

The first clauses of the Act under consideration cite it as an offence to apply any false trade description to goods. Now the contention of the Birmingham gunworkers is that the engraving of an English maker's name on a weapon is calculated to lead the purchaser to suppose that the weapon in question represents the goods or merchandise of the person whose name it bears. The expression trade description refers amongst other things to the place or country in which any goods were made or produced. In the cases which have been fought under the Act it has rested with the prosecution to prove that the goods to which it is affirmed that a false trade description has been applied, were substantially made at a place other than that indicated by the marking.

In the well-known German chisel case, proceedings were instituted in respect to chisels which had been partly made abroad and finished in this country, and the evidence was wholly directed to show the relative proportion in the finished article of the preliminary manufacturing processes carried out abroad, and the subsequent ones for which our own countrymen were responsible. In the watch case the mathematical dividing of processes was carried so far as to show in parallel columns the foreign and English origin of every screw, part and process. Upon the information so established the Court was called upon to decide whether the material parts of the watch were substantially English or foreign. In applying a similar process of dissection to the manufacturing processes of firearms, any practical man could arrive at a very fair notion of what would be an equitable decision in a court of law. Where the dependence upon the foreigner is so slender as to represent merely a question of barrel tubes, then the Merchandise Marks Act would hardly apply. Under these circumstances it would be interesting to know in definite terms just what class of divided workmanship the Birmingham operatives regard as overstepping the limits so clearly laid down in the cases which have been fought under the Act which they so freely quote.

ELEY'S LITEMODE CARTRIDGE.

SINCE the Pegamoid cartridge was introduced to the sporting world very few novelties in shot-gun ammunition have been brought forward. All the more credit is, therefore, due to Messrs. Eley Bros. that they have been able to design what may be regarded as a new line of cartridge. The essential characteristic of the new Litemode cartridge consists in the fact that it is specially constructed throughout with a view to giving the very low recoil that necessarily accompanies the use of a 7-8ths oz. charge of a shot in a 12-bore gun. The idea of using this load of shot is by no means novel. The origin of the new cartridge is, therefore, limited to the special construction which has been incorporated into its design for the purpose of making the reduced charge fire under conditions which are in every way as systematically standardised as is the loading of full charges into ordinary cartridges.

The *Field* system of loading lays down the standard method of filling 12-bore sporting cartridge cases with ordinary bulk powders and charges of shot varying from one to 1⅛ oz. Custom and general experience have alike ordained that 42-grain powders are seen at their best when loaded either with 1 1/16 oz. or 1⅛ oz. charges of shot. The wadding appropriate thereto is of recognised dimensions, and the shooting obtained when this system of loading is followed may be described as of the best. Powders of the 33-grain class are similarly dealt with in reference to loads of one and 1 1/16 oz. of shot. Cartridges may admittedly be loaded for shot charges outside the limits above enumerated, but in such instances it is necessary to admit that the results obtained are more than ordinarily liable to be marred by incidental troubles of one kind and another. In attempting to work out a suitable combination of charge and wadding to suit 7-8ths oz. of shot the ordinary design of the cartridges is interfered with in a number of ways, so that there is a difficulty in securing normal behaviour in regard to pressure, velocity and pattern.

The new Litemode cartridge is made with a cone base so as to diminish the interior capacity of the case, and thereby obviate the need for inserting an unduly long column of wadding between the powder and the shot. A special smokeless powder of extra sharpness in action is also used. The charge is 25 grains, and it is ignited by a cap containing an extra powerful composition. In this way measures are taken to ensure a three-ton pressure in spite of the lack of confining power exerted by the reduced charge of shot. The wadding employed is of the kind ordinarily used for the full charges working in combination with ordinary powders. It will be clear from the above description that in order to do justice to the reduced charge of shot it has been necessary to make up a special cartridge comprising a special powder, primer and case. While the new cartridge does not of course profess to be the equal in efficiency of ordinary cartridges containing the usual loads, it is regarded as satisfying the special needs of shooters who by the possession of extra light guns, or for other special reasons find it necessary to diminish recoil to the greatest possible extent. The Litemode cartridge is put forward as a thoroughly efficient brand of ammunition for shooting over the shorter distances at which driven birds are mostly shot.

A RIFLEMAN'S HANDBOOK.—Of the publishing of handbooks on rifle-shooting, there is in the nature of things no likely end. A book of this kind must, therefore, contain many exceptional merits to qualify for special appreciation. This, we think, may certainly be accorded to an interesting little pamphlet entitled the "Rifleman's Handbook," which has been sent to us for review by Mr. J. G. Ewing, who possesses a happy combination of practical trade knowledge and experience in the carrying out of musketry instructions. The merit of his work consists, not so much in the fact that he has endeavoured to strike out a new line, but that he has most successfully chosen from the large body of available knowledge just that material which the user of the American rifle requires in order to master the practical working of his weapon. This is aptly divided into a suitable survey of its structural features and a disquisition on its use for range firing over the usual distances. In so far that the American nation has not so extensively cultivated the art of military rifle shooting at the longer distances, it is interesting to note that Mr. Ewing, who is himself Assistant Inspector General of small-arms practice to the Delaware National Guard, has explained just those questions which most severely tax the judgment of the shooter who, though fairly proficient at the shorter distances, finds that he is somewhat out of his depth when facing the complications that are incidental to the minimising of error at the extreme distances. The fact that the author has summarised in terse sentences the teachings of each chapter will prove of considerable use to the reader, since by this means the more salient points are firmly fixed in his mind. The essence of the lesson being so to speak, committed to memory, the arguments and facts which justify the conclusion, will take their proper place as subsidiary to the actual instructions that must be faithfully obeyed. The book is published by the Laflin and Rand Powder Company of New York, and there seems to be good reason for anticipating a successful issue for the utilitarian policy by which commercial profits are used for issuing books describing the use of a firm's manufactures.

ROUND THE TRADE.

The Wilkinson Sword Company report to us that two sub-target gun machines have been purchased from them by the Maharajah of Gwalior.

We have received a mourning notice relating to the death on the 17th ult. at the age of 78 years of Monsieur Jules Félix Gévelot, whose name is so well known in connection with the French arms industry.

Mr. Percy Newton has been appointed Manager and Secretary of Messrs. F. Joyce & Co., Ld., so dealing with the situation created by the recent death of Mr. Harry Rayment. Mr. C. W. Dickens has been appointed Assistant Secretary.

The Winchester Repeating Arms Company have put on the American market a new single-shot ·22 cal. rifle known as the Thumb Trigger model, in which the trigger consists of a thumb-piece on the upper side of the grip to the rear of the bolt, the shooter pressing this in place of pulling the trigger.

Messrs. Edward Evans & Company, Chartered Patent Agents, write to us calling attention to the fact that Section I. of the Patents Act 1902 is, by an order of the Board of Trade just published, to be brought into operation on the first January next, so that on and after that date all applications for English Patents upon which complete specification has been filed, will be examined to ascertain whether the invention as disclosed in the subject matter of the application has been wholly or in part claimed or described in the specification of any prior English Patent granted for 50 years before the date of the application.

It was recently announced in Birmingham that the War Office had signified that it was prepared to take delivery of the new rifle at the rate of 1,500 per week, instead of 1,060, the figure to which it had been reduced by the recent re-arrangement of the department's plans. The news has created the liveliest satisfaction, inasmuch as the dismissal of workmen had already begun. The official explanation of the order to retard delivery appears to have been that it was not practicable to inspect the new rifles as rapidly as they were being turned out. The inspection is much more rigid and thorough than was formerly the case.

The Home Office has issued to owners of metalliferous mines a notice concerning the use of explosives containing nitroglycerin (such as dynamite, gelignite, blasting gelatine, &c.) when in a solid or frozen state. The most effective precaution against accident is to require that in the winter months the explosive shall always be thawed in the warming pans before use; and a special notice requiring this to be done should be exhibited by mine owners at the mine. A form of notice has been prepared for this purpose, which should be posted on the door of the magazine or store from which the men fetch their explosives, or otherwise be brought prominently to their notice.

The South British Trading Company, whose most efficient management of the agency for the Stevens Arms Company will have been apparent to all gunmakers and dealers who do a business in these accurate weapons, have recently extended their field of work. They have in fact completed their arrangements for representing the Savage Arms Company, whose make of rifle is not so well known in this country as its merits deserve. The new pattern of ·22 cal. rifle with the Savage system of rotating magazine has been anxiously looked for during the past year by English miniature shooters, and now that the weapon is ready and the arrangements for its sale are in competent hands it will probably not be long before it establishes a firm position.

On the 24th instant on Broomhead Moor near Sheffield, belonging to Mr. R. H. Rimington Wilson, a party of nine guns, including Mr. Rimington Wilson himself, made a world's record bag of 2,743 grouse, or 1,371½ brace. The gunners were The Earl of Onslow, The Earl of Powis, Lord Cecil Manners, Lord Savile, The Mackintosh, Major Acland Hood, Mr. Heatley Noble and Mr. H. Rimington Wilson, all first-rate shots. The ammunition used was 1⅛ oz. of shot and the standard charges of Schultze E.C. Smokeless Diamond, Kynoch and Henrite, the guns being of modern manufacture, the majority of them being single-triggers on the Boss system similarly bored in both barrels. On the second day 1,252 rabbits were bagged with cartridges containing less than an ounce of shot with corresponding powder charges.

The latest issue of the *Birmingham Chamber of Commerce Journal* contains a carefully written statement by Mr. A. Tunstall of the contentions of the Birmingham gun barrel makers concerning the attitude they adopt towards the marking of foreign made tubes. The fact that Mr. Tunstall divides the making of a gun into two processes, viz., the making of the barrel or tube and the making of the gun, appears to imply that he treats these two processes on an equal footing as regards their importance in the finished weapon, and he does not appear to lay himself out to argue the real gist of the legal question. A foreign made barrel, that is a tube, must not of course be marked English when it is foreign. The marking on a finished gun applies to the whole weapon, and if five per cent. of its total value is represented by a foreign tube the gun would appear to be substantially of English manufacture. This is the point which we discuss in another column, and which must be faced if the question ever comes to be seriously argued in a court of law.

The American *Sporting Goods Dealer* announces the death of Capt. H. C. Aspinwall on June 28th last. Capt. Aspinwall was well-known to the leading manufacturers of explosives in this country, largely on account of his intimate expert knowledge of all that appertains to the business. He held the position of Superintendent of the Laflin and Rand Powder Mills at Haskell, New Jersey, and when that company was consolidated with the E. I. Du Pont Company he was made general superintendent of their smokeless powder manufacture. The factory in which the later years of his life have been spent has been described to us by Mr. R. W. S. Griffith as one of the most romantic he had ever visited, it being situated on the sloping sides of a winding ravine, the buildings being perched on niches formed in the rocks so overlooking a wide extent of country. So much was the distance to be covered in a round of inspection that Capt. Aspinwall regularly rode on horseback from point to point. The American powder trade has undoubtedly lost one of its ablest representatives, and we in this country may congratulate ourselves that he was born in the pretty Surrey town of Epsom, having migrated when a lad. His Captaincy was gained in the Twelfth Infantry of his adopted country.

Mr. W. Fletcher, the well-known inventor and patentee of rubber anti-recoil heel plates, has recently brought out a new pattern of this useful minimiser of recoil which will recommend itself to all gunmakers. Hitherto the indiarubber surface of the heel plate has been mounted on a vulcanite fibre backing. This latter was necessary because it would be impossible in ordinary circumstances to screw a piece of springy india-rubber on to the butt of a gun, and leave a neatly finished joint of suitable permanency. The accurate bedding of the vulcanite fibre on to the back of the stock is a nice operation requiring the skilled services of a careful gun finisher. Mr. Fletcher has now brought out a new form of rubber heel plate, in which the rubber may be attached directly to the stock without the interposition of a piece of vulcanite. This is effected by moulding into the body of the rubber heel plate a piece of brass which contains the usual holes for the two fastening screws. The screws draw the plate on to the butt so compressing the intermediate layer of rubber tightly on to the flat end of the stock. The pressure of the brass plate causes the rubber to make a perfect joint. As soon, therefore, as the screws are home the extending edges of the rubber pad may be ground down flush with the wood on an ordinary grindstone. This method of fixing saves time and expense, and can be carried out by a class of mechanic who would hardly be suitable for the more delicate operation of fitting the hard vulcanite plate. Mr. Fletcher, as we have already announced in our columns, has recently started business for himself at 46 Wilson Street, Finsbury.

THE LOADING OF SPORTING POWDERS.

THE arrival of the *Sporting Goods Review* card of loading instructions always raises a number of interesting questions concerning our leading English nitros. The fact that the old loads are mostly reproduced, in no way implies that progress has been arrested. The cartridge case maker is every year approaching nearer to perfection in the preparation of his cap mixture, and the filling of the same into the metal shell of the primer. Slight improvements in method and manipulation go for a great deal in the behaviour of the powder. Consequently we may assume that in the cap at any rate, each year sees a modest improvement on previous records.

In the cartridge case, again, we have a great opening for improvements that do not meet the eye. To anyone who has been in the habit of making frequent use of cartridge gauges, a very notable change during recent years will be apparent. In time gone by the ·735 in. plug showed great variation in regard to its fit in the paper tubes of 12-bore cases. A set of cartridges picked at random from ordinary stock contained a certain proportion which entered the tube with the correct amount of tightness. The remainder of the cases could then be divided into those which were too small and others which were too large. Nowadays the proportion of cartridges which exactly correspond with the plug is greatly increased, and the extreme sizes above and below represent a markedly smaller variation from the normal than has ever before been experienced. This small factor in the loading of cartridges does not strictly enter into the calculations of the ordinary loader. Within certain limits he must accept delivery of the components which are sent to him, but with the improved quality of these components the efficiency of the resulting cartridge is greatly increased.

Wads in a similar manner are cut very much truer to size than at any previous period in the history of the sporting cartridge. The extensive publication of the ·735 in. interior diameter of the tube has established the corresponding ·738 in. diameter of the card wad. These two sizes are now clearly understood by all cartridge loaders, so that while in the past they had no definite sizes with which to check the deliveries they received, they now have before them established dimensions to which they can refer whenever they feel so inclined. The acceptance of these two important dimensions by gunmakers and ammunition manufacturers in the country has led to a serious exercise of effort to see that they are duly reproduced in practice. We therefore find that the conditions present in the cartridge case and the card wadding of the present day are of a kind that promise an increasing guarantee of satisfactory results in the presence of ordinary good loading.

The annual publication of a card of instructions to cartridge loaders acts as a complement to the improved standardisation of cartridge cases and wads, to say nothing of the nitro powders to be fired in them. In the presence of superior components it would be surprising to find that the loader has remained stationary in the matter of making up the complete cartridge. In point of fact we find that the due appreciation of the need for accurate measurement of powder and shot has gained ground amazingly within a quite recent period. The constant checking of the weight of charge thrown, whether it be powder or shot, is fully recognised as essential in every well-conducted filling room; and the improved results obtained are manifest to anyone who examines samples of commercial cartridges as obtained on the open market. Our contemporary's loading card serves as a useful reminder of the values that must be observed, and every cartridge loader should possess himself of one of these cards. They may be obtained by sending the necessary stamps to the publisher at 68, Aldersgate Street. E.C.

THE TEMPERATURE OF COMBUSTION OF EXPLOSIVES.

BY F. W. JONES.

PART I.

IT is hardly necessary to make an excuse for bringing this subject to the notice of our readers. It is universally acknowledged to be of the first importance, not only because of its bearing on erosion in guns and the safety of blasting powders in fiery mines, but also because the temperature of the gases resulting at the moment of explosion or combustion, is one of the two most important factors in any consistent theory of Interior Ballistics.

During the last quarter of a century a number of researches have been made, and the results are found in the publications of learned societies and other serials. The following may be considered as excerpts from these publications.

The methods by which this problem has been attacked are three in number, viz.: (1) Estimating the pressure of explosives fired in closed chambers; (2) Measuring the heat given out by explosives on combustion; and (3) Actually measuring the temperature of the explosive flame at the instant of combustion by means of suitable pyrometers. The first two of these may well be considered together, and the third method can be dismissed in a few words.

The actual measurement of the temperature of combustion has been undertaken by Messrs. Macnab and Ristori, and their researches have been published from time to time in the proceedings of the Royal Society. The results of the investigations of these experimentors have supplied innumerable facts germane to the subject we have in hand, but as regards the actual temperature of combustion up to the present time, they cannot supply more than comparative figures. It appears that the thermo-electric readings depend on the state of division of the explosive, the position of the charge with respect to the thermo couple, and also the amount of explosive used: consequently one can quite appreciate the difficulty of an actual evaluation of the temperature. Mr. Macnab stated recently at a meeting of the Society of Chemical Industry that the solution of the problem was near, and Dr. Silberrad, the research chemist to the Explosive Committee, from his own experiments, supported this sanguine view. In the meantime it appears desirable to ascertain to what degree of accuracy the published *data* enable us to calculate the temperature of combustion.

If we know the amount of heat developed per unit weight by the combustion of an explosive, and also the mean specific heat of the resulting mixture of gases, &c., *i.e.*, the amount of

heat necessary to raise unit weight 1 deg. C., then the rise in temperature follows from the relation

$$t = \frac{Q}{c}$$

where t = temperature, Q = heat per unit weight, and c = mean specific heat.

Again, if a given weight of a gas in a known volume exists at a known pressure, its temperature can be set down. Therefore the temperature calculated from thermo-chemical *data* and the specific heat can be checked or corroborated by taking the pressure in a closed chamber.

To indicate the applicability of the above, we may take cordite composed of 58 per cent. nitroglycerin, 37 per cent. nitrocellulose and 5 per cent. vaseline. A chemical equation can be set down in which these components have the following percentage proportion:—Nitroglycerine 58·07 per cent.; nitrocellulose 36·56 per cent.; and vaseline 5·38 per cent. From the published thermo-chemical figures and the specific heats at high temperatures of the gases produced, it can be shown that the temperature at constant volume is 2,824 deg. C. With this value of the temperature of combustion the pressure in closed vessels for different densities of loading can be obtained. The table below shows the relation between such calculated values and those observed by Sir Andrew Noble.

CLOSED CHAMBER PRESSURES OF CORDITE.

Density of Loading.	*Observed Pressure.*	*Calculated Pressure.*
0·05	3·00 tons.	3·40 tons.
0·10	7·10 ,, ...	7·13 ,,
0·20	16·00 ,, ...	15·81 ,,
0·25	20·63 ,, ...	20·88 ,,
0·30	26·58 ,, ...	26·58 ,,
0·35	31·00 ,, ...	33·39 ,,
0·40	36·53 ,, ...	40·17 ,,

One may say that from very low values of pressure up to nearly 30 tons, the calculated and observed agree, thereby proving the accuracy of the thermo-chemical method of arriving at the temperature. Beyond 30 tons the discrepancy between the measured and calculated becomes greater and greater for reasons that are understood, but as 30 tons pressure is beyond the highest limit of service pressure in guns, this discrepancy is not of practical importance. It may be argued that as the pressure of detonation of blasting powders certainly goes beyond the limit stated, this method of arriving at the temperature is unsuitable for blasting explosives used in fiery mines. This objection is not, however, fatal because the dangerous temperature is that of the products when they come in contact with the inflammable gases present in the mine, and in every case, at such a time, the products would have expanded to a pressure below 30 tons.

The reliability of this thermo-chemical method of estimating the temperature of the combustion is thus established, and we will proceed to explain the same.

We are indebted to the French scientists for most of the work on the temperature of combustion of explosives. *MM. Mallard and Le Chatelier* published a note on the subject in the *Mémorials des Poudres et Salpêtres* in 1888, and *MM. Berthelot and Vieille's* researches are found in the *Annales de Chémie et de Physique, 1885*. M. Sarrau has also contributed considerably towards the subject.

If c denotes the mean specific heat of a given weight of explosive at constant volume between 0°C and t°C, and if Q denotes the heat developed by this same weight of explosive, then t^0 (the temperature) is obtained from the relation

$$c\,t = Q \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

It has been proved by the authors referred to above that the specific heat of gases is not the same at all temperatures, but increases as the temperature rises in such a way that the variable specific heat may be represented as follows:—

$$c = a + b\,t$$

Where a and b are experimental values, constant for certain gases Replacing this value of c in (1) we obtain

$$a\,t + b\,t^2 = Q$$

$$t = \frac{-a + \sqrt{a^2 + 4\,b\,Q}}{2\,b} \quad \ldots \quad \ldots \quad (2)$$

Thus to find t we must know a and b.

The value of c as a function of the temperature, for the different gases has been ascertained, and MM. Mallard and Le Chatelier proposed the following in gramme calories:—

For CO_2 ... . $c = 6{\cdot}26 + {\cdot}0037\,t$
,, H_2O ... ... $c = 5{\cdot}61 + {\cdot}0033\,t$
,, perfect gases (P) ... $c = 4{\cdot}80 + {\cdot}0006\,t$

By perfect gases are meant the so-called uncondensable gases such as O_2, H_2, N_2 and CO.

Now if a weight of explosive w, on explosion, develops Q calories of heat and is resolved into the gases

$$\alpha\,CO_2 + \beta\,H_2O + \lambda P.$$

then

$$a = 6{\cdot}26\alpha + 5{\cdot}61\beta + 4{\cdot}80\lambda$$
$$b = {\cdot}0037\,\alpha + {\cdot}0033\beta + {\cdot}0006\lambda$$

These values substituted in (2) will give the temperature of combustion. The solid products do not complicate the estimation, because the specific heat of these solids is practically constant for the temperatures obtained. It should be noted that the above values of c are not identical with those proposed by Berthelot, although at 3000°c the differences between the former and those of Berthelot are very slight. Those given have been generally adopted, because they are in a form easy to manipulate.

From what has been said, it follows that if the heat evolved by the chemical transformation, due to the combustion of an explosive mixture or compound, is measured, the temperature can be obtained. Or if the heat evolved can be obtained from a knowledge of this transformation and the published heats of formation, then the temperature can be obtained without experiment.

From the pressure side of the subject it can be shown that where the temperature and pressure are comparatively high, as in explosives, the pressure P and volume V and absolute temperature T of a gas are related to the same amount of gas at normal pressure, p_0 occupying volume v_0 at absolute temperature 273 (*i.e.* 0°c) by the following expression:—

$$P = \left(\frac{p_0\,v_0}{V - u\,v_0}\right)\frac{T}{273} \quad \ldots \quad \ldots \quad (3)$$

u being a factor found by experiment to be practically constant for gases and equal to ·001.

The expression (3) may be reduced to a more simple form, thus p_0 is the pressure of a normal atmosphere, and in the metric system equals 1·003 kilos per square centimetre. Also if w denotes the weight of the gas or explosive considered and Δ its density, then we have

$$\Delta = \frac{w}{V} \quad \therefore V = \frac{w}{\Delta}$$

replacing these values of p_0 and V in (3) we obtain

$$P = \frac{f\,\Delta}{1 - A\,\Delta} \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where $f = \frac{1{\cdot}033\ T}{273}\ \frac{v_0}{w}$ ... ... (5)

and $\alpha = u\ \frac{v_0}{w}$ ... ... (6)

f is termed the specific force of the explosive and α its co-volume.

Records of pressure taken in closed chambers enable us, with the knowledge of the volume of the products, to calculate f by means of (4). Having obtained f, (5) gives the temperature. Thus Noble's results of the closed chamber pressure of cordite give $f = 10370$ kilos per square centimetre or 65·8 tons per square inch. This value of f in (5) gives $T = 3097°$c absolute temperature or 2824°c above zero.

Note that $\frac{v_0}{w}$ is the gas evolved per unit weight, also that α, the co-volume, is $\frac{1}{1000}$ this value.

If there are any products non-gaseous, the volume of these must be taken into account in the negative term of the denominator of (4), $\alpha\ \Delta$ being replaced by say α, Δ where α, $= \alpha +$ the volume of the non-gaseous products per unit weight of explosive. In the absence of more precise *data* the volume of the solid products must be taken from their specific gravity at normal temperature. This is near enough where the solid products are comparatively small in percentage; but where, as in black powder, they form a large part of the products, the increase in volume due to the temperature must be taken into account.

To repeat then, there are two experimental ways of getting at T, viz.: either by measuring the heat evolved and analysing the products or taking the closed chamber pressure. There is still a third and purely theoretical method of obtaining T which requires only an accurate knowledge of the composition of the explosive and also providing the transformation on ignition can be assumed in certain respects with accuracy. For this purpose tables are necessary giving the heats of formation, specific heats, &c. In the sequel, for our examples, we shall give a small table, those interested being referred to the literature on the subject for tables containing more complete details.

The accuracy of calculations on temperature of combustion rests on the reliability of the estimated specific heats of the products at high temperatures. For this reason the methods used possess more than ordinary interest. The plan adopted was to fire explosive gaseous mixtures in bombs and note the pressure. The temperature is then given by Boyle and Marriotte. From a knowledge of the chemical transformation on ignition the heat evolved is obtained from the tables This heat divided by the temperature gives the mean specific heat at that temperature. MM. Mallard and Le Chatelier used Bourdon manometers to obtain the pressure and MM. Berthelot and Vieille a dynamical method which possesses so much interest from a ballistic point of view that we have included a full account of one of their experiments.

The closed vessel in which the explosive mixture was fired, was pierced vertically by a piston of known weight to which was attached a tuning fork. Just prior to firing the gases the tuning fork was set vibrating and as the piston was projected upwards by the gas pressure the tuning fork made its trace on a rapidly revolving drum. An actual example will make this quite clear.

In this example the explosive mixture consisted of one part hydrogen and 8 parts oxygen ($H_2 + O$).

Weight of piston and tuning fork ...	15·595 grms.
Tuning fork period	·001864 secs.
Velocity of cylinder	23·33 mm. per period of tuning fork.

Trace taken on paper divided into squares, 5 mm. sides so that with the above velocity of rotation each square corresponded to $\frac{5 \times 0{\cdot}001864}{23{\cdot}33}$ seconds, horizontally.

The curve obtained plotted out as follows:—

Horizontal.	*Vertical* (y).	*Vertical differences.* 1st (dy)	2nd (d^2y.)
73·00 mm. ...	6·10 mm.		
68·00 ,, ...	6·86 ,,	... 0·76 mm.	
63·00 ,, ...	9·18 ,,	... 2·32 ,,	... 1·56 mm.
58·00 ,, ...	13·06 ,,	... 3·88 ,,	... 1·56 ,,
53·00 ,, ...	18·63 ,,	... 5·57 ,,	... 1·69 ,,
48·00 ,, ...	25·78 ,,	... 7·15 ,,	... 1·68 ,,
43·00 ,, ...	34·55 ,,	... 8·77 ,,	... 1·62 ,,
38·00 ,, ...	44·90 ,,	... 10·35 ,,	... 1·58 ,,
33·00 ,, ...	56·66 ,,	... 11·76 ,,	... 1·41 ,,

Now force, or pressure multiplied by area of piston, equals mass moved multiplied by acceleration, thus

$$F = m\frac{d^2y}{dt^2}$$

$$m = \frac{\text{weight of piston}}{\text{gravity}} = \frac{0{\cdot}013595 \text{ kilos}}{9{\cdot}8088 \text{ metres}}$$

d^2y = maximum vertical second difference = 0·00169 metres

$$dt^2 = \left(\frac{5}{23{\cdot}33} \times 0{\cdot}001864\right)^2$$

The arithmetic gives F = 14·68 kilos, and as the area of the piston was 1·692 square centimetres the pressure $= \frac{14{\cdot}68}{1{\cdot}692} =$ 8·67 kilos per square centimetre, or 8·41 atmospheres above the atmosphere, *i.e.*, 9·41 atmospheres actual.

MM. Berthelot and Vieille's experiments included 215 pressure readings of 42 distinct gaseous mixtures. They used as oxidizers not only oxygen but also the oxides of nitrogen, and as combustibles, hydrogen, carbon-monoxide, cyanogen and some of the volatile hydrocarbons. The experiments demonstrated that the specific heats of the so-called perfect gases are practically identical, and are affected very slightly by the temperature, whereas water and carbon dioxide increase rapidly with the temperature. Also even up to 4,400 °c dissociation was little or absent in the two latter gases. The temperature values observed in these experiments exceed those of any practical gunpowder or blasting agent, the densities were, however, low in comparison with explosive practice. The highest pressure observed did not exceed 30 atmospheres, but up to this limit it was proved that the specific heat is independent of the density.

In the second and concluding part examples will be given, the temperatures being calculated for several well known explosives.

CORRESPONDENCE.

THE BALLISTIC PENDULUM.

TO THE EDITOR OF *Arms and Explosives*.

SIR,—I am much interested that you have thought it worth while to describe so fully the Ballistic Pendulum which I set up for the N.R.A. at Bisley last month. The formula which you give for obtaining the velocity is much too complicated to be of practical use for calculation. I use the following:—

$$v = \frac{W}{w} \times \frac{\pi}{12t} \times a$$

in which w = weight of pendulum in grains.
w = „ bullet „
t = time in seconds of a single swing of pendulum.
a = movement of pendulum measured in inches *plus* correction for friction.
π of course = 3·14159.

$\frac{\pi}{12t}$ thus becomes a constant when the pendulum has once been adjusted, and, for any given series of observations in which the weight of the pendulum is maintained unchanged (as it may be from 30 to 50 shots) w is also constant. The calculation thus becomes very simple. If desired, labour can be saved by calculating the average velocity of a series of shots instead of that of each shot separately. I may mention that the main parts of the instrument set up for the N.R.A. were made more than ten years ago, and that I have had during that time a precisely similar instrument in use. Two other similar ones are in existence. Were I to re-design the pendulum now, in the light of experience, I should modify it in certain respects, so as in some degree to meet the points in which it is open to criticism. But experience has shown it to be in its present form accurate enough for all practical purposes.

T. F. FREMANTLE.

Newton Harcourt, Leicester,
August 17, 1904.

TO THE EDITOR OF *Arms and Explosives*.

SIR,—In your issue of this month you give a description of Major Fremantle's Ballistic Pendulum, erected at Bisley, in which you point out that the formula required entails a rather troublesome calculation. This difficulty, however, is not a serious one, as the formula admits of being put into a more convenient form. Taking the same notation which you have employed, viz.:—

w = weight of pendulum + bullet.
w = „ bullet.
v = velocity of pendulum at its lowest point.
v = velocity of bullet.
g = value of gravity.
l = length of pendulum.
a = movement backward.

For the limits of swing within which the arc may be taken as sensibly equal to the chord, we have

$$v = a\sqrt{\frac{g}{l}}$$

so that the formula becomes

$$v = \frac{w}{w}\,v = a\,\frac{w}{w}\sqrt{\frac{g}{l}}$$

which is a very convenient form for calculation as for a series of experiments with the same bullets, the term $\frac{w}{w}\sqrt{\frac{g}{l}}$ is constant, and the velocities corresponding to the various readings of the Vernier scale can be read off from one setting of the slide rule.

H. MELLISH.

Hodsock Priory, Worksop,
August 19, 1904.

[The formulæ above proposed are identical, as will be seen at once, on replacing t in the former by its value $\pi\sqrt{\frac{l}{g}}$ and noting that the former expresses a in inches and the latter in feet. This formula assumes that the Ballistic Pendulum behaves as a "Simple Pendulum," that t is independent of the amplitude of the swing, and that the arc of swing is equal to its chord and to a. The accuracy of the first assumption depends on construction, and the latter assumptions are true only when the angular movement does not exceed a few degrees. The formula we presented is true for large or small values of a or l. The difference in complexity is more a matter of appearance than reality. W and t are constant, therefore a table of the values of w v in terms of a, obtained by a few calculations and squared paper, being once and for all set out, v would be given by dividing these values by w. ED.].

TRADE MARKS.

ADVERTISED AUGUST 3—24, 1904.

264,768 } The word AQUAPOID to apply to cartridges, wads, powders, and caps. Eley Bros., Ld., London. July, 7, 1904.
264,769 }
264,282 The word TURBITE to apply to shot, bullets and air-gun pellets. Lane Bros, London. June 15, 1904.
264,550 } The word VICTOROID to apply to arms and explosives.
264,551 } Cogswell & Harrison, Ld., London. June 27, 1904.

Registrations of Trade Marks of interest to our readers have not figured in the Journals of the past month.

APPLICATIONS FOR PATENTS.

JULY 25—AUGUST 20, 1904.

16,371. Automatic Targets. M. Hurst.
16,707. Armour Piercing Projectile. H. Stanbridge and W. Walker.
16,767. Ordnance Sighting Apparatus. A. T. Dawson and G. T. Buckham.
16,811. Range Finders. G. M. Lawford and D. S. Capper.
16,847. Topedo Steering Mechanism. J. Whitehead.
16,919. Recoil Operated Firearm. A. E. Hall.
16,922. Blank Cartridges for Small-Arms. King's Norton Metal Co., Ld., T. A. Bayliss and H. M. Smith.
17,053. Bullet Deflector for Targets. L. Jeffries.
17,153. Projectiles. P. M. Justice (Agent for *The Bethleham Steel Co.*).
17,154. Gun Sights. P. M. Justice (Agent for *The Bethleham Steel Co.*).
17,268. Range Finder. T. Kirkland and D. L. Capper.
17,406. Target Apparatus. Auto-Electric Rifle and Target Co., Ld. (Agents for *Automatic Target Machine Co.*).
17,410. Target Apparatus. Auto-Electric Rifle and Target Co., Ld. (Agents for *Automatic Target Machine Co.*).
17,524. Range Finder. E. Schmalz.
17,619. Gun Mounting. Beardmore & Co., Ld. and A. Bremberg.
17,656. Explosive Receptacle. P. Müller and F. Wommelsdorf.
17,658.* Trigger Mechanism. C. D. Abel (Agent for *Rheinische Metallwaren und Mf.*).
17,719 Range Finder. J. S. Dumaresq.
17,731. Targets. R. Riley.
17,788.* Shrapnel Shell. F. Krupp, Ag. (Date of application in Germany, November 2, 1903).
17,827. Ammunition Hoist. A. T. Dawson and G. T. Buckham.
17,832. Telemeter, G. Aragno.
17,856. Automatic Firearms. The Webley Scott Revolver and Arms Co,, Ld. and W. J. Whiting.
17,880.* Explosives. H. Boyd.
17,882.* Ordnance. La Société Schneider et Cie. (Date of application in France, February 19, 1904).
18,082. Projectile Fuses. King's Norton Metal Co., Ld., T. A Bayliss and C. W. Hill.
18090.* Ordnance Rammers. P. M. Justice (Agent for *Bethleham Steel Co.*).
18,097. Flight of Shot. G. C. Dymond (Agent for *C. la Dow*).

*These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

JULY 28th—AUGUST 18th, 1904.

COMPILED BY HENRY TARRANT.

15,505 (1903). **Torpedo Turbine Apparatus.** J. Stumpf, Germany. A method of obviating the use of a reducing valve in torpedo turbines driven directly by high pressure air or gas, by regulating the supply to the turbine. The number of nozzles first connected to the gas reservoir is restricted, and the remaining nozzles are gradually inserted according to the fall of the pressure. Accepted July 13, 1904.

16,384 (1903). **Laying Mechanism for Ordnance.** M. Darmancier and A. Dalzon, France. Laying or pointing apparatus for ordnance, consisting principally of two screws mounted concentrically one within the other. One is connected with the barrel and the other with the sight, and each is provided with its own operating mechanism By a single adjusting device alterations may be effected in the position of the barrel and the sight independently of each other. Accepted July 7, 1904.

17,415 (1903). **Compressing Guncotton Blocks** G. W. Bell, Ipswich. Guncotton pulp is introduced into a chamber exhausted of air. After the mass of guncotton has been rendered as free as possible from air, water is introduced into the chamber. The interstices of the block become filled with water, and the air spaces are so avoided. By this method it is claimed a block of 500 pounds may be formed in from 10 to 15 minutes Cylindrical and other shaped blocks may also be produced This patent has relation with specification No. 17,890, 1903, below. Accepted July 28, 1904.

17,625 (1903). **Luminous Sight for Small Arms.** E. Preda, Italy. A small-arm sight so constructed that it may be illuminated at night. The foresight is covered by a hollow glass triangle, and the slanting backsight is also covered with glass. These glass covers are filled with liquid phosphorescent matter. A small dry electric accumulator is provided in the butt of the arm and is connected by wires with the glass covers. Switches are arranged for cutting off the current. Accepted July 14, 1904.

17,890 (1903). **Apparatus for Compressing Guncotton.** G. W. Bell, Ipswich. A press for compressing blocks of guncotton in which the mould-containing cylinder is provided with means for making a water-tight joint between it and the ram at the open end. Water under pressure is provided within the casing in contact with and surrounding the charge under compression, so that it shall be available for safety and for obviating the absorption of air by the charge on its expansion caused by the release of the ram pressure. Accepted July 21, 1904.

19,238* (1903). **Nitroglycerin Nitrate of Ammonia Explosive.** C. O. Lundholm, Stevenston, N.B.

19,874 (1903). **Ordnance Breech Mechanism.** Sir W. G. Armstrong, Whitworth & Co., Ld., Newcastle-on-Tyne. (Agents for *Soc. An J. Cockerill, Belgium*). In connection with breech blocks of the type which are situated in a chamber eccentric to the axis of the gun, an elastic support in the form of a spring is provided to balance the weight of the block and so to compensate the varying pressures on the breech arising from the eccentricity of the centre of gravity of the block. Accepted July 21, 1904.

20,216* (1903). **Safety Blasting Explosive.** M Bielefeldt, Germany.

20,311 (1903). **Manufacture of Projectiles.** R. A. Hadfield and A. G. McK. Jack, Sheffield. In order to impart to a projectile good complete armour-piercing qualities, the head is shaped in a special manner The shape is formed by the revolution about its axis of a segment of an ellipse the dimensions of which are based upon the diameter of the projectile. The segment taken is a portion of the ellipse adjacent to the minor axis, which axis is approximately equal to twice the diameter of the projectile. A head so shaped may be readily machined Accepted July 21, 1904

20,429* (1903). **Back Sight for Rifles.** J. T. Peddie, London.

24,458 (1903). **Manufacture of Small-Calibre Projectiles.** A. Reichwald, London (Agent for *Fried. Krupp, Ag., Germany*). To reduce the cost of production of bullets, they are made from a steel rod which is coated with a jacket of softer metal. The coated rod is divided up into pieces the length of a projectile. The softer metal jacket is adapted to take the rifling. The rod may be divided and the bullet pointed as required simultaneously. The coating of soft metal may be applied to the rod by electrolytic deposition. Accepted July 21, 1904.

24,789 (1903). **Shields for Transportable Ordnance.** A. Reichwald, London (Agent for *Fried. Krupp, Ag., Germany*). The shield protecting the gun screw of transportable ordnance has, because of its situation at the breech, necessarily a big aperture to allow of the movements of the gun. The patentees provide the shield aperture with a roof-like screen attached to and projecting forward from the shield towards the muzzle of the gun. The roof may either be pivoted or fixed according to circumstances. Accepted July 21, 1904.

6,116 (1904). **Aiming and Shooting Practice.** C. Lorenz, Germany. Electrical apparatus for aiming and shooting practice, in which a light ball is supported and is kept moving by a jet of water from a fountain. In the supply pipe is an electro magnetically adjustable cock so arranged that it acts, through a circuit combined with the gun, if the gun is truly aimed and the trigger pulled, to cut off the water. Accepted July 14, 1904.

12,551 (1904). **Projectile Percussion Fuse.** C. P. Watson, U.S.A. Safety in handling and sureness and quickness of hammer action when the shell strikes is sought by the patentee. In the percussion fuse described a pair of pivoted wings are interposed between the hammer and the cap. These are locked until overcome by centrifugal force during the flight of the projectile To prevent the hammer "hanging" when the projectile strikes, air passages are provided to prevent "cushioning." Accepted July 7th, 1904.

12,772 (1904). **Obturating Pads for Ordnance.** Lt.-Col. H. C. L. Holden, Woolwich. An obturating pad to prevent the escape of gas past the breech screw of ordnance is so constructed that its plasticity and other properties shall not be sensibly affected by variations of temperature between extreme limits of heat and cold to which it is subjected in actual use. This end is attained by substituting for the mutton suet which is generally used, an oil which possesses a very high flash point and a very low freezing point such as rape oil. Accepted July 7, 1904.

12,807 (1904). **Cast Iron Projectiles for Ordnance.** C. F. & H. E Cowdrey, U.S.A. The patentees discover that the principle objection to the use of cast iron shell—premature bursting—is caused by the gases generated by the combustion of the propelling charge, which is so highly penetrative as to pass through the pores of the cast iron at the base of the projectile. To obviate this, and thus premature bursting, a shield of metal impervous to the gases of these propulsive charges is fitted either within or around the base of the cast iron shell. Accepted July 7, 1904.

12,900 (1904). **Luminous Targets.** G. H. Herrmann, Germany. It has been usual to use an explosive contained in sewn bags of linen to produce luminous targets. Certain disadvantages arise from the use of such bags and the patentee constructs a seamless bag of woven animal hair which is neither torn nor ignited by the explosion. Complete combustion of the explosive is by this means assured and the flash is caused to extend in all directions. Accepted July 28, 1904.

13,147 (1904). **Loading Indicator for Rifles.** G. Luger, Germany. A lever is so arranged in the mechanism of a rifle as to indicate whether the barrel is loaded or not. One end of the lever is pushed outwards by the cartridge when entering the barrel, so forming a conspicuous projection visible to the eye, or in the dark, feelable by the fingers. The indicator is specially applicable to arms of the automatic type. Accepted July 14, 1904.

13,950 (1904). **Shrapnel Construction.** Lt. P. D. van Essen, Holland. The effect of the impact of shrapnel shell is increased, without sacrificing the time-fuse action, by the arrangement of the bursting charge separated from the shrapnel charge. The bursting charge is fired only at the moment of impact. The bursting charge is arranged in the forward part of the shell while the scattering charge is in a base chamber. The shot lies partly between the bursting charge and the shell walls, and partly between the bursting charge and the base chamber. Accepted July 21, 1904.

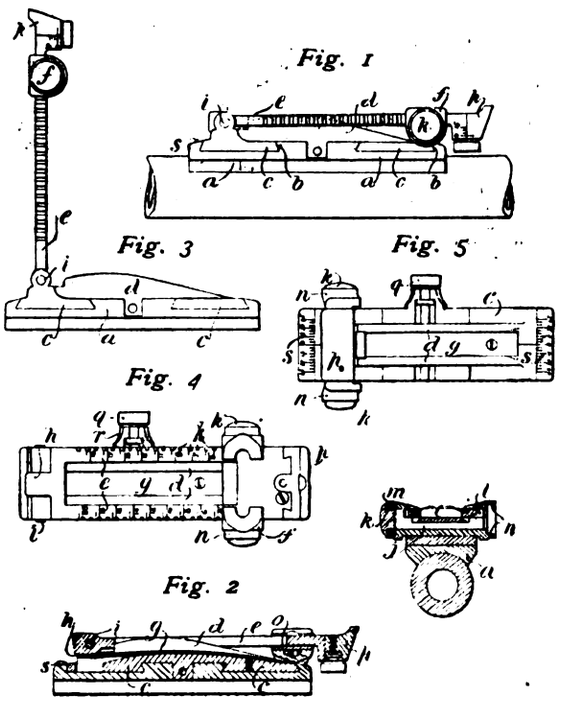
* These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

THE PEDDIE WIND-GAUGE RIFLE BACK SIGHT.

20,429 (1903). J. T. Peddie, London. A wind-gauge back sight for rifles of the military type forms the subject of this specification. The sight is of a pattern similar to that attached to the new service rifle, and is designed to allow of rapid and correct adjustment of the sliding cross bar to various ranges, and of strong and effective adjustment for wind allowance. The sight may be easily removed for the purpose of cleaning.

In the drawings reproduced upon this page the sight is clearly illustrated. The bed *a* is attached to the top of the rifle barrel and is provided with dovetail guideways *b* in which slide the tongues *c*. The tongues are connected by the bridge pieces *d* and to the forward end of these tongues the sight leaf *e* is pivoted. When the leaf is in its closed position as in Figs. 1 and 2 the bridge pieces lie within its



central slot. The leaf carries the moveable cross bar *f* which is adapted to slide over the curved top surfaces of the bridge pieces *d* and so to regulate the height of the sighting notch situated on the end of the leaf. The leaf is constantly pressed back to its horizontal position by the spring *g* which lies between the bridge pieces *d*. The back end of the spring is secured by a screw, and it is splayed as is illustrated in dotted lines in Fig. 5 to prevent the spring falling out when the pin is removed. The forward end presses upwards against the end of the knuckle *h* on the leaf through which the pivot pin *i* passes. As the angle of the leaf with the sight bed becomes more obtuse, the spring end is caused to slide over the corner of the knuckle end. The pressure of the spring is in this way transferred to the bottom of the knuckle and is caused to hold the leaf firmly in the vertical position as in Fig 3.

The sliding cross bar *f* is locked in varying positions on the leaf to accord with different ranges. The leaf edges are toothed and ratchets on the cross bar are spring pushed into these teeth. The arrangement of the teeth is such that by means of the alternate spacing of one set of teeth with the other, an adjustment of the cross bar may be made equal to half the pitch of one tooth. The ratchets consist of two bars *j* to one end of which push buttons *k* are attached and to the other the ratchet teeth *l*. These bars *j* are adapted to slide side by side with one tooth half a pitch in advance of the other. The ratchet teeth are drawn inwards towards the leaf edges by the springs *m* contained in annular recesses in the buttons *k*. The buttons slide within short sleeves *n* of the cross bar and the teeth are released by pressing the buttons. The upper parts of the bars are covered by the plate *o* to keep out dirt. The under portions are protected by the flat bottom of the cross bar which slides over the curved surfaces of the bridge pieces *d*. The adjustment of the sight for the various ranges marked on the surface of the sight (Fig. 4) is regulated up to a certain point by the position of the cross bar upon these curved surfaces. An adjustment for finer degrees of range is obtained by means of the sliding piece *p* which carries the sighting notch. This piece may be moved upwards or downwards by the turning of a finely threaded screw—graduated marks upon the leaf showing its position clearly.

In order to allow the sight to be laterally adjusted to counteract side divergence of the bullet, a screw *q* is provided. The turning of this screw shifts the tongue pieces *c* in the dovetailed grooves either to one side or to the other. The screw possesses a collar which is free to rotate within the groove formed in the boss *r*. When the sight carrier is removed the screw *q* may be lifted out The scales *s* are engraved on the bed to indicate the windage adjustment. Accepted July 28, 1904.

NITROGLYCERIN-NITRATE OF AMMONIA EXPLOSIVE.

19,438 (1903). C. O. Lundholm, Stevenston, N.B. Explosives of the nitrate of ammonia class at present on the market have a small specific gravity because on compression they become more and more difficult to explode, and they require, in order to develop with safety their maximum effect, a stronger detonator than a No. 6. On the other hand, nitroglycerin explosives have to be thawed in winter, and this operation the manufacturers have long desired to render unnecessary. No means have yet been discovered and all the nitroglycerin explosives in use have need of thawing in winter.

So says the patentee; and by introducing nitroglycerin in nitrate of ammonia explosives he discovers that remarkable results are obtained. The explosives can with ease be exploded with a No. 6 detonator, not only when filled loosely into cartridges in the ordinary way but when compressed into plugs with a materially increased specific gravity. Cartridges made with such plugs can be detonated in the open when placed end to end in columns and this propagation of explosion takes place whether the cartridges have a temperature above the freezing point of nitroglycerin or after being frozen hard by means of solid carbonic acid. In order to enable the nitroglycerin to be retained by the explosive without exudation under pressure it is introduced absorbed in wood-meal or guncotton.

The nitroglycerin—nitrate of ammonia explosives are always hygroscopic and as a protection are put up in waterproof wrappers. The plugs may be directly waterproofed by dipping in molten paraffin wax, rosin, cresin, or other suitable body or mixture of bodies. The first method is preferable since the plugs have been known to swell and crack the coating. The waterproofing does not prevent the effective detonation by a No. 6 detonator. An example of the new explosive may be made up of 80 per cent. of nitrate of ammonia, 10 per cent. of nitroglycerin, and 10 per cent. wood-meal. Accepted July 14, 1904.

SAFETY BLASTING EXPLOSIVE.

20,216 (1903). M. Bielefeldt, Germany. It is known that the safety of explosives as regards liability to cause accidents in fire-damp may be enhanced by the addition of sodium chloride (see Berthelot, Dictionnaire des matières explosives 1902, p. 285, and the annual report of Her Majesty's Inspectors of Explosives for the years 1898-1899, p. 125). This result is partly obtained however at

the expense of the strength of the blasting composition. Experiments have illustrated to the patentee that safety may be considerably increased by the addition of potassium perchlorate instead of sodium chloride.

At the time of detonation the explosive splits up into potassium chloride and oxygen, the first of which enhances the safety of the composition, as is the case with sodium chloride, while owing to the decomposition of the potassium perchlorate a loss of explosive force does not take place. Hitherto the use of perchlorate has been prevented by the belief that its application in considerable quantities would be dangerous. The patentee asserts that perchlorate is comparatively stable and may be utilized in the manufacture of blasting compositions without danger. The quantity of perchlorate added depends of course on the nature of the particular explosive into the composition of which it is to enter. Accepted July 14, 1904.

OPPOSITION TO AN EXPLOSIVES PATENT.

IN the matter of an application by William James Orsman for Letters Patent No. 11,440, dated 19th May, 1903, and the opposition by Ammonal Explosives, Limited, to the grant of Letters Patent thereon, the Comptroller-General has given the following decision:—

The Grant of letters patent is opposed on the ground that the invention has been patented on Wenghöffer's Specification No. 24,377, A.D., 1899, and Führer's Specification No. 16,277, A.D., 1900. The invention which it is sought to patent is for "Improvements in safety detonating explosives for use in coal or other fiery mines or for general blasting purposes." These explosives consist, according to the first claim, of powdered aluminium in combination with a highly oxidised compound. According to the second claim, these compounds are stated to be ammonium nitrate with *or without* nitrates of the alkali metals, the latter being specified in the third claim as nitrates of potassium or sodium. The prior Specifications also relate to explosives in which aluminium is an essential constituent.

Specification No. 24,377, A.D., 1899, claims finely divided aluminium in combination with a large number of materials, amongst which salts rich in oxygen generally, and nitrates in particular are mentioned in the description. Specification No. 16,277, A.D., 1900, covers an explosive consisting of aluminium and ammonium nitrate. A chemical equation, given in the description, shows by calculation that about 18 per cent. of aluminium and 83 per cent. of ammonium nitrate might be used, but the specification does not appear to be limited to that composition.

Mr. Thompson for the applicant argued that only the claim in Specification No. 16,277, A.D., 1900, before it was amended, could be considered. I do not agree with this, but even if that form of the claim be alone regarded, I hold that it is sufficient to show that an explosive consisting of these two bodies, aluminium and ammonium nitrate was *inter alia* intended to be claimed. Mr. Thompson further contended that the applicant's explosive was a safety detonating explosive and that the others were not of that class. It appears, however, that Führer contemplated the use of strong fulminating agents with his explosive and that Wenghöffer constantly refers to various members of the high explosive class. Führer also refers to the safety of his explosive in manufacture and use. Evidence was adduced to show that the applicant's explosives have any greater degree of safety. As regards the allocation of these explosives to the so-called safety class, it has been pointed out to me that Ammonal, a compound with 4 to 6 per cent. of aluminium and 93 to 97 of ammonium nitrate, has been placed on the Permitted List in the "Explosives in coal mines order of the 10th December, 1903." In this connection I may remark that the applicant's provisional specification does not mention any composition and that the complete specification, which does specify the proportion of 7 per cent. of aluminium to 93 of ammonium nitrate was not filed until the 11th February, 1904. Under these circumstances I cannot regard the applicant's explosives as differentiated from those of the opponent's, either in respect of their safety or of their detonative character. I further find that finely divided aluminium has been used in conjunction with highly oxidised bodies generally, also with nitrate generally, and particularly with ammonium nitrate.

On the other hand I have not found any definite claim for the applicant's particular combination of aluminium with ammonium nitrate and nitrates of the alkalies. In order to confine the invention to that somewhat limited field which is possibly both obvious and useless as the opponent points out extensive amendments of the specification would be necessary, and I do not feel called upon to indicate the nature of such amendments, even if I would allow them in view of the Law Officer's expression of opinion in Whittaker's case XIII., R.P.C., 380. Even if I would allow them they should, I think, be supplemented by some statement of what has gone before. Pending a decision, however, I offered to consider any amendments that might be suggested in the applicant's specification, and an amended specification has now been filed. Therein it is suggested that with other amendments there should only be one claim as follows:—"The improvement in safety detonating explosives applicable for use in coal or other fiery mines which consists in using powdered aluminium in combination with a highly oxidised compound substantially in the proportion specified." One specified proportion only is retained in the amended description. As stated above, that is, 7 per cent of aluminium to 93 per cent. of ammonium nitrate, and it is not indicated in the provisional specification. In view of the Solicitor General's decision in Lancaster's case XX., R.P.C., 368, I could not allow such an amendment.

It therefore seems to me that the subject matter, which is not definitely covered in terms in the prior specifications, is not what the applicant desires to patent, and that the part of his alleged invention, which he now desires to claim, is not definitely described in his provisional specification, and is generally covered in the prior specification. I therefore refuse to seal a Patent on this application.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

Express Cartridge Sizes.—For some time past it has been apparent to all who are concerned in the manufacture and sale of Cordite express rifles that something ought to be done to lay down a series of chamber sizes such as may receive the endorsement of the leading firms in the trade. The old-fashioned method of applying to the ammunition makers for gauges is not half so satisfactory as the more modern system of working to a mutually agreed series of decimal dimensions. The arithmetical standard defines the ideal, and when a whole range of cartridges is systematically considered on this basis it is generally found that something in the nature of a uniform method of working can be established. The most favourable degree of taper, the nature of the curve forming the shoulder or bottle neck of the case, and the diameter at the nose in that way receive proportional consideration. Consequently all these sections of the cartridge chamber are dealt with on a broad general principle that tends to produce the most satisfactory practical result. The diameter of the bullet being fixed by the bore and depth of rifling the front end of the chamber must of necessity be such as to allow for the thickness of the brass at the mouth of the case. The slight extra margin of diameter which facilitates free extraction can then be laid down. The other dimensions follow in due order, so soon as the examination of existing models shows the general outline that has been ordained by practical experience. At the present time the manufacture of express rifles of the high-power class has been so far systematised that the occasion is ripe for dealing with the chamber dimensions on a permanent footing. The task of blending such diversity of practice as may at present exist should not be very difficult in view of the many practical benefits that would arise from an agreement as to the leading dimensions of the cartridges which are in greatest demand.

Cheap Cartridges.—A correspondent recently wrote to the *Field* stating that upon receiving an invitation for a few days' shooting he asked his host to advise him as to how many cartridges it would be desirable to take along. He replied, "Don't burden yourself with cartridges as I have had sent me an ample supply of good ones at a price less than is usually paid by sportsman." This suggestion was duly followed out, and five days of enjoyable sport was obtained, subject to the single exception that everybody appeared to be in bad shooting form. The cartridges were accordingly suspected, and an examination of their contents showed them to be of a thoroughly bad and inferior quality. Though this lesson may be learnt by a few sportsmen here and there, the fact remains that there is a very large body of sporting opinion which refuses to believe that cheap cartridges are in any wise inferior to those of a more expensive quality. Good sport of any kind is of necessity so expensive that it really seems a pity that so many shooters should be willing to sacrifice the full opportunity of enjoying their outings merely because they begrudge the odd shilling or so in the price of a hundred cartridges. It is one of the most unfortunate aspects of the cartridge business of the present day thatprices have

been driven to so low a level as to make it well-nigh impossible for the conscientious loader to run his business in a satisfactory manner and still keep pace with the growing demand for cheap cartridges. The sportsman is in the nature of things unable to explain his misses, and trade experience shows the impossibility of testing a cartridge by its shooting in the field, although inefficiency must none the less explain a definite proportion of the misses that are experienced.

The State of the Shooting Season.—It is even now difficult to say exactly how far the original favourable anticipations concerning the present shooting season may be said to be in course of realization. Up to the present time of writing there is not any very marked sign of exceptional activity amongst loaders of ammunition. With the opening of October the nominal commencement of pheasant shooting arrives, but it is not of course until November that the large shooting parties are organised. It is then that the state of the coverts throughout the country can best be judged. Reports as to the earlier progress of the birds can only be of a partial nature in the absence of any organised system of enquiry. Moreover it is not until the period of the large shooting parties that partridge driving is carried on under the conditions that show the true head of game which an estate carries. Until therefore the information available is of a more precise character it will be desirable to postpone anything in the nature of unduly confident anticipations of a bumper season. From the experience already gained we are, however, in a position to affirm with all due emphasis that the ammunition which has been supplied this year appears to have given every satisfaction. One hears very little about defective loading or caps under suspicion. While cheapness is regrettably the order of the day such care and intelligence as can be shown in the making up of a cartridge are lavished without stint. Thus we find that, although the components may not in every case be the most expensive, the results to the shooter are all that can be secured by skilful manipulation and attention to detail in the complicated processes of the loading room.

Sporting Outfitters in the Gun Trade.—It is a remarkable aspect of modern developments in the gun business that the sporting outfitter should be devoting so much attention to the organisation of gun departments where proprietory articles may be dispensed on the same lines as tennis rackets and sporting hosiery. Competition among the manufacturers has forced them to develop as far as possible that side of their business which involves the supply of a fixed pattern of weapon which may be ordered more than one at a time. Hitherto the gunsmith has laid down in detail the specification of weapon he thinks best for the needs of his customers; and he has found in the manufacturer a person always ready to co-operate in the successful working out of special designs and requirements. On the other hand now that the general sporting stores have taken up the supply of firearms and ammunition they look to the manufacturer to supply them, within the limits of specified prices, with the best all-round weapon that can be put together. The profits of such a distributing business would soon be lost if much time was given up to studying the views of individual customers. The tendency is, therefore, to cater rather for the man who demands sound value at a moderate price than for those who are willing to pay a little more for special attention but not a sufficient extra amount to cover all that is involved in the unproductive expenditure of time that is generally required. In other words the new class of competitor with whom the gunmaker properly speaking has now to contend is one who aims at taking the most profitable section of the business, leaving alone only that which is at times likely to give more trouble than is justified by the result. This new and growing form of competition is one with which every trader with an established business must deal according to the special circumstances of his surroundings. The only general advice which can be given in such a connection is to study the methods by which it is sought to develop a gun business in a local outfitting stores, and to incorporate where possible the same methods into the carrying on of one's own business. Judicious admixture of the two modes of trading would certainly be better than to adhere too rigidly to the older ideas which may in some respects be out of sympathy with the views of the purchasing public.

Rifle Clubs and their Needs.—It now appears that the rifle club movement has so far accomplished its purpose that we have in all parts of the country consistent bands of rifle shooters who are steadily practising with a view to becoming adepts at marksmanship. The actual trade turnover in respect to the rifles purchased and the ammunition consumed by these clubs has no doubt proved a disappointment to a good many gunmakers who may at one time or another have hoped to find in them a valuable source of new custom. It cannot be denied that the secretaries of many of these clubs exercise a great deal of ingenuity in securing the needful supplies of weapons and ammunition without having recourse to the retailer. On the other hand, there must be a large number of embryo marksmen who willingly place themselves in the hands of an expert adviser in the hope that their equipment will be such as to enable them to acquire the most satisfactory results from the shooting they do at the club ranges. In order to cater for this class of trade the expert gunsmith must depart in a measure from the methods he ordinarily pursues in dealing with those of his clients whose fancy is mostly for the shot gun. Rifle shooting, whether at miniature, intermediate or longer distances, is essentially a scientific pursuit; and it is necessary that the gunmaker should make a special study of all that appertains to rifle shooting so that the advice and assistance he gives should be sound and practical. Whole chapters might be written on the principles that underlie the selection, adjustment and fitting of sights for different classes of shooting, and it is certain that the gunmaker who can file and re-adjust sights so as to improve the standard of performance obtained at the range by the shooter will find that his services are in great demand. From the experience of club shooting which we have ourselves gained in various quarters we can confirm the view that there are few clubs whose shooting could not be vastly improved by a thorough overhauling and adjustment of the sights by a skilful gunsmith. The stock-in-trade required comprises little more than a carefully selected assortment of the most modern types of rifle sight, the services of a mechanic with a leaning towards the use of delicate files, and finally the possession of a suitable range, at which the necessary adjustments can be effected.

THE PROOF MARKING DISPUTE.

The influential newspaper publicity which is given to the arguments of those who are agitating for a reform of proof marking procedure sufficiently indicates the national importance which is attached to the principle at issue. The hostile attitude of the Birmingham gun trade agitators represents an unfortunate aspect of a situation in which there should be but little opening for radical differences of opinion. The Guardians of the Birmingham proof house have associated themselves with a reasonable policy of reform. The London proof house and the two gunmaking associations, all prominent organisations have done their utmost to forward the policy referred to.

The *Times* of the 23rd ult. contains a statement of certain aspects of the question by Mr. S. G. Middleton. He says, "it is now accepted that the proof marks bear the significance of trade descriptions." By this he intends to infer that the English proof mark is a mark of origin within the meaning of the Merchandise Marks Act, and that it is accordingly a punishable offence to sell a foreign made arm so impressed unless it also bears a clear indication of its foreign origin. Trade custom would in our opinion upset the legal contention so advanced; but we certainly do agree with Mr. Middleton's condemnation of the existing regulations which allow foreigners "to get the English proof marks affixed to their guns and sell them, both in this country and abroad, as if they were the work of British craftsmen, whose skill is hereditary." Both proof houses, both gunmakers' associations and all genuine gunworkers sincerely echo this complaint, and as a consequence an endeavour was made in re-drafting the rules of proof to secure the adoption of two clauses making provision for the differential marking of foreign arms.

The proof houses with the approval of the two master Gunmakers' Associations put forward certain rules which in their opinion provided a suitable definition of the extent of foreign manufacture that should constitute a weapon foreign-made for purposes of proof. The gunworkers through their organisation objected to the proposed wording and asked for something far more severe even than the definition of foreign manufacture which has been established by legal interpretation of the Merchandise Marks Act. Failing to agree upon the disputed points the question was left for the War Office to decide. This department referred the question as one of purely commercial interest to the Board of Trade, but the latter body, in the person of Mr. Bonar Law, absolutely refused to make any recommendation on the subject unless the masters and workmen could arrive at a satisfactory understanding.

If the Birmingham gunworkers really wish to secure a reasonable measure of reform they should make a radical change in their tactics. If they would endeavour to ascertain exactly how far the masters would be willing to go in remedying existing abuses they would doubtless find that a large amount of reform could be obtained without producing a serious disturbance of of business, the fear which is the master's sole reason for refusing to spoil his trade for the purpose of spiting the foreigner. If the two contending sides were thus to define a policy to which they would mutually guarantee their support appropriately worded new rules could be put into force in less time than is necessary to organise a charity bazaar.

TECHNICAL INSTRUCTION BY THE PROOF HOUSE.

If there is one thing that will alienate sympathy with the agitation mongers of the Birmingham gun trade, it is the very ungenerous spirit in which they regard the sincere efforts of the Birmingham Guardians to improve the status of the workers at the bench. At considerable expense and after mature consideration of various alternative schemes, they established a practical school of gunmaking at which youths desirous of obtaining instruction in the methods of high class workmanship could do so under the supervision of carefully selected skilled gunmakers. This school, instead of receiving the support of the gunmakers' representatives, has been attacked with all the unfairness of the political frame of mind. The Guardians of the proof house have lately been actually condemned for establishing a school of gunmaking which takes the young beginner away from the municipal technical classes where he would in the ordinary way spend his evenings. We are of course glad to hear that the young gunworker is so diligent a student of machine drawing, applied mechanics and other forms of engineering physics,

Those of us who have been through the initial stages of a workshop career, will always remember the trouble that was experienced in securing the assistance and guidance of experienced mechanics during the rush and bustle of the ordinary day's work. As a general rule the apprentice learns very little beyond what he can pick up in an incidental manner, and he is lucky indeed if an older man will show an interest in his early endeavours and explain by friendly criticism and practical demonstration how faults may be eradicated, and a higher standard of workmanship attained. The evening school of gunmaking has been specially organised under the supervision of a committee of practical gunmakers, and in this connection we need only mention the name of such a judge of fine workmanship as Mr. J. C. Scott to show that the right kind of instruction is given. In the light, therefore, of all that has been done to provide a really useful gunmaking education it indeed seems ungrateful on the part of the class most interested that such disparaging remarks should be put forward.

We frankly admit that an excellent supplement to the present code of tuition would be provided by a class for the giving of practical insight into the bearing of mechanical science on gunmaking. To teach the use of decimal gauges, to show what are the methods of examining the stress on working parts, and to explain the relation of the pivotting centres to the working surfaces of gun mechanism would represent a form of theoretical instruction which would be of the greatest possible value. Unfortunately, there is not even a text book which deals with these subjects. The construction of the gun has been built up by a process of slow evolution, and hitherto there has been no practical gunsmith who has tackled the problem from the point of view of a scientific aquaintance with the theoretical side of applied mechanics. Consequently the absence of such tuition mainly arises from the non-existence in Birmingham of anyone who is at one and the same time a scientific demonstrator and a practical gunsmith. Some day it may happen that the gap may be filled, but meanwhile attendance at the gunmaking classes does not bar the student from learning his mechanics at the municipal school and applying them to the best of his ability to the details of gun construction.

LOW RECOIL CARTRIDGES.

A good deal of discussion appears to have followed Messrs. Eley's bold move in introducing a special low charge cartridge calculated to minimise recoil. While the standard sporting charge for a 12-bore gun must remain at 1⅛ oz. it seems now to be generally understood that the sixteenth-ounce smaller charge of shot is the most frequently adopted for the bread-and-butter trade of the large cartridge loader. The one-ounce charge has gained a great many adherents during recent years; but careful enquiry seems to show that the actual proportion of cartridges so loaded is still very small. This may be attributed partly to the fact that notwithstanding the considerable improvements of late years in the chambering and boring of guns, this charge is one which is not seen at its best in the average run of cheap sporting firearms. The cartridge loader must continue to study his interests by legislating rather for the cheap class of weapon than for the very best. A good quality gun will do equal justice to most loads of shot, but there is a very large number of cheap and well-nigh obsolete guns in use by shooters, who if they were so minded could well afford a superior piece of mechanism.

Many of the older guns which are in common use have eccentricities in the chamber and elsewhere which militate against the successful use of the one-ounce charge; and so long as these guns remain in use it is likely that the larger charge will retain its popularity. When a gun is so bored as to do equal justice to any charge of shot, provided the cartridge is properly loaded, the one-ounce charge will prove very satisfactory upon practical trial. For rabbits, for shooting in the early season before the birds are wild, and for use on driven game it will commend itself to every practical sportsman by reason of the smallness of its recoil, and the fact that it does not batter the game when used for the shorter distances.

The minimising of recoil may not appear at first sight to be of very special importance to the shooter whose cartridge consumption per day is apt to run into small quantities, but when it is remembered that a low recoil makes a light gun more endurable to the shooter, a clear case is made out for removing from the shot charge any surplus weight of pellets. To the practised shooter there is no satisfaction greater than the bringing off of a clean right and left, whether it be at grouse, partridges, pheasants or rabbits. With a low recoil cartridge the physical shock and disturbance of aim due to the firing of the first barrel are remarkably small. This provides for a rapid recovery and a consequent readiness to do justice to the second shot after a momentary interval of time.

When we come to the reduction represented by the Eley Litemode cartridge we find an extreme carrying out of the principle of reduced loads. The charge itself is not such a novel one that we need to question its efficiency for use under ordinary sporting conditions. There are many shooters who have for years used this charge of shot with considerable satisfaction. They are of course mostly to be found amongst men of wealth and position who shoot over heavily stocked preserves. The conservation of their physical energy represents one of the most important factors in the success and enjoyment of their day's sport, and a cartridge which brings the recoil down to the conventional absolute minimum must be regarded by them with a very friendly eye. Consequently if they find upon practical trial that a cartridge containing a ⅞th oz. charge of shot is an efficient killer, they will be apt to echo its praises amongst their friends. The question of its relative efficiency as compared with other cartridges is one upon which diverse views may reasonably be held.

Some pattern experiments recently published by the *Field* appear to show quite clearly that these cartridges should not be tested at the usual 40 yards distance. We have ourselves questioned for some time past the desirability of making a sporting test at a distance beyond that at which the gun can be expected to give efficient results. The ordinary cylinder barrel throws a pattern under the standard conditions of testing equivalent to a distribution of about 110 pellets on the 30-inch circle. While it takes only one pellet under favourable circumstances to bring game to bag it must be understood that when the total pellets of the charge are more or less irregularly spread over a 40 or 50-inch circle it is more a matter of luck than judgment to bring a bird to bag. In fact we are inclined to regard a distribution of 200 pellets on the 30-inch circle as representing the most satisfactory killing pattern for use on ordinary forms of game. Even here a gap in the pattern may allow a large-sized bird to go unscathed; but the chances are strongly in favour of a successful shot. This condition implies that while the gunmaker can effectually test the behaviour of a gun at 40 yards, the actual consideration of its killing properties can best be determined by its behaviour at the distance at which it gives a killing pattern. The ordinary cylinder gun throws a killing pattern at about 28 yards, and this means that the cylinder gun should not be expected to produce clean and certain results beyond a measured range of 30 yards.

The improved cylinder on the other hand throws a killing pattern from about the distance of 32 yards, which many sportsmen agree should be regarded as a maximum range at which to fire at game. As the charge of shot is reduced the thinning down of the pattern necessarily diminishes the effective range of the gun. While this may be corrected by the addition of more choke, such a remedy may be put on one side by recognising the fact that among shooters who really understand their weapons the improved cylinder is regarded as the closest shooting type of gun that should be adopted by the rank and file of English sportsmen. So long as the tendency of modern game shooting is to give the sportsman an ever increasing supply of quick-flying birds which are taken at an average distance of from 15 to 35 yards, the gun and ammunition must be so adjusted as to produce the most favourable results at a range lying somewhere between these limits. Distant birds must be allowed to go by in the hope that they will provide sport for another day, and attention must be concentrated on the rapid-flying overhead and crossing bird which affords ample opportunity for the exercise of high-class marksmanship under conditions giving a good average of clean sporting kills. It cannot possibly be expected that the ranging power of a lightly charged cartridge can equal that of the heavier brands of ammunition, but in shooting, as in everything else, the most successful all-round results can only be obtained by a happy compromise of opposing influences. The trend of recent developments appears to suggest that the best average of results, combined with the greatest pleasure to the sportsman, is to be obtained by the increasing use of what may be termed short-range cartridges.

THE ARMS INDUSTRY IN BELGIUM.

We have received from the Continent a well-printed pamphlet which reproduces the material contained in an article on the above subject which appeared in the August number of the *Revue Economique Internationale*. Although the article has naturally been written in a somewhat optimistic spirit there is still contained in it a good deal of useful comment and statistical information. In reviewing the history of Liége as a gunmaking centre it is pointed out that this city has always been known in this connection since the first introduction of firearms. As a consequence many existing firms date a long way back, no less than seven still in existence having been founded between the years 1801 and 1830. The oldest of all, that of Renkin et fils, was established in the year 1772. It seems that Liége has possessed since the latter half of the seventeenth century a proof house for firearms under the control of the State. In 1810 it was re-organised, and again in 1846 its constitution was thoroughly overhauled. A more recent alteration was made in the year 1888, when the proof master became a Government official. When however, it is added that the tests of the Liége proof house are more severe than any other such establishment we must disagree with the author, and consider him the victim of a romantic frame of mind. The accompanying interesting table showing the number of proofs carried out since the year 1840 is taken from the pamphlet under consideration. It shows in the clearest possible manner the fluctuating but nevertheless steady development of the trade in arms during the past 64 years.

Barrels Proved at Liége.

Year.	Single Barrels.	Double Barrels.	Pistolets. d'arçon.	Pistolets de pouche et revolvers.	Canons de mousquets.	Total.
1840	58,473	23,935	23,374	88,208	18,448	212,438
1850	161,662	67,537	28,796	289,374	44,063	591,432
1860	192,333	80,605	30,272	189,090	179,660	671,960
1870	226,980	166,088	139,756	267,392	59,862	860,078
1871	214,149	124,287	97,692	228,458	35,058	699,644
1872	229,277	154,470	149,448	269,121	29,841	832,157
1873	236,794	151,791	121,022	275,005	48,747	833,359
1874	270,413	141,823	177,032	279,676	53,768	922,712
1875	257,715	112,034	83,362	275,260	18,827	947,198
1876	190,763	78,932	45,362	299,847	11,338	626,242
1877	218,494	80,677	37,970	341,100	26,136	704,377
1878	210,553	113,121	51,732	403,649	48,686	827,741
1879	208,416	139,759	48,988	371,725	38,217	807,105
1880	248,582	164,013	49,660	389,626	47,878	899,759
1881	320,882	175,114	40,258	428,051	93,907	1,058,212
1882	336,675	136,418	52,420	423,940	88,693	1,108,146
1883	300,534	186,792	45,380	408,437	47,875	989,018
1884	303,794	187,981	42,520	426,369	72,008	1,032,462
1885	235,166	159,683	11,774	413,333	20,129	840,085
1886	551,931	259,191	27,448	450,475	30,748	1,319,793
1887	676,300	343,864	19,165	416,746	35,988	1,492,063
1888	751,775	341,755	30,217	406,150	27,634	1,557,531
1889	865,959	403,047	26,722	466,992	36,308	1,799,028
1890	998,526	474,290	23,121	451,548	24,092	1,971,577
1891	1,043,292	493,667	17,820	469,692	28,514	2,052,985
1892	658,990	289,977	18,079	500,759	74,983	1,542,788
1893	685,622	344,956	37,708	449,586	148,538	1,666,410
1894	709,544	353,570	40,550	339,318	136,041	1,639,033
1895	809,857	407,854	47,434	417,291	103,770	1,786,206
1896	787,685	410,957	37,495	426,339	133,513	1,795,989
1897	763,281	399,116	23,504	445,021	81,878	1,712,800
1898	911,358	488,376	26,547	485,919	35,134	1,968,708
1899	963,871	535,437	55,485	548,833	135,200	2,238,326
1900	1,024,304	598,857	47,009	512,411	137,108	2,319,689
1901	1,013,098	728,380	55,926	435,849	88,768	2,322,621
1902	855,521	637,647	54,759	456,129	113,711	2,117,767
1903	768,926	536,433	55,976	483,530	93,605	1,938,470

The second table, which accompanies this article, affords a very interesting comparative index of the trade in firearms between Belgium and its leading customers. We have converted the values given in the original text to pounds sterling and the figures for the year 1894 are compared with those for last year. The third column clearly shows the amount of variation registered.

Exports of Firearms from Belgium.

Country of Destination.	1894.	1903.	Difference.
	£	£	£
German Empire	121,454	121,274	— 180
France	91,527	113,886	+ 22,359
United States	16,231	88,480	+ 72,249
Russia	2,793	50,119	+ 47,326
Austria Hungary	20,296	41,495	+ 21,199
Great Britain	38,397	38,689	+ 292
Italy	19,760	35,577	+ 15,817
The Netherlands	62,347	17,440	— 44,907
Congo Free State	7,269	14,420	+ 7,151
Brazil	27,536	11,820	— 15,716
Australia	3,999	11,368	+ 7,369
Switzerland	5,013	8,422	+ 3,409
Canada	3,003	7,730	+ 4,727
Argentine Republic	13,487	6,128	— 7,359
Denmark	2,730	5,431	+ 2,701
Spain	611	4,580	+ 3,969
Turkey	13,196	4,452	— 8,744
Portugal	11,303	3,479	— 7,824
Norway and Sweden	7,882	2,747	— 5,135

In reviewing the figures given in the second table it will be noticed that Belgium has lost several of its customers during the past ten years. China, which in 1894 took £13,366 worth of arms, Greece which bought to the value of £2,544, and Cuba and the East Indies £274, represent so much trade which is entirely gone. China which was formerly an important market for firearms has been barred by an international agreement stopping the trade. In a similar way Persia and certain of the Balkan States are closed markets. On the other hand new accounts have been opened in other directions. For instance, Bulgaria, £894, Chili £3,077, Mexico £3,299, Egypt £10,664, Morocco £10,247, French possessions on the West Coast of Africa £9,450, and Portuguese possessions in the same region £1,927.

Germany continues to be Belgium's largest customer for firearms; but it must be remembered that as Hamburg is included in the German Empire for the purposes of the accompanying table, a large amount of the exports credited to Germany are in reality transhipped to other countries beyond the seas. The large amount of trade with France serves to show that the activity of St. Etienne as a centre of arms manufacture cannot be very considerable, a conclusion which is largely upheld by the small number of proofs carried out in that city. In spite of the very severe import tariff that guards the American market we find that a considerable trade is done with that country. Not only is it large in amount but it represents by far the largest individual increase in the table showing the variations of business in the period under review. Russia represents a well-known market

for Belgian firearms, and it is pointed out by our contemporary that the exports to that country consist almost entirely of highly priced weapons. Austria-Hungary has doubled its purchases in ten years notwithstanding the large arms factories at Weipert and Ferlach. Here again it may be supposed that high-class weapons are well received. Great Britain stands sixth on the list of Belgium's customers for firearms, and it is interesting to note that the actual volume of trade done is practically stationary. It is, however, only right to point out that the actual value of exports does not appear to be in proportion to the amount we hear of Belgium as a rival to our business. It must, therefore, be understood rather that Belgian competition affects us by the number of arms which are sold to other countries in competition with our own than what we actually import to this country.

The optimistic spirit, already referred to, in which the Belgian arms trade is reviewed takes no account of the fact that, although Belgium undoubtedly exceeds us in number and in value of turnover, the fashion in mechanism and style generally is set by Great Britain. If any proof of this contention were needed it would only be necessary to point out that the technical gun terms used in Belgium are of pure English origin. Even now they speak of a "hammerless" gun which is a tribute to our own enterprise in having introduced the change from the old hammer system. Then again great as is the position attained by Belgium it must be remembered that no statistics are available which are capable of showing how many Belgian arms are sold under cover of registered descriptions in the English language and under the guarantee of the English proof mark. England thus has the name and Belgium the turnover. We see the old and ungenerous statement again put forward in this article that without Belgian guns to prove our London proof house would have to shut its doors. This at least shows what a lot of guns the Belgians know they send to London for proof in spite of the alleged superiority of the Belgian test; but the unfortunate absence of statistics showing the transactions of our London proof house makes it impossible to contravert the allegation that we have no guns of our own to prove in London. Again we notice the old sneer that it is no secret in England that Belgian guns are purchased from Liège and are subsequenty sold as the work of our own gunmakers. Where this happens we should like to see it stopped. Properly considered measures carrying out such a policy would confer a great benefit on the English gun trade: first, by taking away the opportunity for recurrences of these damaging remarks, and second, by giving to our own manufacturers the trade in Belgian arms that would thus be displaced. In speaking of the trade with Italy our contemporary points out that while that country is an excellent customer to Belgium it has a factory at Brescia where the commonest class of weapon is made up largely by the conversion of old military weapons. The fact that there is no proof house to test the stability of these weapons is regarded as prejudicing the reputation of the Belgian firearms going to the same countries, certain regions of Spanish America being specially named. Similar observations apply in a certain measure to Spain, which has in addition established a high importation tariff. There they manufacture very cheap forms of revolver, which are exported to many parts of the world.

The Latin nations of America appear to take very few firearms. The rate of exchange is largely against the carrying on of business, as also is the unstability of the political situation in many of the smaller States. Several countries on this continent completely forbid the entry of firearms, while in others the Belgian industry is greatly affected by the inferior productions of Spain and Italy. Moreover substantial orders are very rare. Belgium can only count among its best customers Brazil, the Argentine Republic, and Mexico, which took all told only £24,323 worth of arms in 1903, whereas ten years ago Brazil alone bought more than this amount of firearms and the Argentine Republic considerably in excess of half this total. The African market in the neighbourhood of the Congo has during the past ten years shown signs of becoming an important market capable of considerable development. The export to the African colonies are mostly for flintlock weapons, arms so fitted being more popular among the negroes than those with the more modern method of ignition by percussion. This apparent preference is largely aided by the wise prohibition of more deadly forms of firearms in certain districts of the African continent. More than this a local supply of black powder overcomes the difficulties that would otherwise exist in importing a sufficient supply of cartridges and caps.

The portion of the pamphlet which deals with the importation of arms to Belgium is naturally not of any very great importance, since Belgium is not to any extent a consuming centre for firearms, the total imports for last year being £68,468. Of this amount England is responsible for £9,211. Unfortunately, as our contemporary puts it, some of the better class of sportsmen are in the habit of buying English weapons. This it seems is due to "snobisme" rather than to any real superiority in quality. They take heart, however, from the discovery that it is often found on taking apart these weapons which have cost so much to purchase that they bear the marks of the Belgian proof house. In discussing the future prospects of the Belgian arms trade the reviewer points out the constant necessity for working towards an ever-increasing perfection of mechanism, and taking every possible opportunity to introduce useful improvements into the technicalities of a highly difficult business. Prompt delivery and a moderate price accompanied by constant improvement of quality appear to represent the prime essentials for developing business, no opportunity to be allowed to pass by for extending wherever possible the machine processes. It is pointed out that what may be an optional improvement to-day may be absolutely essential in the future. Hence the need for alertness in considering every possible opportunity for development. References are made to the steps which have been taken by the firm of Pieper to extend the mechanical operations of gun manufacture to every detail in the turning out of double-barrel sporting weapons. It seems that even in a country like Belgium where labour is so cheap substantial economies result from the adoption of machine processes. More than this it is pointed out that no matter how closely the machine operations are carried towards the final formation of the parts there is no reason why the quality of finish that ultimately results should be in any wise inferior. A radical change in the method of manufacture, that is from hand to machine work, facilitates the economical turning out on a large scale of various fixed types of firearm, but it can never detract from the estimation in which hand work is held, since it is the medium by which a kind of artistic individuality is expressed.

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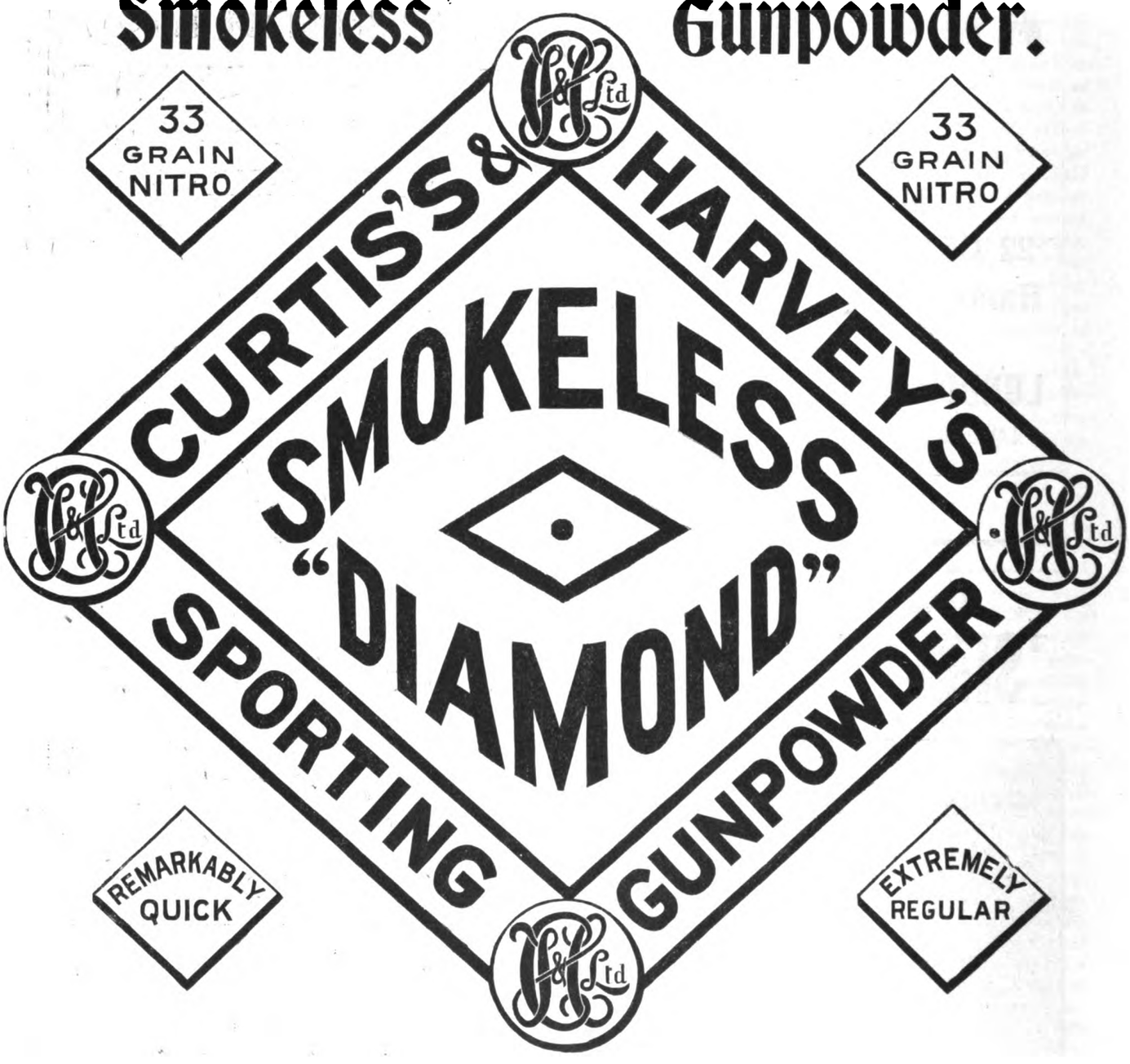

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ROUND THE TRADE.

A recent issue of the *Times* placed on record the marriage of Mr. J. W. Smallman of single-trigger fame.

We understand that bankruptcy proceedings have been set on foot with respect to Mr. J. A. Walter, gunsmith of Leicester.

We are asked to take note of Mr. Charles Lancaster's change of address from 151, New Bond Street, to 11, Panton Street, Haymarket.

We are reminded by one of the brothers Lane that it is now fifty years since Harry Lane, late of the Old Shot Tower, Lambeth, started making shot.

The marriage is announced of Mr. F. R. Martin, son of the late Alexander Martin of Glasgow and partner in the firm of Alex. Henry & Co. of Edinburgh.

The Naval and Military Patents and Equipment Syndicate, Ld., has been registered with a capital of £2,000 for the purpose amongst other things of manufacturing and dealing in arms, implements, and munitions of war.

At the North London Rifle Club shoot held at Bisley last month a world's record of 105 out of a possible 105 was made, the shooting being conducted under the conditions laid down for the first stage of the King's prize.

Mr. John Rigby has recently removed from his residence at Streatham and has taken up his quarters at 25, Queen Anne Street, W. We give this intimation because so much of his correspondence was dated from his private address.

We understand that Messrs. Hope Bros., Ld., the well-known outfitters, are going into the sporting goods trade on an extensive scale, and that they contemplate opening gun departments in their various depôts all over the country.

The firm of Joseph Lang & Son, Ld., have registered the issue on the 25th August of £3,500 debentures, being part of a series created by resolution in 1898 to secure £15,000 charged on the Company's undertaking and property. The total amount previously issued of the same series stands at £8,000.

The British Explosives Syndicate, Ld., was registered in Edinburgh on the 25th August with a capital of £40,000 to acquire the business of the Company in liquidation bearing the same name, the object being to manufacture and carry on trade in explosives. The registered office is situated at 65, Renfield Street, Glasgow.

Messrs. Curtis's & Harvey have forwarded for our inspection a series of very neat leather-covered sportsmen's note books. Two of them are for the taking down of ordinary memoranda, and the third represents a game register, which is certainly an improvement on many alternative patterns we have seen in the past, by reason of the fact that its finish and compactness make it an ideal companion for the waistcoat pocket.

It will be remembered that following upon the South African war a demand arose for a field gun carriage fitted with buffers for taking up the recoil. Such an arrangement was calculated to provide for a greatly increased rapidity of fire due to the reduced displacement of the gun upon discharge. Messrs. Vickers, Armstrong and Beardmore all submitted designs for a new form of carriage working on this principle, and it is now reported that orders have been placed with the two former firms for guns built on the pattern finally approved. Messrs. Beardmore, it will be remembered have since combined interests with the Vickers Company with regard to trade in which they are mutually interested.

The report for 1903-4 of the Société Centrale de Dynamit of Paris, whose share capital has been reduced from £800,000 to £560,000 by the cancellation of £240,000 new shares which was authorised at the last general meeting, shows net profits amounting to £37,220, as compared with £40,700 in the previous year. It is proposed to pay a dividend at the rate of 30 francs per share as against 24 francs in 1902-3. As a result of the sale of shares held in the Spanish Explosives Company and the purchase of shares in the Belgian Dynamite Company and the Italian Explosives Company, there is a reduction in the value of the investments from £920,000 to £742,700. The profit realised on the sale of the Spanish shares has been transferred to a special reserve fund.

The Annual report of Sir W. G. Armstrong, Whitworth & Co., Ld. for the year ended June 30th. states that, after deducting depreciation and adding £81,576 brought forward, there remains a profit of £583,263. It is proposed to declare on the ordinary shares a dividend of 3s. per share, tax free, of which 6d. per share has been already paid as interim dividend. This, with the usual half-yearly payment on the 4 per cent. preference shares, will leave £86,369 to be carried forward. The directors have for some time past been approached by shareholders as to the possibility of increasing the interim dividend. Any arrangement of this kind must, of course, be dependent on future circumstances, but it is proposed to increase the interim dividend payable in April, 1905. In view of their long connection with the Italian Government, and in order to strengthen the position of the company at Pozzuoli, and in other quarters, the directors have acquired an interest in the firm of Messrs. Ansaldo and Co., of Genoa. The report was adopted at the annual meeting held on the 28th ult., Sir Andrew Noble presiding. In the course of his remarks he explained certain matters connected with the amount standing on the balance sheet to the credit of goodwill.

We understand that Mr. F. C. Borer has retired from the Schultze Gunpowder Company, the directors having shown their keen appreciation of his yeoman services in the past by granting him a handsome life pension. It is interesting to call to mind that the smokeless powder business is no longer the infant it was formerly considered. This may be shown by the fact that Mr. Borer has nearly twenty-five years service with the Company to his credit. He joined the Company when quite a youngster, having been forced to abandon his articles of apprenticeship under the late John Sumner, the well-known gun engraver, on account of his eyesight. We feel sure that Mr. Borer's retirement will be marked by the heartiest good wishes from the many friends who have always found in him a staunch comrade and an earnest man of business. Among his many achievements Mr. Borer is probably most proud of the fact that he was one of the founders of the Clay Bird Shooting Association, and he attributes to the credit of that body the fact that clay bird shooting is now seriously regarded by sportsmen as a suitable means of acquiring skill with the gun, whereas in the past they were apt to treat it with contempt, thinking that no benefit would follow from what the shooting journalist is in the habit of calling "a course with the clays."

The report of the directors of the Birmingham Small Arms Company, Ld., states that the accounts for the year to July 31st show a trading profit of £48,184, which, with interest on investments, £2,568, and the amount brought forward, £3,898, places at disposal the sum of £54,651. Full allowance has been made for depreciation. An interim dividend of 5 per cent., free of income tax, on the Ordinary shares, and of 2½ per cent. on the Preference shares, was paid on April 1st. The directors now recommend a further dividend on the Ordinary shares of 5 per cent. (making 10 per cent. for the year), together with a bonus of 2s. 6d. per share, free of income tax, and on the Preference shares of 2½ per cent., payable on October 6th. These payments amount together to £47,768. The directors further recommend that a sum of £5,000 be carried to the reserve fund, which will then stand at £40,000. This will leave £1,883 to be carried forward. The gun department was only partially employed in the earlier part of the financial year in completing the old contract for Lee-Enfield rifles, but owing to the delay in obtaining gauges for the new rifle, deliveries under the contract for this arm were not commenced till April. In consequence of this difficulty, the gun department was unproductive for six months. Regular deliveries of the new rifle are now being made. The additions and alterations to buildings and plant have been completed, and no further capital expenditure is at present contemplated

THE PACKING OF EXPLOSIVES.

The following Order in Council has been issued for the purpose of giving notice as to the rules that must govern the packing of explosives for conveyance :—

1. In these Rules unless the context otherwise requires :—

The expression "Outer packet" means a box, barrel, case, or cylinder of wood, metal, or other solid material, of such strength, construction, and character that it will not be broken or accidentally opened, nor become defective or insecure whilst being conveyed, and will not allow any explosive to escape;

The expression "Inner packet" means a substantial case, bag, canister, or other receptacle, made and closed so as to prevent any explosive from escaping.

Wherever an explosive is distinguished as belonging to a particular class or division of a class, reference is made to the classification of explosives as contained in an Order in Council made under section 106 of the Act.

The expression "Authorised Explosive" means exclusively an explosive defined in a List of Authorised Explosives signed by a Government Inspector and in force for the time being.

The expression "Propellant" means an authorised explosive of Class III. adapted and intended exclusively for use as a propelling charge in cannon or small arms.

The expression "Special Authority" means a written authority granted by a Government Inspector, to which may be attached such conditions as may in the opinion of the Government Inspector be necessary to meet the special requirements of the case.

2. The interior of every packet shall be free from grit and otherwise clean.

3. Save as hereinafter provided there shall not be any iron or steel in the construction of any packet unless the same is covered with suitable material so as effectually to prevent the exposure of such iron or steel.

4. Every packet when actually used for the packing of one explosive shall not be used for the packing of any other explosive or any other article or substance. Provided that this rule shall not prohibit the packing of inner packages containing a propellant in an outer package with inner packages containing gunpowder or another propellant.

Provided also that this rule shall not prohibit the packing of any article which is not of an inflammable or explosive nature, or liable to cause fire or explosion, in the same package as explosive of the 1st Division of the Sixth (Ammunition) Class.

5. Subject to the foregoing provisions, the following shall be the method of packing Authorised Explosives of the various Classes respectively and the maximum amounts which may be in any one package :—(Then follows a detailed specification of the method of packing to be adopted for each kind of explosives).

6. Nothing in this Order shall be deemed to prohibit the use of an additional packet whether inner or outer, provided that such an additional package shall not be of such character as shall have been prohibited in writing by a Government Inspector.

7. An explosive which is not an Authorised Explosive shall be packed in such manner as may be directed by a Special Authority with reference to such explosive.

8. On the outermost packet there shall be affixed in conspicuous characters by means of a brand or securely attached label or other mark, the word "Explosive," the name of the explosive, the number of the Class and Division to which it belongs, and the name of the manufacturer or sender. In the case of explosives of Classes III. and IV., there shall be added the date of manufacture or issue from the factory, or such sign indicating such date as may be approved by a Government Inspector. Provided that in the case of cartridges or charges for cannon, shells, mines, blasting or other like purpose, which do not contain their own means of ignition, the marking shall be as for the explosive when not so made up. Provided also that in the case of explosives of Class VI., Division 1 (Safety Fuse excepted), there shall be added the words "Not liable to explode in bulk." Provided also that in the case of Pin Fire Cartridges for pistols there shall be added the words "Pin Fire Cartriges." Provided also that in the case of Safety Fuse or Gunpowder the word "Explosive" and the number of the Class and Division may be omitted. Provided also that where an outer packet contains more than one explosive, the marking above required shall be affixed separately in respect of each explosive so contained.

9. To meet special cases exemption may be granted by Special Authority from the observance of any one or more of the conditions imposed by these Rules.

10. This Order shall come into operation on the 1st day of January, 1905.

(Copies of the Order may be had from Messrs. Eyre & Spottiswoode, price one penny each. Ed.)

THE TEMPERATURE OF COMBUSTION OF EXPLOSIVES.

By F. W. Jones.

PART II.

When an attempt is made to set down, in chemical terms, the metamorphosis or transformation which occurs on the combustion of an explosive, assumptions must be made. The door is thus opened to criticism. In case of doubt an investigation is necessary to ascertain if the alternate assumptions affect the result. Should it be found that the estimation of temperature depends on equally probable assumptions, then the actual temperature can only be given between limits.

The heats of formation from the elements of a compound, given in the table below, relate to constant pressure, and as our calculated temperatures refer to constant volume, it is necessary to make a correction to the net heat calculated for a given transformation. Now, if a given weight of an explosive develops gases which measure v_0 at atmospheric pressure and 0°c, then the difference between the heat given out at constant pressure and constant volume is equal to the quantity of heat absorbed by the gases while expanding from the constant volume v_1 to v_0. If w is the work done by the gases, then this heat equals $\frac{w}{E}$ where E is the mechanical equivalent of heat. The work done is $(v_0 - v_1)\, p_0$ where p_0 is the pressure of an atmosphere and equals 1·0335 kilos. per cm² and v_0 equals, in c.c's 22320 × number of gramme molecules (n_0). Without appreciable error we may ignore v_1 in comparison with v_0 and write in kilos calories

HEAT OF FORMATION FROM ELEMENTS AND SPECIFIC HEAT.

SUBSTANCE.	Formulæ.	Molecular Weights.	PER GRAMME MOLECULE.		
			Specific Heat.	Volume.	Heat of Formation from the Elements in Kilos. Calories.
				c.c's	
Carbon	C_2	24	4·8	6·85	—
Sulphur	S_2	64	12·8	31·36	—
Mercury	Hg	200	6·6	14·70	15·4 (heat of volatilization)
Carbon Monoxide	CO	28	—	22·320	25·8
Carbon Dioxide	CO_2	44	—	do.	94·0
Sulphur Dioxide	SO_2	64	—	do.	69·2
Water	H_2O	18	—	do.	68·4 (liquid) 58·2 (gaseous
Potassium Chlorate	$KCl\,O_3$	122·6	25·7	52·60	94·6
„ Nitrate	KNO_3	101·1	24·2	49·00	118·7
„ Carbonate	K_2CO_3	138·2	30·0	62·00	277·8
„ Sulphate	K_2SO_4	174·2	33·2	66·00	342·2
„ Sulphide	K_2S	110·2	19·0	37·00	102·2
„ Chloride	KCl	74·6	20·0	38·70	105·0
Ammonium Nitrate	NH_4NO_3	80	36·4	41·00	87·9
Antimony Sulphide	Sb_2S_3	336·6	28·2	75·00	34·0
„ Oxide	Sb_2O_3	288·6	24·8	53·00	177·4
Vaseline	$CH_4(CH_2)_n$	—	—	—	14·4 + n 7·3
Dinitrobenzene	$C_6H_4(NO_2)_2$ ...	168	—	—	12·7
Mercury Fulminate	$Hg\,C_2N_2O_2$	284	—	—	— 62·9
Guncotton (Insoluble) ...	$C_{24}H_{29}O_9(NO_3)_{11}$ ...	1143	—	—	624·0
Collodion Cotton	$C_{24}H_{31}O_{11}(NO_3)_9$ ...	1053	—	—	696·0
Nitroglycerin	$C_3H_5(NO_3)_3$	227	—	—	98·0

$$\frac{W}{E} = \frac{10335 \times 22{\cdot}320}{425 \times 1000} \times n_0 = {\cdot}5424\, n_0$$

This represents the addition which must be made to the heat evolved at constant pressure to equal that which would be given off at constant volume.

The specific heat of gases, temperature variable, is as follows:—

Carbonic acid gas (also say so_2) $c = 6{\cdot}26 + 0037t$
Water ... ... $c = 5{\cdot}61 + 0033t$
Perfect gases ... ... $c = 4{\cdot}80 + 0006t$

CAP COMPOSITION.

For our example we will take the Government composition for percussion caps for small arms (not ·303).

Ingredients.	PERCENTAGE COMPOSITION.	
	Specified.	By reaction below.
Mercury Fulminate... ...	37·5 per cent.	37·54 per cent.
Antimony Sulphide	25·0 „	25·02 „
Potassium Chlorate ...	37·5 „	37·43 „

$$16\,Hg\,C_2N_2O_2 + 9\,Sb_2S_3 + 37\,KCl\,O_3 = 16\,Hg + 37\,KCl + 9\,Sb_2O_3 + 27\,SO_2 + 30\,CO_2 + 2\,CO + 16\,N_2$$

Estimation of Heat evolved.

Heat of Formation of Ingredients.			Heat of Formation of Products.		
16 ×	— 62·9 =	— 1006·4	16 ×	— 15·4 =	— 246·4
9 ×	34·0 =	306·0	37 ×	105·0 =	3885·0
37 ×	94·6 =	3500·2	9 ×	177·4 =	1596·6
			27 ×	69·2 =	1868·4
		2799·8	30 ×	94·0 =	2820·0
			2 ×	25·8 =	51·6
					9975·2

Correction for Constant Volume.

$$\frac{W}{E} = 0{\cdot}5424 \times 91 = 49{\cdot}36$$

	2799·8
Net heat at constant ~~volume~~	7175·4
	49·4
Net heat at constant volume	7224·8

$$\text{Heat per gramme} = \frac{7224{\cdot}8 \times 1000}{12105{\cdot}9} = 596{\cdot}8 \text{ gram. calories}$$

$$\text{Gas per gramme} = \frac{91 \times 22320}{12105{\cdot}9} = 167{\cdot}8 \text{ c.c's } (H_g \text{ vapour}).$$

$$\text{TEMPERATURE } t = \frac{-a + \sqrt{a^2 + 4b\,Q}}{2b}$$

	$a = 16 \times 6{\cdot}6 = 105{\cdot}6$
$b = 57 \times {\cdot}0037 = 0{\cdot}2109$	$37 \times 20{\cdot}0 = 740{\cdot}0$
$18 \times {\cdot}0006 = 0{\cdot}0108$	$9 \times 24{\cdot}8 = 223{\cdot}2$
	$57 \times 6{\cdot}26 = 356{\cdot}8$
$0{\cdot}2217$	$18 \times 4{\cdot}80 = 86{\cdot}4$
	1512·0

Whence t = 3246 °C

Thus this cap composition has the characteristic per gram. v_0 = 167·8 c.c's H = 596·8 cal. and t = 3246 °C.

BLACK POWDER.

This example is instructive, but eminently unsatisfactory, because the experimental results and the interpretations offered by various authorities differ so much that a final view is not possible.

We will take Waltham Abbey Pebble Powder, because Noble and Abel have published the pressure results in closed chambers for densities from 0·05 up to 0·90. These figures are given below.

Now it has been shown previously that—

$$P = \frac{f\,\Delta}{1 - A_1\,\Delta} \quad \text{so that } f = \frac{P}{\Delta} - P A_1$$

Where P = pressure for density Δ

f = the specific Explosive Force.

A_1 = the co-volume per unit weight of the gaseous products plus the volume of the solid products

Obviously f is constant for the same explosive, therefore for two distinct densities we have—

$$\frac{P_1}{\Delta_1} - P_1 A_1 = \frac{P_2}{\Delta_2} - P_2 A_1$$

$$\therefore A_1 = \frac{1}{P_2 - P_1}\left(\frac{P_2}{\Delta_2} - \frac{P_1}{\Delta_1}\right)$$

For the Pebble Powder results, the most consistent value of A_1 is 0·69. With this result of A_1, f equals 14·05 tons per square inch, or 2212·8 kilos per cm². Therefore closed chamber pressures of Pebble Powder can be calculated by the formula—

$$P = \frac{14{\cdot}05 \times \Delta}{1 - 0{\cdot}69\,\Delta} \text{ tons.}$$

The following table shows the relation between these calculated pressures and those measured by Noble and Abel:—

Density of Loading.	Pressure.		Differences tons.
	Observed.	Calculated.	
·90	32·46 tons.	33·38 tons.	+ ·92
·80	25·03 ,,	25·03 ,,	nil.
·70	19·09 ,,	19·02 ,,	— ·07
·60	14·39 ,,	14·39 ,,	nil.
·50	10·69 ,,	10·72 ,,	+ ·03
·40	7·75 ,,	7·76 ,,	+ ·01
·30	5·33 ,,	5·31 ,,	— ·02
·20	3·26 ,,	3·26 ,,	nil.
·10	1·47 ,,	1·50 ,,	+ .03
·05	0·70 ,,	0·72 ,,	+ ·02

To obtain the temperature from these pressures we have previously shown that absolute temperature

$$T = \frac{f}{1{\cdot}033}\,\frac{273}{V_0}\,W$$

Where V_0 is the volume of gas in c.c's given by w. grms. of explosive. For Pebble Powder Noble and Abel obtained per grain 278 c.c's, the calories being 721·4. Therefore

$$T = \frac{273 \times 2212{\cdot}8}{1{\cdot}033 \times 278} = 2105^\circ \text{ C}$$

so that $t = 2105 - 273 = 1832$ °c.

This figure does not agree with Noble and Abel's, they somewhat arbitrarily adopted 0·57 for A_1, and obtained f from the 0·9 density pressure. The calculations of pressure derived from their values, with the exception of the 0·9 density, are about 10 per cent. in excess of the observed, and their value of f gives $t = 2347$°c. It is not suggested that our value of the temperature is nearer the truth because it is very probable the gases collected by Noble and Abel refer to a time after the true explosion when the gases are augmented by changes taking place in the solid products. Dr. Debus investigated Nobel and Abel's results at length and he came to the conclusion that gunpowder in closed chambers burns in two stages. At first a process of oxidation, the true combustion, and later a process of reduction during which the carbon and sulphur left free at the end of the first stage re-acts with the liquid products generating more gas. Dr. Debus expressed this for pebble powder as follows:—

First stage—

$$16\ KNO_3 + 21{\cdot}18\ C + 6{\cdot}63\ S = 3\ K_2CO_4 + 5\ K_2SO_4 + 9\ CO_2 + CO + 8\ N_2 + 8{\cdot}16\ C + 1{\cdot}63\ S.$$

The characteristics are per grm. $V_0 = 193$ c.c's, Calories 728 and $t = 3020$ °c.

During the second stage this becomes

$$5\ K_2CO_3 + 2\ K_2S_2 + K_2SO_4 + 11\ CO_2 + 7\ CO + 8\ N_2 + 1{\cdot}63\ S.$$

The characteristics being per grm. $V_0 = 278{\cdot}5$ c.c's, Calories 600 and $t = 2477$ °c.

If we assume Dr. Debus' first stage represents the actual conditions when the values of pressure observed by Noble and Abel obtained, then the gas per grm. being only 193 c.c's the temperature from the pressure tests is $t = 2759$ °c. It is, we think, a fair criticism to say that the literature on the subject makes it clear that the temperature of combustion of black powder is not yet known.

CORDITE.

The service explosive provides an example as satisfactory as black powder is unsatisfactory. The published experimental results are nearly as complete and are in absolute concordance.

The following represents the composition and metamorphosis of cordite with sufficient accuracy for practical purposes:—

$$8\ C_3H_5(NO_3)_3 + 12\ CH_2 + C_{24}H_{29}O_9(NO_3)_{11} = 20\ CO_2 + 40\ CO + 34\ H_2O + \tfrac{35}{2}\ H_2 + \tfrac{35}{2}\ N_2.$$

As regards this transformation the table shows that no appreciable error is made by taking vaseline as $(CH_2)n$. The nitrocellulose shows a nitrogen (viz., 13·47) high for commercial guncotton, but this may be said to be compensated by the percentage of vaseline being 5·38 and guncotton 36·55 instead of the specified 5 per cent. and 37 per cent. respectively.

Heat of Formation.

Ingredients.	Products.
8 × 98.0 = 784·0	40 × 29·0 = 1160·0
12 × 7·3 = 87·6	20 × 97·0 = 1940·0
1 × 624·0 = 624·0	34 × 68·4 = 2325·6
1495·6	5425·6
	1495·6
	Net heat at constant pressure 3930·0

Per grm. at Const. Pres., water liquid $= \frac{3930000}{3127} = 1256$ Cal.

,, total volume of gases, water gas $= \frac{124 \times 22320}{3127} = 885{\cdot}0$ c.c's.

Comparison of MacNab and Ristori's results with above:—

	Calculated.	McNab and Ristori's.
Calories	1256	1253
Total volume of gas, c.c's	885	882
Water, c.c's	244	235
Composition of Permanent Gases		
CO_2	22·2 per cent.	24·9 per cent.
CO	44·4 ,,	40·3 ,,
CH_4		0·7 ,,
H	14·0 ,,	14·8 ,,
N	19·0 ,,	19·3 ,,

For pressure calculations in closed chambers the heat of formation of water must be taken gaseous and the heat evolved at constant volume. Water being gaseous the heat per gramme is 1148 cals., and the addition for constant volume 22·7 cals. per grm., total 1170·7 cals. per grm. To obtain the temperature the values of a and b are taken out as illustrated under Cap Composition, the arithmetic gives $t = 2824$ °c $\therefore$ $T = 3097$ °c from which $f = 65{\cdot}8$ tons is obtained as already explained. This value of f enables one to calculate closed chamber pressure, and in the case of Cordite the calculated pressure agrees exactly with that observed up to about 30 tons pressure. In other words this means that if we had calculated, by the methods illustrated under Black Powder, the temperature from the closed chamber pressure observed by Sir Andrew Noble, we should have arrived at the same value for the temperature as is obtained here by an entirely different procedure. A higher corroboration of the accuracy of the methods employed could not be wished for.

BLASTING AGENTS.

Most of the blasting powders used in England are of indefinite composition, it is therefore difficult to set down more than probable transformations. Consequently, it is proposed to illustrate the control of the temperature of combustion by theoretical mixtures. It is unnecessary to give the details of the arithmetic, the characteristics of each mixture alone being given.

Ammonium nitrate is from an explosive point of view, a base *par excellence* for low temperature explosives. It has been proved by experience that mixed with small percentages of combustibles or explosive bodies, the mixtures are completely detonated by the usual methods. With this base, practical blasting powders can be made containing oxygen for complete combustion, oxygen in excess (Per-oxidation) or a deficiency of oxygen (Hypo-oxidation). The following will illustrate the influence of these variations on the temperature of combustion :—

Complete Combustion. Ammonium nitrate containing 17·35 per cent. dinitrobenzene.

$$10\ NH_4NO_3 + C_6H_4(NO_2)_2 = 11\ N_2 + 22\ H_2O + 6\ CO_2$$

Characteristics per grm. $v_0 = 899$ c.c's Cals. $= 1206$ and $t = 2177$ °c.

Per-oxidation. Ammonium nitrate containing 7·75 per cent. dinitrobenzene.

$$25\ NH_4NO_3 + C_6H_4(NO_2)_2 = 26\ N_2 + 52\ H_2O + 6\ CO_2 + \tfrac{1}{2}\ O_2.$$

Characteristics per grm. $v_0 = 942$ c.c's Cals. $= 876{\cdot}6$ and $t = 1674$ °c.

Hypo-oxidation. Ammonium nitrate containing 34·4 per cent. dinitrobenzene.

$$4\ NH_4NO_3 + C_6H_4(NO_2)_2 = 5\ N_2 + 5\ H_2 + 7\ H_2O + 3\ CO_2 + CO.$$

Characteristics per grm. $v_0 = 960{\cdot}5$ c.c's Cals. $= 865{\cdot}3$ and $t = 1916$ °c.

Per-oxidation with 9·5 per cent. of Collodion. French Explosif P. N° 2.

$$124\ NH_4NO_3 + C_{24}H_{31}O_{11}(NO_3)_9 = 24\ CO_2 + 263\ H_2O + 129\ N_2 + 50\ O_2.$$

Characteristics per grm. $v_0 = 947$ c.c's Cals. $= 793$ and $t = 1276$ °c.

Per-oxidation with 11·9 per cent. of nitroglycerin. French Grisoutine-Couche.

$$21\ NH_4NO_3 + C_3H_5(NO_3)_3 = 3\ CO_2 + 45\ H_2O + 22\ N_2 + \tfrac{21}{2}\ O_2.$$

Characteristics per grm. $v_0 = 941$ c.c's Cals. $= 742$ and $t = 1457$ °c.

Note should be taken of the fact that for these characteristics, the calculations are taken at constant pressure, and the total volume of gas (v_0) assumes that the water is gaseous at 0°c. The temperature, however, is calculated for constant volume, water being gaseous. These calculations show that per-oxidation is preferable not only because of the greater effect on the abatement of the temperature, but also because by this method carbon monoxide is not a product of combustion. Unfortunately, per-oxidation is not possible with all oxidizers, because the excess of oxidant is not decomposed. For example the French Authorities found that when blasting gelatine is mixed with twice its weight of potasium nitrate, the solid residues left after detonation contain about 40 per cent. of undecomposed nitrate. Therefore, it is necessary to make experiments to ascertain if the transformation set down really takes place. Sufficient, however, has been proved to show that intelligent investigation of the possible transformations give the temperature of combustion exactly, or within limits which are more or less close, depending on the information at hand or obtainable.

A NEW STEVEN'S RIFLE.—We have recently received from the South British Trading Company a sample of the new model medium-weight Ideal rifle. Many of us have often no doubt felt regret that these popular rifles could only be obtained in two extreme weights, the Ideal pattern of miniature rifle running a trifle over 7 lbs., and the Favourite about 4¼ lbs. The new English model of Steven's rifle weighs an ounce or so short of 6 lbs., and having the superior style and finish of the Ideal model, and an altogether nicer balance, it should prove a great commercial success. The lines of the new weapon are in our opinion more pleasing than those of the alternative models, being a happy mean between the light build of the Favourite and the heavy construction of the Ideal. The latter is to the English way of thinking somewhat overweighted forward, and this is overcome in the new model by a barrel tapering towards the muzzle.

TRADE MARKS.

ADVERTISED. SEPTEMBER 7—28.

265,375 } The word LITEMODE to apply to ammunition. Eley
265,376 } Bros., Ld., London. August 4, 1904.

REGISTERED. AUGUST 25—SEPTEMBER , 1904.

264,768 } Eley Bros., Ld.
264,769 }
264,282 Lane Bros.

APPLICATIONS FOR PATENTS.

AUGUST 22—SEPTEMBER 24, 1904.

18,114. Targets. F. Holland.
18,188. Explosives. N. Guthridge.
18,247.* Ordnance Breech Mechanism. P. M. Justice (Agent for *The Bethlehem Steel Co.*).
18,253. Torpedoes F. W. Baynes.
18,261. Ordnance Mountings. A. T. Dawson and G. T. Buckham.
18,269. Cordite Manufacture. L. le Brocquy.
18,274. Ammunition. G. C. Baker.
18,346.* Ordnance Sights. A. Reichwald (Agent for *Fried. Krupp, Ag.*)

18,442.* Turret Guns. C. P. E. Schneider.
18,489.* Repeating Rifles. C. Ryland and R. C. Stevenson.
18,504. Ordnance Sighting Gear. Sir W. G. Armstrong, Whitworth & Co., Ld., and A G. Hadcock.
18,522. Guncotton as a Motive Power. T. R. Beaumont.
18,536. Projectile Time Fuses. J. E. Read and G. W. F. Lester.
18,601.* Increasing Ballistic Action in Firearms. C. Puff. (Date of application in Germany, December 11, 1903.)
18,727.* Ordnance Sighting. Fried. Krupp, Ag. (Date of application in Germany, September 7, 1903.)
18,742. Nitrocellulose. P. Krais and the Bradford Dyers' Association, Ld.
18,751.* Automatic Firearms. H. H. Lake (Agent for *The Winchester Repeating Arms Co.*).
18,808.* Aiming Stand for Rifles. B. Rüthling.
18,824. Breech-loading Small-Arms. P. T. Godsal.
18,898. Ordnance. P. M. Justice (Agent for *The Bethlehem Steel Co.*)
19,043. Lubricator for Gun Barrels. L. le Brocquy.
19,059.* Targets. W. H. Pike.
19,148. Ordnance. A. T. Dawson and G. T. Buckham.
19,166. Testing Time Fuses. H. C. L. Holden.
19,194. Bullets. H. Jones.
19,200. Explosives. F. Hall.
19,231.* Air Torpedoes. W. T. Unge.
19,624. Air Gun Pellet Catcher. N. Hall.
19,670. Saloon Magazine Rifle. F. Linner.
19,807.* Hammerless Guns. J. B. Lichtfous and H. Radoux.
19,933. Foresight Protector. G. L. Jeffries.
19,966. Expanding Shot Plug. J. J. Ney.
20,069.* Ordnance Sights. L K. Scott.
20,104.* Ordnance Loading. C. P. E. Schneider.
20,106.* Explosives. N. Evangelidi.
20,145.* Projectile Fuse. The King's Norton Metal Co., Ld., T. A. Bayliss, and H. M. Smith.
20,150.* Rifle Cleaning. W. C. Buckelew and J. P. Hournoy. (Date of application in U.S.A., September 19, 1903.)
20,203. Ordnance Sights. L. K. Scott.
20,208. Double-Barrelled Small-Arms. J. Carter.
20,284. Explosives. W. Hope.
20,302. Small-Arm Projectiles. H. Stanbridge and W. Walker.
20,366.* Projectiles. A. H. Emery.
20,369. Telescopic Sights. E. A. Chapman.
20,519. Targets. W. M. Campbell.
20,540. Indicating Gun Positions. W. D. Kilroy, and Evershed & Vignoles, Ld.

*These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

AUGUST 25th—SEPTEMBER 22nd, 1904.

COMPILED BY HENRY TARRANT.

17,272 (1903). **Electrical Blasting Apparatus**. T. Granger, Scotswood-on-Tyne. Apparatus adapted to fire blasting cartridges electrically, in which three cells of a battery are connected with two of three binding screws. To the third, and to one of the two binding screws, the terminals of the firing cable are attached. The current is passed through the firing cable through the medium of a lever—working on the middle binding screw—which is turned into contact with the third binding screw. When the lever is disconnected from the third screw and turned into contact with the second of the other two the battery is practically short circuited. Accepted August 4, 1904.

17,333 (1903). **Automatic Small-Arms**. J. J. Reifgraber, U.S.A. Recoil-operated mechanism applicable to hand or shoulder-arms, or to machine guns is dealt with in this specification. The gases of combustion are conducted through port holes near to the muzzle of the barrel, back to a gas chamber surrounding the breech end. The slidable breech bolt, driven back by the gases after being unlocked from the barrel, is caused to extract the spent cartridge, and, during the subsequent forward movement influenced by a spring after the gas pressure is exhausted, to insert a fresh one in the chamber. Accepted August 10, 1904.

17,414 (1903). **Formation of Guncotton Blocks**. G. W. Bell, Ipswich. A method is described in this patent of pressing long blocks of guncotton so as to render them more uniform from end to end than hitherto and to produce a given average density with less pressure than has been required. A horizontal stationary receiver is employed and this is adapted to hold the mould containing the charge to be compressed. Two hydraulic plungers fitting within the mould and moving independently of each other are caused to compress the guncotton in the mould between them. For fastening the receiver a device is provided similar to that described in patent No. 17,890, of 1903. Accepted August 4, 1904.

18,514 (1903). **Driving Bands of Projectiles**. R. A. Hadfield and A. G. McK. Jack, Sheffield. A method of lubricating the bore of a gun during the passage of a projectile consisting in providing the soft metal driving band with a groove charged with such material as lumbago or graphite. During discharge the lubricant is forced out of the groove by the compression of the band into the rifling. The bore is protected against the hot action of the gases of combustion by this device. Accepted August 25, 1904.

20,246 (1903). **Air Gun Breech Fastening** G. L. Jeffries, Birmingham. A breech fastening for air guns consisting of a rotatable bolt, semi-circular in cross section. This bolt is turned by a thumb lever against the action of a returning spring to allow the barrel to be parted from the breech. When the barrel is being closed the flat side of the bolt is engaged by the barrel end. The bolt is turned sufficiently to allow the barrel to be snapped back into the locking position. Then the bolt is returned by its spring and automatically locks barrel to breech. Accepted August 25, 1904.

20,355 (1903). **Machine Guns**. F. Coe, Derby. A muzzle attachment is provided to machine guns by which the force of explosion of the service rifle blank charge may be utilized so that it has force enough to cause the barrel to recoil and to perform the operations necessary automatically to unload and reload the gun. The adjustment and setting of the means whereby the barrel is returned are not interfered with. The attachment consists of a cylinder provided with side exhaust holes which are only uncovered after the barrel has recoiled some distance. Accepted August 25, 1904.

20,586* (1903). **Adjustable Foresight for Small-Arms**. W. G. Woolfrey, London.

21,123 (1903). **Elevating and Sighting Gear of Ordnance**. Sir W. G. Armstrong, Whitworth & Co., Ld., and R. T. Brankston, Newcastle-on-Tyne. Apparatus by which the elevation of ordnance may be altered without modifying the line of sight. The elevating gear consists of two parts—the aiming gear, operated by a handwheel for directing the sight upon the target; and the ranging gear, which is operated separately by a second handwheel, and is designed, without altering the line of sight, to impart to the gun the proper angle of elevation for any given range. Accepted September, 1, 1904.

22,174* (1903). **Trigger Mechanism for Sporting Guns**. G. Knight, London.

23,458 (1903). **Centre Pivot Gun Mountings**. A. Reichwald, London (Agent for *Fried. Krupp, Ag., Germany*). Hitherto the type of gun carriage in which the gun trunnions are journalled in a fork rotating on a vertical pin, in a fixed block attached to the ground or to the deck of a ship, has been provided with a rotating service platform rigidly connected with the trunnion fork. The oscillations of the fork were in this arrangement transmitted to the service platform, and to obviate the disadvantages a separate bearing on a fixed portion of the carriage is provided for the service platform to revolve upon. Accepted August 11, 1904.

23,766 (1903). **Explosive Composition for Fuses**. W. T Unge, Sweden. The slow burning composition in fuses sometimes increases in volume during storage and cracks with a consequence that it is liable to explode and bring about premature ignition of the main charge. With the materials forming such slow burning composition the patentee incorporates a non-volatile grease or oil which increases elasticity and decreases hygroscopic properties and so obviates these defects. Accepted September 1, 1904.

3,253* (1904). **Nitrate of Ammonia Explosive**. H. J. Haddan, London (Agent for *J. Führer, Austria*).

10,837 (1904). **Fuse Head for Electric Blasting.** F. Reader, Manchester. A fuse head designed effectively to prevent short circuiting and to ensure proper sparking of the wires when necessary. A cup of some non-flammable and non-conducting material adapted to hold the exact amount of explosive is at its base pierced with four holes. The wires are passed through two of the holes and their ends are bent over and are returned through the other two. This arrangement prevents displacement. Accepted August 11, 1904.

13,453 (1904). **Manufacture of Ordnance.** J. E. Sheriff and F. L. Nichols, U.S.A. A method of producing a wire wound gun in which the stresses shall be so distributed as to render the gun light and strong. The core of the barrel is composed of tubes so related, prior to the winding of the wire thereon, that an exterior tube of the core may be materially compressed without materially compressing an inner tube. Accepted August 18, 1904.

14,636 (1904). **Target Practice Apparatus.** H. H. Cummings, U.S.A. Improvements in target practice apparatus of the type described in patent No. 745, 1903, in which a device to be aimed at, is so associated with other means as to enable a marksman to know how he is aiming without the use of a projectile and without the necessity for extended space. Accepted August 11, 1904.

14,753 (1904). **Breech Adapter for Ordnance.** Capt. J. W. Reid, London. In Patents Nos. 2,568 and 12,852, 1899, ordnance breech adapting mechanism to allow of practice with miniature ammunition, was set out. This apparatus is so modified that whereas self-centreing attachments of the firing tube were expanded in and fitted the chamber only, they may now be expanded to fit either chamber or bore according to circumstances, while the rear end of the tube is provided with a breech disc fitting the breech of the gun in a manner similar to the ordinary breech block. Accepted August 4, 1904.

15,028 (1904). **Ammunition Wagons.** A. Reichwald, London (Agent for *Fried. Krupp, Ag., Germany*). In connection with the type of ammunition limber having a box door which opens and extends into the space between the limber-box and the ground, and affords protection to the gun crew, a steel plate is so attached to the door that when the door is closed the plate lies parallel with it. When the door is open the plate opens out and increases the covered space between the box and the ground. Further the protection from frontal fire is thus provided. Accepted August 11, 1904.

15,357 (1904). **Ammunition Receptacle.** Lieut.-Col. H. T. Bru de Wold, Natal. An ammunition receptacle, designed to be carried upon the back of a pack-horse, consisting of two leather pieces—one for each side of the horse—to which are secured a number of rows of pockets arranged to contain packets of ammunition. Suitable means are described for fixing the device securely over the horse's back. Accepted August 25, 1904.

15,707 (1904). **Small-arm Bullets.** E. Roth, Austria. A bullet for small-arms or machine guns, consisting of a hard core having a combined double envelope. The outer cover is of hard metal and alone surrounds the nose of the core. The inside envelope consists of lead, and starts from a shoulder formed in the inside of the nose base of the outer cover, and gradually thickens towards the base. The bullet is designed especially for piercing armour plates, and is intended not to lose much of its bulk by stripping during such piercing. Accepted August 25, 1904.

15,788 (1904). **Swabbing and Cooling Ordnance.** A. G. Winter and E. G. Buckner, U.S.A. By means of a removable hood placed against the breech of the gun when the block is removed, a fluid such as air under pressure is introduced into the barrel. By this means the barrel is cleaned out of the remains of products of combustion, so obviating premature explosion of a succeeding charge, and is cooled at the same time. Accepted August 25, 1904.

16,252 (1904). **Recoil Strengthener for Automatic Small-arms.** P. Mauser, Germany. A modified form of recoil strengthener for automatic small-arms, consisting of a sleeve closely surrounding the front end of the barrel. A mouthpiece with a narrowed opening is arranged in front of this sleeve. The front end of the sleeve is designed to carry both the muzzle sight and the circular grooves by which the mouthpiece is kept in position. Separate fastenings for the sight and for the mouthpiece are by this arrangement rendered unnecessary. The sight bed may be used if necessary for fixing the mouthpiece in position. Accepted August 25, 1904.

* These Specifications are more fully described under "Selected Patents.

SELECTED PATENTS.

TRIGGER MECHANISM FOR SPORTING GUNS.

22,174 (1903). G. Knight, London. Trigger mechanism in which the trigger is so mounted as to be easily detached, and a system of safety mechanism for break-down sporting guns are described in this specification. The sear lifting device, consisting of the vertical swinging part, is carried in the trigger, as is also a hooked arm through which the sear lifter is carried clear of the sear when the safety device is operated to lock the trigger.

The mechanism is clearly set out in the illustrations herewith. Mounted upon the trigger plate *a* in the usual way is the box *b*. The trigger *c* is slotted longitudinally, and is provided with the projection *d* adapted to be engaged by the safety device to lock the trigger. The front end of the trigger is provided with the hook *e*, which takes over the pin *f* running through the box *b*. At the rear of the trigger is a projection *g* adapted to hold the trigger in position. The screw head *h* (Fig 2) is provided with a notch through which the projection passes when the trigger is being placed into the action. The screw head is turned to hold the trigger therein. The mounting and dismounting of the trigger are simplified by this arrangement.

Fig. 1

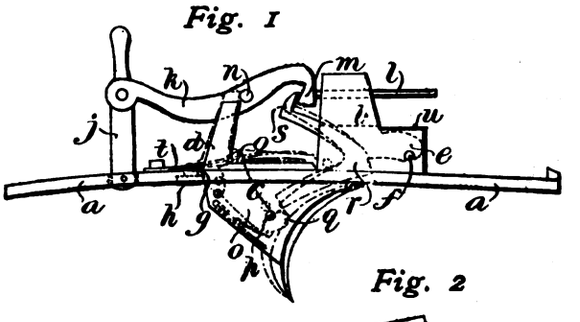


Fig. 2

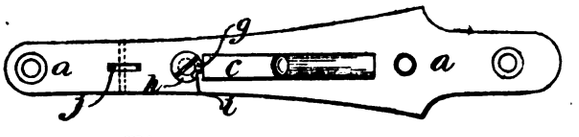


Fig. 3

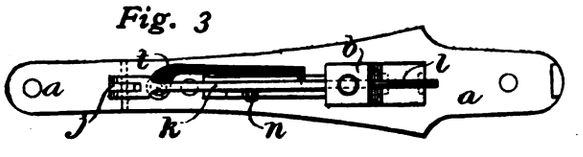
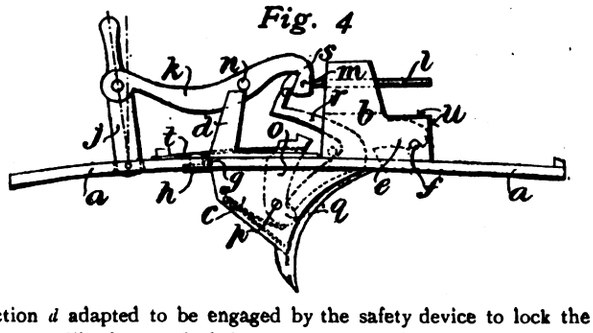


Fig. 4



The safety mechanism consists of the lever *j* pivoted on the trigger plate. To the lever *j* is pivoted one end of the bar *k*, the

other end of which is provided with the guide rod *l* running through the box *b*. The bar *k* carries the hook *m* and the pin *n*. Within the longitudinal slot in the trigger is mounted the vertical swinging piece *o* pivoted at *p*. The top edge of this tumbler operates the sear when in the unlocked position illustrated in Fig. 1. The bent slide *r* is also carried in the trigger and its hook *s* is adapted to engage with the hook *m* upon the bar *k*. Its other end engages with the tail *q* of the tumbler *o*. When the safety lever *j* is drawn back to the position shown in Fig. 4, the hook *m* actuates the slide *r*, causing it to turn the tumbler *o* against the pressure of its spring, from beneath the sear tail. At the same time the pin *n* on the bar *k* is carried over the projection *d* of the trigger, the upward movement of which is in this way prevented. When the safety is pushed forward again the parts assume the positions set out in Fig 1, and are free to lift the sear when the trigger is pulled. The spring *t* depresses the trigger after being raised by the pull, and the thin sheet of metal *u* covers in the box *b*. Accepted August 25, 1904.

AMMONIUM NITRATE EXPLOSIVES

3,253 (1904). H. J. Haddan, London (Agent for *J. Führer, Austria*). Modified compositions of the class of explosives composed of nitrate of ammonia and a finely divided metal are dealt with in this patent. Experiments have demonstated that the disruptive power of such explosives is enhanced by employing, besides the ammonium nitrate and aluminium, the higher nitro substitution products of benzine, toluene, phenol, crasol and napthalene, with or without the addition of carbon. Di- and tri-nitrotoluene have been found to be particularly suitable for the purpose. The addition of a small amount of carbon diminishes the hygroscopicity. An example of the explosive is as follows;—Ammonium nitrate 65 per cent., Carbon 2 per cent., Di-nitro-toluene 10 per cent., Aluminium 23 per cent. These ingredients are mingled exceedingly intimately. The aluminium is preferably employed in grain such as may be obtained with a sieve of 40 meshes to the square centimetre. The compression test, as employed in Austria for the determination of the disruptive power of explosives, has shown that the lead testing cylinder was crushed at least three millimetres more by the explosive mixture above set out than by picric acid. The proportion of ingredients may of course be varied, and another of the light metals may be used in place of aluminium. Accepted August 25, 1904.

REVOLVING FORESIGHT FOR SMALL-ARMS.

20,586 (1903). W. G Woolfrey, London. An adjustable fore-foresight is set out in this specification. A rotatable block carries extra sights, any one of which may be brought into view by merely turning the block. The sight may be elevated or depressed to accord with circumstances which slightly alter the shooting of the rifle; such, for instance, as individual peculiarity in sighting, a change in weight or temperature of the powder, or a change in the weight of the bullet. The bed in which the sight is mounted acts as a sight protector.

In the drawings here reproduced Fig. 1 represents a top view, Fig. 2 a longitudinal section, and Fig 3 an underside plan view of the sight and its mounting. The block *a* is provided with dovetails *b* through which the sight is held in the rib of the arm. A slot *c* is cut in the block and extends from the bottom nearly to the top. It terminates in a narrower slot *d* through which one of the foresight-tips protrudes. Slightly rearward of the slot *d* a circular recess *e* is provided. In this hole a disc *f* works flush with the top surface of the sight block. Mounted upon the pin *g*, running from side to side of the block, is the lever *h*, which carries the arms *i*. The ends of these arms are connected by the pin *j* (Fig 3), and the rotatable sight carrier *k* is adapted to turn about the middle of this pin. The sight carrier *k* is provided with the foresights *l*, of varying shapes, the fronts being tipped with ivory or other suitable material. The lever *h* is retained in the desired position by its nose *m*, which is pressed against the periphery *n* of the flange *o* by the spring *p*. The flange *o* is eccentric, so that when the disc *f* is turned by means of the slot *q* by any suitable medium, the lever *h* is rocked in its pivot *g*, and is caused to raise or lower the sights. The spring *p* also prevents accidental movement of the disc or of the sights. This construction provides against damage to the foresight, which if accidentally struck is depressed into the block, the spring

Fig. 1

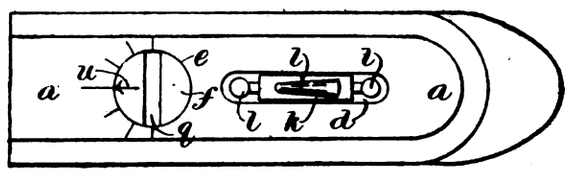


Fig. 2

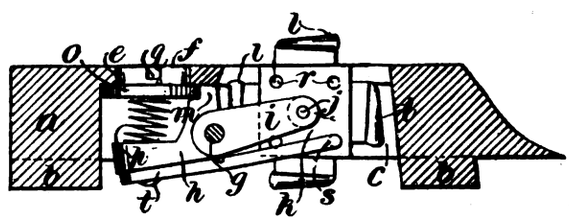
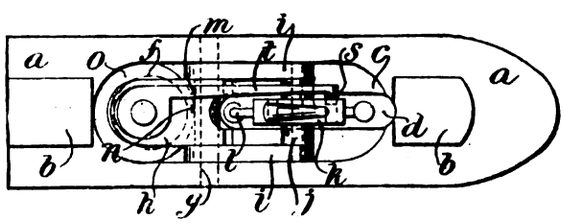


Fig. 3



p returning it to position when the cause of the accident is removed. In order further to secure the sight block in the various positions when the different sights are exposed, the carrier is provided with the holes *r*, which are engaged by a pin *s* on the end of the spring *t* attached to the underside of the lever *h*. The index and pointer *u* are provided to regulate the amount of elevation or depression. Accepted August 4, 1904.

Arms & Explosives

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CONTENTS.

CURRENT TOPICS.

Miniature Rifle Clubs.—Now that winter is approaching we must recognise that the season of indoor rifle shooting is upon us. The summer months provide an ideal opportunity for the practice of this popular pursuit in the open air, but the value of an indoor range consists in the fact that it may be used all the year round. At any rate the Miniature Bisley which sets the fashion in regard to rifle practice with miniature weapons takes place in the spring, and may, therefore, be regarded as the climax of the indoor rifle-shooting season. Whatever may be the opinion of gunmakers as to the precise lines upon which this sport is developing, one circumstance at least must never be ignored. It is that many thousands of our young citizens are by the agency of rifle clubs becoming familiar with the use of a weapon which in the ordinary way they would grow up to regard as dangerous and objectionable. Out of the many who take up rifle shooting under more favourable conditions than are open to the volunteer there must be at least a proportion who will pass by a natural process of development to the use of the shot gun. It is for this reason that gunmakers as a class, whatever may be their precise dependence upon a rifle business, should regard with a very kindly eye everything that transpires in connection with this movement. While it is objected that the National Rifle Association insists too much upon the use of the service weapon it must not be forgotten that there still exists a comparatively poor, but still vigorous, body which is known as the Society of Miniature Rifle Clubs. Notwithstanding its limited exchequer this society has done more to popularise true miniature rifle shooting than is commonly recognised. It is, therefore, necessary above all things that this body should be supplied with the funds which it urgently requires to enable it to put forward its best efforts in aid of a cause which interests us all from the financial point of view.

Rose Barrel Tubes.—We have received a copy of a circular which has been sent out by Rose Bros., Ld., of Birmingham inviting support from the trade in connection with the development of their business for the supply of home-made barrel tubes. Sentiment is of course a somewhat doubtful factor in commercial matters of any kind. Consequently this circular must be regarded from a strictly financial aspect. Even when we lay down this proviso we cannot but feel certain that buyers of barrel tubes will strain every effort to purchase home productions, provided there is a reasonable certainty of at least equal quality and promptitude of delivery, coupled with a price which is not excessive. All that Messrs. Rose ask is that firms who are in the habit of purchasing gun and rifle tubes should give an intimation as to the average extent of their annual consumption. Messrs. Rose imply that upon compliance with this request they will place themselves in a position to carry out to the satisfaction of the purchaser all orders that are entrusted to their care. Personally we think this method of solving the barrel tube question far more suited to practical conditions of business than the attempt to force forward developments by legislative interference. The latter could only cause an indefinite amount of immediate inconvenience with but uncertain advantages in the long run to the tube-makers. We may,

therefore, accept Messrs. Rose's circular as evidence that more practical methods are now being adopted for the furtherance of the policy of obtaining the gun component in question from the home manufacturer. B. S. A. barrels are already making a reputation for sterling worth, and we sincerely trust that Messrs. Rose's productions will prove of similar merit when put to the test of open competition.

Aperture Rifle Sights.—A curious deadlock has recently arisen in Birmingham with reference to the N.R.A. regulations concerning the class of sights to be used in miniature rifle contests. The miniature range is as a rule more or less of an artificial character, and without particularising details, it may be laid down as a general experience that the illumination of the target is in most instances deficient as compared with that which obtains in the open-air ranges covering the usual military distances. Whether due to overhanging shadows, unsuitably coloured bullet-catching hoardings, or the peculiarities of artificial lighting, the fact remains that a miniature range usually presents exceptional difficulties in regard to the definition of one's sights. This difficulty is so readily overcome by the adoption of the Lyman aperture sight or its equivalent in other makes, that shooters have eagerly clamoured for the recognition of the orthoptic principle by the National Rifle Association. Against allowing this privilege, it is argued that the aperture sight has no military usefulness for ordinary distances of shooting, and, therefore, that it should be discouraged in rifle clubs which are carried on under official patronage of one kind and another. Personally, we favour the view that if the use of Lyman sights can be avoided so much the better, since the change from miniature to military distances would not then necessitate a course of enlightenment covering the use of a different system of sighting.

The Cause of Disagreement.—It is quite easy to see why the member of the miniature club is so anxious to take the short cut to perfect shooting which is rendered possible by the adoption of the Lyman sight. Whatever the difficulties of illumination that may exist, these disappear in a great measure in the presence of this simple device. So long as the illumination of miniature ranges is defective in one way or another, the use of open sights necessitates an amount of strain on the eye far greater than is experienced when shooting in the open air. While, therefore, we have every sympathy with those who seek to alter the policy of the ruling authority on rifle shooting we would still prefer to see all shooting done with the open sight. Perfect scoring is not everything in rifle shooting, and if the national purpose of rifle shooting is to receive first consideration it would be better that the course of instruction pursued in our clubs should be based on a class of sight analagous to that which is found on military weapons. The orthoptic spectacle is of great assistance to the shooter who finds a difficulty in focussing his eye on a near object; and the fact that its use is permitted should be an answer to those who wish for the admittedly more effective Lyman backsight. Shooting with Lyman sights is of course better than no shooting at all. But the general adoption of open sights for rifle club work, carries with it advantages to the cause of national rifle shooting, which in our opinion justify the position taken up by the N.R.A. We are against them in what we consider their undue favouring of the service rifle for shooting at distances to which its sights cannot be adjusted, but we are heartily with them in their endeavour to popularise the open sight as distinguished from the pin-hole aperture.

The New Service Rifle.—Amongst all the comments which have appeared concerning the service rifle we think that one of its most important characteristics as influencing the future has been somewhat lost to sight. While everybody knows perfectly well that the new rifle has been provided with a lateral adjustment of the backsight, virtually in consequence of the Palma match, the effect of this improvement on the use of weapons so fitted for miniature practice at short ranges will be of the greatest importance. It is well known that the front sight of our service rifle must be set to one side of the axis of the bore so as to correct the side flip of the barrel. When shooting at miniature ranges the false setting of the front sight shows its effect upon the target. Therefore the so-called wind-gauge provides a means of securing true alignment when using the Morris tube, or other form of reduced ammunition, In future we are likely to find that the early stages of rifle shooting instruction will be carried out on the system of using the bull not only as the intended receptical for the bullet fired but also as the point of alignment of the sights. At the present time the need for aiming off the bull at reduced ranges has caused a good deal of difficulty in the mind of the young marksman, and the greater facilities for adjustment which occur in a well-designed miniature rifle have given the latter a superiority over the service weapon which is not entirely explained by the relative deviation of the bullet from the average line of fire.

Our Lecture on Air Resistance.—We have several times lately been in the fortunate position of introducing to our young gunmaker readers some of the latest developments in scientific gunnery. The lecture in our current edition shows for the first time a practical method for determining the progressive lowering of velocity in a projectile travelling over a given range. Capt. Hardcastle has informed us that results obtained from the Smith chronograph are of sufficient accuracy for determining by direct examination the characteristic value for air retardation in respect to every shape of projectile. Bearing in mind that this factor has only been obtained for the service bullet by the indirect means of examining trajectory results at different ranges we must fee proud of the advance which has now been made. So concerned is the gunmaker in obtaining a perfect flight for the bullet of his express rifle that he cannot but be interested in a new kind of investigation which will afford a means of measuring the ranging power due to the bullet's shape as distinguished from its observed velocity. Our sincerest thanks are due to Capt. Hardcastle for having pointed out the valuable source of enquiry which has hitherto lain unheeded at our elbow so to speak. By his remarkably ingenious method of smoothing over instrumental readings the chief difficulty connected with the sound interpretation of such experiments has been satisfactorily overcome. Notwithstanding, therefore, the apparent complexity of the subject we advise our gunmaker readers, both old and young, to devote careful attention to the very simple statement of the process which is given in a lengthy contribution elsewhere.

OFFICIAL SECRETS.

A VERY curious aspect of the ideas that prevail in connection with our ordnance factories relates to the working of the Official Secrets Act. Manufacturers and contractors who come into contact with the ordnance officials often discuss matters of a scientific character which are of mutual interest. The manufacturer, if he is up-to-date, as they all must be to retain their position against competition, necessarily possesses a large amount of interesting scientific *data* which has been evolved by his laboratory experts. If he discusses the scientific aspects of a chemical, a physical or any other problem relating to the manufacture of ordnance, he finds in the Woolwich official a man who has devoted a considerable amount of time to the same class of investigation. Needless to say, the Woolwich official is very anxious to increase the range of his own information, and the manufacturer is quite willing to talk to him provided the principle of fair exchange is observed on both sides, This, however, cannot be the case under the present working of the Official Secrets Act. At odd moments the official mouth is closed by reason of the terrors of his confidential position. The most ordinary every-day fact is treated as a gem of great price, provided that knowledge of it has been gained in a Government laboratory. So severe is discipline upon this point that any officer who possesses intelligence out of the ordinary, and desires to check his own views in the light of the practical experience gained by others, is for ever in a state of trepidation as to whether his conversation or his correspondence may inadvertently be quoted. However wary he may be, it is impossible to make sure that something which he tells as common knowledge will not be pounced upon by his official superiors as embodying a breach of official confidence.

It has often been alleged against the officers of the British army that they show far too little interest in the technical aspects of their profession. This cannot be a source of surprise amongst those who know that the moment an interesting item of intelligence becomes known the small group of officers immediately interested therein are the only ones who can share its benefits. While we must admit that the various text books and handbooks which are issued by the Government contain a large amount of interesting information, those who are in the know must realise that there is another side to the picture. No fact, except what can be regarded as common knowledge, is allowed to enter into these publications. So ridiculous is the distinction drawn between official secrets and general information that those who are entrusted with the writing of the chapters in these books must limit their descriptions to things which have been published in other directions. For instance, if the scientific head of a manufacturing firm reports the results of certain investigations in the form of a lecture before one of the scientific societies, the material in question may be used in a Government book, but if the same information is only available as a result of Government research, then its publication is barred, however valuable it may be to the general run of officer readers of the book. Such an attitude of concealment must necessarily introduce a large number of ridiculous situations. For instance, we may find that an experimental fact which is hoarded as a secret too precious to convey even to those holding His Majesty's commission, is thoroughly well understood by everyone who finds it necessary to familiarise himself with the subject. Moreover, a system of concealment has the worst possible effects on the development of ordnance materials. It is well known that the man who would conduct original research must first and foremost acquaint himself with the conclusions of earlier workers. Government material is locked up in the form of a number of confidential minutes to superior officers; and it is certain that these are pigeon-holed, and are of little or no further use. If on the other hand the material were more largely published independent criticism and checking experiments would follow, which would doubtless extend the first conclusions.

In discussing a delicate question of this kind it is of course necessary to enquire whether there is any genuine utility in endeavouring to prevent rival nations from stealing our ideas. If we look at the existing types of our military small arms, field guns and other equipment the most patriotic amongst us cannot be struck either by their originality of design or efficiency of working. On the other hand if we do introduce a new item that possesses substantial advantages evidence is not lacking that outsiders in a very short time know more about it than our own officers who are not immediately connected with the development. Private manufacturing firms again are very much hampered in their development of new ideas by the want of co-ordination between their own laboratories and those of Woolwich and elsewhere. The private firm knows thousands of things that Woolwich is endeavouring to ascertain, and in the same way it is possible that Woolwich has arrived at conclusions upon matters in which we are still groping in the dark. Were these two branches of our national constitution to be brought into closer touch there is little doubt that the Government would benefit far more than could be balanced by any possible loss of exclusive information such as might filter into the hands of hostile rivals. So ineffective is the system of the official wire fence that any firm who desires to keep in touch with what is being done at headquarters has only to offer a substantial position to a military officer to get him to throw up his post and take over private employment. It is notorious that the existing fettering restrictions of Government employment drive the most intelligent officers away from Woolwich, and their life is certainly more pleasant after the change has been accomplished. Whatever may be the pains and penalties of what the ruling chiefs consider injudicious chatter all restraint is necessarily removed when once an officer has entered into private employment. There is no Act of Parliament which refuses to the individual the power to make a living out of the accomplishments he has previously acquired. Hence the facts and experiences which are so carefully husbanded are open to any firm which is in the habit of paying large retainers to men of undoubted ability. Moreover an officer who has lived for years on good terms with his subordinates is always sure of a kind reception when he re-visits his old haunts. The feeling towards an officer who has accepted a private appointment is not inspired by the suspicions which are accorded to a deserter. Rather is such a man regarded as one who has taken a bold leap which the younger men hope to emulate with equal success at a later stage of their career. It is possible that in proving our case to our own satisfaction we are merely crying in the wilderness, but even so these words may reach a quarter where their reasonableness will be appreciated.

THE BALL BEARING GUN.

It is always open to an inventor to meet the distrustful criticisms of over-candid friends by pointing out that if their predecessors had allowed themselves to be similarly discouraged the world would be the poorer to-day. There is really no more ungracious task than to browbeat the unhappy inventor; but we must nevertheless insist upon our privilege of free comment in respect to inventions which are made the subject of press adulation before practical trials have established their worth. We might by some extraordinary chance be on unsound ground when condemning the principal of a gun in which spiral ball races take the place of ordinary rifling; but we are absolutely sound in our verdict when we condemn the fallicious reasoning which is put forward in favour of the new device. A journal, the name of which appears to be *Patents*, contains in its October number a notice of the new gun which we must consider as a caricature of scientific writing.

After describing the system of construction it is pointed out that the projectile travels upon a rolling bed which offers the least possible resistance to both its forward and rotatory motions. We might point out that this might be read to imply that the lateral grip of the balls would be so slight that the projectile would not rotate at all. Then again we hear that the projectile is made to fit closely to the balls, and its elasticity, combined with that of the walls of the grooves and of the balls, ensures that the gas does not pass by the bullet, which moreover can be conceived of as moving so easily and so rapidly that the gas has scarcely time to get ahead of it. It is of course an interesting development of gunnery to realise that steel is sufficiently elastic to obturate crevices in the bore, also that the gas which propels a projectile is incapable of overtaking it and getting past it through an open vent.

A more detailed reference to the methods of construction adopted, brings us to the claim of the inventor that recoil is done away with. Since this introduces an entirely new physical law we must be excused for feeling a little doubtful in the matter. We know that if a pellet of explosive were ignited between two suspended billiard balls they would be driven in opposite directions, notwithstanding the fact that their separation could be regarded as unaffected by friction. Existing scientific belief leads us to suppose that the gun is driven backwards by the force of the explosive acting upon the breech face, and that the sole effect of friction is to modify the confinement of the explosive. In apparent contradiction to previous remarks we are told that the tendency of the new kind of rifling is rather for the shot to drag the gun after it than to kick it away behind it. At any rate this is yet another anomaly which needs to be harmonised with the accepted science of gunnery. When we hear that the new gun gives 40 per cent. greater average velocity, penetration and range than can be obtained from a similar charge fired from an ordinary gun we are apt to wonder whether these three things vary in such a uniform proportion. Our complaint in this matter is not concerned with the attempted originality of the inventor so much as with the fact that he endeavours to uphold the principle of construction he advocates by absolutely unscientific arguments which are ridiculous from the point of view of every practical artillerist.

METRIC MEASURES.

The activity of the Decimal Association has called into existence an opposing organisation which calls itself the British Weights and Measures Association. In the course of a pamphlet which the latter body has issued various overwhelming objections to the adoption of the metric units are put forward with a brevity and forcefulness that ensure conviction. We have ourselves constantly urged the view that we are as a nation far too much committed to the use of the inch unit to give serious consideration to belated proposals for a revolutionary change. Nearly every gauge and appliance of the workshop and virtually every manufactured article is based in some way upon the British inch. Both in this country and in the United States our manufactures are governed by a unit of measurement which has a great deal to recommend it when compared with the metre, centimetre or millimetre. Not one of these three metric distances can claim to possess the all-round utility of the English inch. Consequently we strongly support the view of the British Weights and Measures Association in their opposition to the metric units.

On the other hand we cannot but think that they have been misled into adopting an unduly cautious attitude concerning the practical convencience that accompanies the decimalisation of the inch for all fractional parts thereof. The growing exactness of mechanical operations has forced every manufacturer and a large proportion of workmen to adopt the various grades of inch decimals. To anyone who is in the habit of dealing day by day with the problems of measurement and calculation that arise in practical manufacture the great advantage of the decimal fractions of the inch must be very apparent. In our own work with guns and cartridges we can honestly say that an extremely varied range of work is rapidly and accurately accomplished by dealing solely with decimal fractions of an inch to the entire exclusion of the inconvenient and unwieldy vulgar fractions that are necessary when this unit requires subdividing into small length values. If, therefore, the British Weights and Measures Association could see its way to advocate whole heartedly the decimalisation of the inch for all fractional values of that amount, we believe that they would obtain many converts to their cause. The mere use by our school children of clearly marked twelve-inch rules divided into tenths instead of eighths of inch would go a long way to familiarise the population at large with the most essential principles of decimal measurement. These they would use, or at any rate should use, in later life whatever may be the particular occupation they adopt. The subdivision of tenths into twentieths gives the student an appreciation of the length represented by ·05 of an inch. A further division, which is possible in the finest metal rules would represent the fortieth part of an inch, in other words ·025. The constant handling of these values when properly set down in decimal form would promote a more tangible advance in arithmetic knowledge than could be obtained by any other process of tuition we know of. The acceptance of the fortieth of an inch as the minutest measurement that can be obtained on an ordinary scale would naturally pave the way for appreciating the further sub-division of this distance into twenty-five equal parts, whereby the thousandth part of an inch is readily obtained.

NOTES ON SHOOTING.

MESSRS. CURTIS'S & HARVEY have sent us for notice a copy of the 8th edition of their *Notes on Shooting*. We append a few extracts which will doubtless serve to afford our readers a general notion as to the character of its contents. Copies may be obtained on application to the firm at 3, Gracechurch Street, E.C.

From the Preface.—When the previous editions of this work were issued our knowledge of shot gun ballistics was in a transition stage. Although a few pioneers, both here and abroad, were already advancing towards the elucidation of the laws which govern the action of smokeless powders, sportsmen generally, and the majority even of experts, were still under the sway of lingering traditions. As in all infant sciences, there was antagonism between the old school and the new. The former, claiming to be practical, dubbed their opponents theorists, the self-styled practical man firmly believing that his ideas were based on facts observed by himself. Nothing has so retarded the progress of many sciences as this delusion; for phenomena thus observed become unconsciously distorted and refracted by reaching the mind through a medium of preconceived theories and prejudices. The first stage in any science may be said to be that of the clean-slate. Speculative theories and erroneous inferences being once and for all put aside, a true foundation can be laid by careful experiment based on the ascertained properties of matter. It may fairly be claimed that this course has been followed in our recent researches in sporting gunnery.

Advantages of a 3-ton Pressure.—Having a limit of pressure before them, powder makers have exercised the whole of their skill to produce a nitro which will conform to this standard with a minimum of variation under practical conditions of storage and use. That is to say, the modern smokeless powder is standardised to give as nearly as possible the above pressure. In the presence of unfavourable conditions the natural strength of the powder is then still such as to save it from the risk of falling to a level of absolute impotence. If the mistake were made of aiming at too low a pressure, then there would always be the liability that the strength of the powder would fall to an insignificant value in the presence of any one of the possible faults in gun or cartridge which tend to lower the effectiveness of the shooting.

How to Recognise a Bad Pattern.—The difference between a good and a bad pattern is very difficult to define. True cylinder and half-choke guns as a rule give inferior patterns as judged by the test of regularity of count. The average pattern of a true cylinder gun has been stated at 110 pellets. This average is generally made up of a series of readings of a most diverse character. Bad patterns may, therefore, include those in which a considerable deviation from the arithmetical average is evident. Where the deviations are small, the patterns are, as a rule, good in other respects. That is to say the pellets are evenly distributed over the area covered, with but slight indications of a tendency to group in certain spaces to the detriment of others that are left blank by comparison. The amount of deviation from round to round is a very valuable index to the behaviour of a gun or cartridge. It hardly ever happens that clustering and other faults are accompanied by what is known as a regular count. Another sign of defective pattern is the presence on the plate of unduly large splashes, indicative of the adherence of two or more pellets in the form of a ball. Yet another common defect is the presence of an undue proportion of instances where the pellets strike the plate in pairs. It requires, however, a considerable experience in the "plating" of guns to enable a person to express a sound opinion as to the merits of the patterns thrown.

Measuring the Powder.—To insert the correct charge of powder in a single cartridge is an operation of elementary simplicity, but to be equally accurate when hundreds and thousands, and, for that matter, tens of thousands are in question, affords a great test of the satisfactory organisation of a loading department. The golden rule in such a matter is to test the charges thrown by the powder measuring machines at frequent intervals. It is impossible to guarantee that a single setting of the loading machine shall uniformly measure correct quantities of charge. Consequently, accuracy can only be attained by constant reference to the chemical balance, in order to see that the charges that are measured by bulk are also true in weight.

Amberite.—In "Amberite" we have a smokeless powder belonging to what is commonly regarded as the older group of nitros, viz., that in which the standard charge for a 12-bore sporting cartridge is 42 grains by weight. Since the introduction of the newer nitros, for which the standard charge is 33 grains, the two are distinguished as 42-grain and 33-grain powders respectively. Amberite possesses the virtues of the class to which it belongs. The greater weight of the explosive material which propels the charge of shot affords it the advantages that arise from the development of a large body of gas. The 42-grain powder is *par excellence* the nitro which is capable of imparting a high velocity to a full charge of shot. It is accordingly specially adapted for all classes of game shooting in which full charges require to be used by reason of the distance at which the game is shot. Its success as a powder for pigeon guns is similarly due to the fact that the inertia of a large charge of shot is adequately met by the evolution of a sufficiency of gas. More than this, the 42-grain powder stands pre-eminent as the nitro which adapts itself to all sorts and conditions of gun, its reserve of power being such that even in the presence of moderately unfavourable conditions it does its work with great efficiency. In fact, the 42-grain powder has in a great measure the universal adaptability of the older black powder.

Advice to the Reader.—We have been frank with the reader in informing him thus clearly of the scope and limitations of the various combinations of 12-bore nitro cartridge. He must not suppose that these limitations are laid down by way of providing an excuse for inferior results. They are the outcome of a comprehensive system of inquiry which has been conducted solely with the object of gaining a knowledge of the true state of affairs that exists under practical conditions. We must not expect impossibities either from the gunmaker or the powder manufacturer; but when it has been shown that powders will, in favourable circumstances, perform up to a certain standard, then it appears sound policy to indicate to what extent the collaboration of the gunmaker is necessary to see that the best results are obtained in the weapons supplied.

THE NEW SMALL ARMS HANDBOOK.

For years past we have been waiting for the new edition of the *Text Book on Small Arms*. Signs were not wanting that Capt. Wallace, now, we believe, Major Wallace, worked like a nigger on the book, but the order for its publication was delayed until a description of the new shortened Lee-Enfield could be incorporated into its contents. The new volume has departed from its old style somewhat. No longer is it enveloped in a blue paper cover, but it shines forth in the resplendent red binding which we associate with the *Text Book of Gunnery* and other allied publications. The matter is vastly improved. Not only has Major Wallace devoted himself to re-writing the old work from end to end, but he has secured valuable additional help. We like the principle of recognising individual authorship even in a Government publication.

Major Barlow appears to have given valuable general assistance. Major Nathan has written Chapter X., Part I., which deals with the properties and manufacture of Cordite. It is a pity he copied his remarks on rust from the *Handbook on Explosives*, because more recent researches have cast a doubt on his dictum. Major the Hon. T. F. Fremantle has written Chapters II. and VI. of Part I. The first is historical, the other deals with the influences which affect the shooting of rifles and the consequences of wear in respect to accuracy. In this connection it is interestiug to note that a rifle which had a figure of merit at 500 yards of ·68 of a foot after firing 1,000 rounds had only deteriorated to about ·90 of a foot when 10,000 rounds had been fired in it. Another table shows that the time occupied by the bullet in reaching a point 500 yards away necessitates aiming at 4·2 feet in front of a man crossing the line of fire at a walk, 8·4 feet at the double, 12·5 feet for a trotting horse, and 16·7 feet for a gallop. Similar allowances are given for all distances between 100 and 2,000 yards.

Capt. Tulloch, the late Secretary to the Ordnance Committee, now in private employment, is responsible for the greater part of Chapter III., Part II. It deals cursorily and incompletely with the very important subject of internal ballistics. It is such a terribly confidential and secret subject that the gallant Captain was apparently not allowed to communicate to the reader any information which he may have gained in his official capacity. The result is most unsatisfactory.

If Capt. Tullock ranks as internal ballistic expert to the *Text Book on Small Arms* we should like to ask him whether he is responsible for the values of pressure and velocity given in Table IV. of the appendix. As wrong values are systematically stated, we must presume that the correct figures are an official secret. Let us take the ·300 cal. U.S. rifle, the muzzle velocity of which is given as 1,923 feet per second. This is an observed velocity, and when corrected for muzzle, it becomes about 2,000 feet per second. Again, the pressure of the 7 mm. Spanish Mauser is given at 22·3 tons per square inch. The correct figure is, of course, from 17 to 18 tons. With the exception of the British rifle, none of the other results is to be relied upon. Capt. Phipps, R.A., writes on the calculation of trajectory and the use of ballistic tables in Chapter V., Part II. His work is sound and to the point. It is a pity that the treatment of this subject involves so much mathematics. Hence many who will thoroughly understand other parts of the book will break down here.

Taking the volume as a whole, it is probably no worse arranged than other Government publications of a like character. We can see no sufficient reason for dividing it into two parts. The effect is constant confusion between similarly numbered chapters at the beginning and end of the book. Again, we fail to see why the top of each right-hand page should carry only the number of the page. In all well-arranged text books the subject matter of the chapter is at least reproduced for the guidance of the reader. There is no contents table of illustrations at the beginning of the book, and as these are divided over Plates I. to LXXI., and Figs. 1 to 60, some of the tables being marked with both plate and figure numbers, there is, to say the least, an unnecessary amount of confusion. The tabular matter, which contains some of the most useful material in the book, is unfortunately not separately indexed. We have important tables appearing in the body of the text. For instance, on pages 249, 250, and 251 we have tables V., VI. and VII. respectively. On page 275 we have table IV., and on page 143 the real table IV. that runs serially with the above tables V., VI. and VII. Pages 278 to 304 contain valuable tables from A to K. In the appendix we have tables I. to V.

Whatever may be the difficulties of arrangement there can be no doubt that the careful student will find an extraordinary amount of useful information in the course of the 300 odd pages which the book contains. There is plentiful evidence that the author has thrown his net wide to gather in every available bit of relevant information. One is apt at times to regret that the reader is so frequently expected to handle mathematics. There is evidence in places that our own course of lectures to young gunmakers has been taken as a model, and here we find more general demonstration interpreting the broad results obtained from formulæ. Were we asked specially to select the most valuable chapter in the book we should be inclined to name Chapter II. of Part II. as worth all the rest of the work put together. It is a little difficult to locate it by turning over the leaves, but the contents table shows that it commences on page 211, and that it deals with the movements of the rifle on firing. The reader must study it for himself to appreciate its entire merits. For instance, we find on page 220 something which may throw a light on the superior accuracy of Palma cartridges. It is that the Lee-Enfield rifle vibrates during the time that the bullet is passing through the barrel, and that in the ideal combination of rifle and ammunition the bullet should leave the muzzle so that the barrel is in the middle of the upward vibration when firing a cartridge with normal velocity. When this is properly arranged a bullet with a higher individual velocity will leave the muzzle when it is pointing lower, and a similar compensatian will take place for bullets with deficient velocity. This shows us why extra velocity will often produce a lower trajectory at the shorter range. It also indicates the existence of a favourable value of velocity for each rifle such as will produce an automatic compensation for the ordinary variations that are met with in any batch of cartridges. After reading what is stated on this interesting subject and comparing it with our own experiences at the range, we find a scientific explanation for many things that have puzzled us in the past. This aspect of barrel movement is thus established upon a trustworthy basis.

ROUND THE TRADE.

The Directors of the Morris Tube Company have declared a six months interim dividend at the rate of 10 per cent. per annum.

The firm of Rose Bros., whose circular concerning barrel tubes is referred to in another column of this issue, carry on business at Halesowen, near Birmingham.

The financial papers have given us the usual notification of the issue by Messrs. Kynoch of £300,000 worth of debentures which will bear interest at the rate of 4 per cent.

We are very pleased to hear that the trade in ammunition has received an extraordinary impetus during the past week or so. This may be explained by the fact that pheasant shooting has at last seriously commenced.

Our best wishes for a safe and successful journey go out to Mr. J. C. Irvine who sailed on the 27th ult. for the West Indies, the voyage being taken for the benefit of his health which has not been quite up to the mark for some time past.

We have been told, but have not confirmed the information, that gun departments will be opened by Messrs. Hope Bros. in connection with the following depots, viz.: Poultry, Ludgate Hill, Regent Street, Kensington, Leeds, Norwich, Manchester, Liverpool and Bristol.

We have received intimation to the effect that the firms of Webley, Greener and Holland have been awarded a Grand Prix for their exhibit of guns at St. Louis. The most prominent feature of the joint gun trade specimens of manufacture was the new *Field* pressure gun which occupied an important position in a central show case.

"So long as the action of guns and gunmakers was believed to be outside the ordinary laws of matter, progress was impossible." This unfortunate substitution of gunmakers for gunpowders appeared in an announcement of *Notes on Shooting*, in which the preface had been reproduced in order to give the reader an idea of the contents of the book.

The Directors of the National Explosives Co., Ld. announce that, in consequence of the disastrous explosion which took place at the factory in the early part of the year, involving the total stoppage of the works for a considerable period, they consider it inadvisable to declare an interim dividend upon any class of shares for the half year to June 30th.

The Home Office have lately found it necessary to make stringent regulations concerning the deposit of explosives among refuse matter which the municipal authority is in the habit of collecting. The obvious danger that attaches to any such proceeding necessarily justifies the issue of a warning, and the announcement that a penalty will follow from disobedience.

We have been favoured by the Schultze Gunpowder Company with a handsomely produced catalogue showing prices for leading brands of loaded shot-gun cartridges. Altogether there is good reason for believing that the care taken by the makers of the oldest nitro in putting it into cartridges will be appreciated by those gunmakers who find it inconvenient to carry out the whole of their loading.

We hear that the Webley proprietory gun will shortly make its appearance on the market. It will be sold to the trade for a certain price and it must not be retailed at less than a given profit. This secures an ample profit for the retailer, and if a preliminary examination of one of the weapons counts for anything at all it will be possible for the vendor to recommend his patrons to use a hammerless ejector gun costing the above amount.

Messrs. Westley Richards & Co., Ld. have recently put upon the market an important departure in bullets for ball and shot-guns. These are of two kinds, but a similar principle runs through them both, viz., an external form and dimensions proportional to those of an ordinary bullet, and an internal cavity which keeps the weight down to the limit which must be observed in reference to the class of weapon under consideration.

Messrs. Green of Cheltenham are advertising their three-barrel single-trigger gun, though of course in this connection it is open to anyone to point out that the Browning automatic gun satisfies the conditions of a multi-barrel weapon operated by a single-trigger. With the latter we have ourselves fired four cartridges during the flight of a single clay bird, the fifth remaining unused on account of the kill registered with the fourth shot. If partridges were able to take this lesson to heart they would cease to congregate in coveys.

Messrs. L. Le Personne & Co., of 99 Cannon Street, have informed us that they have just been appointed agents for the sale of the Browning automatic shot gun, a description of which appeared in our issue of March last. The weapon on which our notice was based was probably the first that entered this country, and we understand that since that time an important improvement has been introduced by way of a cut-off for the magazine which enables shooting to be carried on with great rapidity by single loading, the magazine supply being thereby held in reserve.

Speaking at the annual meeting of the Birmingham Small Arms Company, the chairman referred to the improvement which they had effected in the methods of boring and setting gun-barrels. These had given such admirable results that they ahd thought it wise to begin manufacturing barrels for sporting guns. Mr. W. L. Powell, in speaking on the same subject, pointed out that the barrel making industry in Birmingham had been a dying one for years owing to the fact that local makers could not compete with Belgium in price. He thought the new departure would restore Birmingham's prestige in that direction, and from a national point of view, he regarded it as a matter of great importance.

For those who desire to retain a copy Messrs. Curtis's and Harvey's *Notes on Shooting* as a book of permanent reference, a limited edition bound in cloth is in course of preparation. Another edition with gilt and leather binding has been reserved for presentation purposes to the friends of the firm. A particular reason why this book is likely to prove of value for reference purposes is due to the fact that the appendix contains a large number of tables concerning sporting cartridge components which are required for daily reference by almost every gunmaker who is called upon to answer the numerous questions which his customers are in the habit of firing upon him without notice.

An important miniature rifle cartridge which does not appear to be as well known in this country as it ought, is the special ·22 smokeless rim-fire, which carries a 45-grain lead bullet propelled by a charge of smokeless powder slightly exceeding three grains. It is of the same external construction as the ·25 Stevens. That is to say it has a parallel bullet as distinguished from the heeled type of bullet which is used in the ordinary ·22 cartridge. The ammunition is known as the ·22 Winchester, model 1890, and its special advantages are an accuracy at 50 yards exceeding that of the ·22 long rifle ammunition, and a noiselessness as compared with the ·25 Stevens which makes it an exceptionally useful rabbit rifle cartridge. The ammunition is also made by the U.M.C. Company.

The Francotte arms factory has recently turned out a most perfectly manufactured Martini rifle which offers every promise of a successful career when its merits become widely known. By the simplest of movements, the breech mechanism can be detached, a quarter-turn of the barrel then enabling the operator to remove the same for cleaning, the system of fastening adopted being that of an interrupted screw. Apart from general good workmanship we believe that this rifle possesses the sterling merit of an exceptionally smooth, sharp and regular trigger-pull, whereby the disturbance of aim at the moment of firing is very greatly reduced. The rifle is chambered for various cartridges, including the ·22 short and the ·310 Greener. Concerning the sights we should like to point out that, while the system of wind-gauge adjustment is most perfect, the firm would do well to consder whether it would not be possible to re-arrange the form of adjustment for elevation, so as to provide a degree of delicacy of positive movement proportional to that which governs the lateral position of the bullets.

CORRESPONDENCE.

AMERICAN PRACTICE CARTRIDGES.

To the Editor of *Arms and Explosives*.

Sir,—In your issue of September, 1904, appears an article under Current Topics on our jacketless bullet for the Krag. As there is no remarkable scientific discovery connected with it, it remains for me to own up as being one of the "unpractical amateurs" whose dream it is. As, however, it is a successful dream, I thought perhaps you might like to know a little more about it, for you are in error in several particulars. In the first place, it is not exactly what can be called a lead bullet, for it is composed of an alloy of 10 deg. tin, 10 deg. antimony, and 80 deg. of lead. This makes an alloy hard enough to follow the rifling at any speed up to 1700 F.S. the troubles I and the various other experimenters have had in producing such a load being more in the fusing of the base of the bullet than in stripping, as recovered bullet showed.

The most satisfactory load we have so far produced with this moulded (178 grain) bullet is a charge of the new Marksman powder sufficient to give about 1500 F.S. velocity. Cartridges so prepared are extremely accurate up to 300 yards, and even up to 600 yards if there is no wind—to which of course they are very sensitive owing to the small energy of the charge. At 200 yards, shooting from a machine rest, we have no difficulty in getting groups of ten shots in a 3 inch circle, which is as good as the best service cartridges for our rifle will do—and they have got to be exceptionally good ones to do that. From these facts it is evident that your "engineer correspondent" bases his criticisms upon insufficient or erroneous *data*.

Of course the object in developing this is the saving of expense, which it does most successfully and satisfactorily. It fills somewhat the same sphere as your Morris Tube, perhaps a little more extended sphere. The first place where it is used extensively is on the indoor ranges provided in all of our armouries, where our volunteers practise during evenings in the Winter months. These ranges are generally from 70 to 100 yards in length. Here we obtain the cheapest practice of all, for the shells stand reloading indefinitely, and the bullet metal is recovered from the trough under the deflecting plate back of the target and used over and over again. As the labor incident to reloading is furnished by the regular staff of armoury employees, practically the only expenditure is for powder and new primers. The actual cost of this reloading is $3.25 per thousand.

Another place where the reduced ammunition results in a great saving is in the outdoor shooting over the 200 and 300 yard ranges, where the volunteers qualify as marksmen. Here, however, as the bullets cannot be recovered and moulded over again, the expense is increased to about $5.00 or $5.50 per thousand. They have not come into general use for ranges above 300 yards owing to their sensitiveness to wind. Where I believe they will prove useful in the future is in the event of a riot. Being on hand for the armory range, there would always be a supply available for riot use, and they would appear to be of about as near the right power for this purpose as anything that could be successfully used in a .30 cal. rifle.

There is no douht that it is even easier to produce reduced loads with jacketed or partly jacketed bullets, as I believe has been done in England. But the prime object of these experiments was to produce a cartridge with a bullet that could be moulded either by riflemen themselves or by the armoury employees, and we have succeeded better than we expected.

Our service weapons are sufficiently near alike to convince me that similar cartridges could easily be designed for your rifle; and if there were any feasible way of getting them to you I would take pleasure in preparing and sending them to you for trial. While the Marksman is the best for our purpose because it will give higher velocity before troubles arise from fusing, we obtained good results from several other powders if content with a lower velocity. Your Schultz, if it is anything like the American Schultz, ought to work well in 15-grain charges, and we also obtained good results from some English made Shot-gun Rifleite, in 11-grain charges. The shotgun smokeless powders are best adapted for the work, because their quick burning properties offset the abnormally large air space.

From the above you will see that we are not offended by your somewhat sarcastic comments upon our work, believing them to be based upon misinformation. On the contrary, we are pleased to think that we have something to offer you in return for favours done us. For in 1901, when our ammunition was probably about as bad as could be found anywhere in the world, your Canadian and Irish teams beat us badly, and did not hesitate to point out where the trouble lay, even though we had by that time caught on to the melanfact; and in 1902, when we had improved our ammunition but had allowed ourselves to become negligent in the study of weather conditions you walloped us in a fishtail wind in such a manner that there was no necessity of pointing out where the deficiency lay. Perhaps it may sound queer to hear of anyone being grateful for a licking but there are times when it requires just that properly to direct attention to a weakness.

W. G. Hudson.
(Capt. & Asst. Surg., 9th Regt. N. Y.)

New York,
Oct. 10, 1904.

[Had it been clear to us at first that the new ammunition was of the "reduced type", that is of a kind to be used for gallery shooting we should certainly not have ridiculed the idea of a great gain in cheapness. Our own Gaudet cartridge with a charge of smokeless powder and a nickel base bullet may be used in competitions where the price of ammunition is limited to 4s. per 100. From another correspondent we have received samples of actual bullets of the Hudson pattern which have been recovered after firing. They have in every instance taken the rifling perfectly. Ed.]

The liquidator's statement connected with the affairs of the Safety Explosives Ltd. discloses an item of £710 odd shillings and odd pence, being commission recovered from directors. As no names are mentioned certain of those not implicated in the transaction have denied connection with it in the financial papers.

Col. J. D. Hopton, as Chief Inspector of Small Arms, has caused a warning to be issued to all who are armed with the service rifle against the injurious practice of using the double pull-through without first detaching the bolt. We may assume that the trouble which arises is due to the rubbing of the cord against the top of the chamber on account of the indirect pull on the cord so caused.

LECTURES TO YOUNG GUNMAKERS.

XXXI.—PROJECTILES AND AIR RESISTANCE.

THE daily work of the gunmaker includes at least one question, the understanding of which involves mathematics of a more or less abstruse kind. It is admittedly possible to evade some of the difficulties that arise through inability to grasp all that is represented in the sighting of a rifle and the examination of its trajectory. To obtain a true knowledge of the behaviour of a rifle it is necessary, among other things, to know the effect of air resistance on the bullet, or at any rate the retardation due to this resistance. The text books which devote attention to the problems involved in the theoretical examination of a bullet's flight appear so abstruse in their phraseology and calculations as to discourage the reader who is conscious of a deficiency in mathematical knowledge. The retardation which is ererted on a projectile by the air is shown in these text books as proportional to $\frac{d^2}{w} \times c$ where d is its diameter in inches, w the weight in decimals of a pound, and c, which is termed the co-efficient of reduction, a further important item in the calculation. It expresses in arithmetical form the resistance effects of the air in relation to the form of the bullet. This factor is influenced by shape, the character of the bullet's surface, its steadiness in flight, and finally by the density of the air through which it passes. The reciprocal of the above value, viz., $\frac{w}{d^2} \times \frac{1}{c}$ is known as the ballistic co-efficient of a bullet. The value of the ballistic co-efficient is absolutely essential for estimating trajectory, remaining velocity, angle of fire, and all other details; and as the weight and diameter are easily ascertainable the value of c remains the sole factor upon which any doubt can exist.

Having obtained the necessary value for c the use of the usual formulæ for converting mean into striking velocity and so forth becomes a question of simple arithmetic. In estimating trajectory and other details of a bullet's flight, recourse must of necessity be had to Bashforth's tables; but here again the student of trajectory may take everything for granted and trust solely to his powers of following out simple instructions as to the handling of the figures that lie in front of him. The well-known Bashforth tables state values which are correct for a projectile having a co-efficient of reduction equal to unity. That is to say the figure 1 is inserted for the value c in the above expression. In actual point of fact the variety of bullets which are used in small-arms are influenced during the passage through the air according to their general formation and shape. The value of the co-efficient of reduction varies from about ·7 for a military small bore bullet to 2 for a flat-headed projectile. When such a wide range of difference is known to exist amongst bullets in actual use, it must be self-evident that without some guidance in respect to the influence of a bullet's shape, calculations of trajectory in which a wrong value of c is used are likely to prove erroneous when put to a practical test.

There are two ways of getting at the co-efficient of reduction for a given bullet. An indirect but very valuable method is to shoot at various ranges, noting the angle of elevation. From this can be derived a value for c, which will agree with the angles shown in the usual tables. The second method is a direct one, and consists in observing the time occupied by the bullet in passing through a series of harp-like screens of electric wires which are placed in its path. The interruptions of current are registered at each screen, and from the time records so obtained on a chronograph of the Smith type the decrease in velocity due to the retardation of the air can be obtained. This second method is associated with so much mathematics, and its efficiency depends so largely upon perfect manipulation of the instrument that until recently the solution of the problem on the lines indicated was restricted to institutions possessing great wealth and a staff with mathematical skill. However, we have in the Smith chronograph an instrument which has shown itself capable of giving the necessary results with a surprising amount of accuracy, the various measuring processes connected with its use being of a kind that do not exercise too great a strain upon an ordinary laboratory staff. The publication by the *Field* of the drop in velocity of a shot charge at various points in its flight has proved that the Smith chronograph is capable of giving a correct answer to problems of this kind. The results lately obtained by our contemporary must not be confounded with earlier efforts to secure the same information with a chronograph taking only one record at a time. The method which was previously pursued for want of a better was to take the time of one cartridge, say from the muzzle to 20 yards, and of another from the muzzle to 25 yards, the difference between the readings being the time occupied by the shot in passing from the 20 to the 25 yards distances. This form of measurement can only be likened to taking the distance from London to Woolwich by the difference between the number of miles from Birmingham to London by one route and Birmingham to Woolwich by another route. The *Field* took with one shot five actual time records showing the time of passage over four successive and adjoining distances of five yards, and this is the first time that such a test has ever been applied to a charge of shot. Later work with the same instrument has shown that it is fully capable of providing a value for the co-efficient of reduction. In this way we have within our reach the means of obtaining information of a kind which has never before been readily available. Within a distance of 200 feet from the muzzle, bullets of an experimental nature can be examined as regards their efficiency in getting through the air with a minimum of friction in just the same way that a yacht designer finds it necessary to ascertain beforehand the influence of a given outline of hull on the passage of the craft through the water.

The actual details of the test are academical, and need not, therefore, be explained for the benefit of those who are probably unlikely ever to be in a position to repeat the experiments. On the other hand a general description of the methods of examining the results obtained will go a long way to serve as an introduction to the task of showing our young gunmaker readers how they may work out tables of trajectory for any combination of rifle and cartridge in which they may be specially interested. Bashforth's method of investigating the ballistic characteristics of a projectile is explained in the *Text Book of Gunnery* (1902 edition). On page 180 an equation is set down which may be reproduced in the following simplified form:—

$$\kappa = \frac{d^2}{w} \times \frac{1}{c} \times \frac{x}{s^2} \times 1{,}000{,}000{,}000$$

Where κ is a factor for air resistance the value for which, in relation to various velocities is given in Table I., page 303, of *Text Book of Gunnery*, in reference to a bullet having a co-efficient of reduction equal to unity, w over d^2 is the sectional density of the bullet which has already been explained, c is the co-efficient of reduction, s is the space between the measuring screens. The value for x, the unknown quantity is obtained by firing a projectile through a succession of screens placed equal distances apart. As the bullet gets further from the muzzle it occupies an increasing amount of time in passing from one screen to another. The time occupied in traversing the successive distances is set down, and as these times become greater and greater as the bullet gets further from the muzzle the difference between the adjoining values shows the rate of diminishing velocity. This value is known as the second difference, that is the difference between the differences, and it should represent as nearly as possible the same identical amount. The second difference is therefore the value that must be substituted for x in the formula, and it relates to the constant amount of extra time required for covering the succeeding measured differences; s^2 on the other hand is expressed in figures by taking the square of the distance between the screens in feet. From this it will be clear that although the formula presents a somewhat alarming appearance, the various letters used are merely signs indicating the space into which values to be supplied by experiments or measurements must be placed. If the calculation were worked out on the basis of the values so far explained it would represent a string of decimals of inconvenient length for subsequent treatment. The multiplication by ten thousand millions is merely a convenient method of bringing the decimal point to within a reasonable distance of the figures that are of real importance.

To continue our demonstration we must take it for granted that we can obtain by experiment a correct value for x. The arithmetic which then becomes possible gives us a value of κ which may be compared in Table I. with the value given in relation to the velocity of the bullet over the distance observed in the experiment. If the figures so compared are not the same, we may feel sure that it is because the co-efficient of reduction of the bullet tested is not equal to unity. The value of κ, which is found by experiment, thus enables us to estimate the true co-efficient of reduction which must be used in connection with Bashforth's tables to arrive at the trajectory, remaining velocity or any other set of particulars may be required for the bullet under investigation. The accuracy of the resulting table of trajectory or striking velocity depends on the correct determination of the second time difference, that is the value x. An example of an actual experiment made will serve to clear away any difficulty that may still exist in the mind of the reader. Five screens were placed in the path of a 480-grain ·450-bore bullet. They were 40 feet apart, and the following record was obtained from the third shot which was fired:—

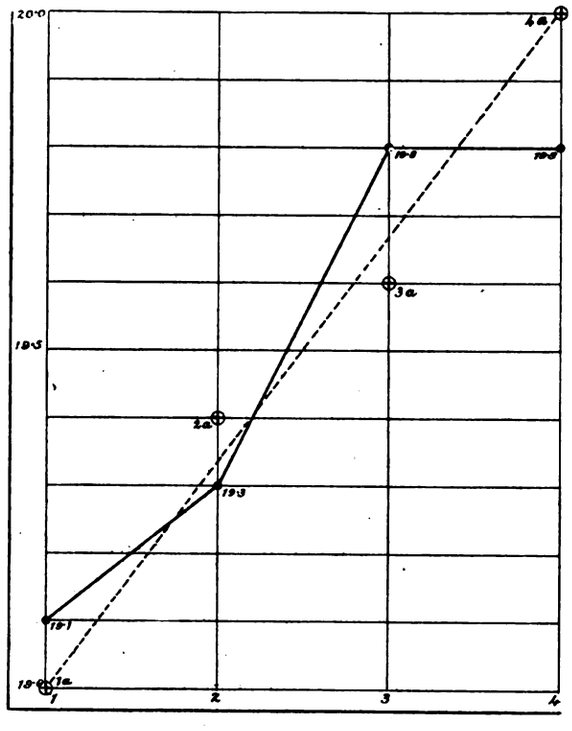
Experimental Values.

Screens	1	2	3	4	5
Tuning Fork Vibrations	0	19·1	38·4	58·2	78·0
First time difference		19·1	19·3	19·8	19·8
Second time difference (viz. x)		·2	·5	·0	

It will be seen that the time is given in tuning fork vibrations, which means that the tuning fork beat 19·1 times during the interval occupied by the bullet in passing from the first to the second screen. As the tuning fork makes one thousand of these movements in a second, the 19·1 represents ·0191 of a second in actual time. We prefer, however, to specify the values in actual beats of the tuning fork, as the precise form in which the figures are given, is for the moment of no account. The times given in the first line of figures represent the number of beats of the tuning fork between the departure of the bullet from the muzzle and its arrival at the particular screens specified. The first time difference shows the interval that elapsed in passing from one screen to another, and the second time difference gives an exact measure of the progressive additions for delay. Now we know that the actual loss of velocity by the bullet if faithfully recorded, would show a constant second difference instead of the figures ·2, ·5 and ·0, which were obtained from the instrument used. In these figures, ·2, ·5 and ·0 lies the secret we wish to unravel, and although it would be easy to add them together and strike an arithmetical average, experience tells us that this may be so far from the real result as to give us a misleading value for the action of air resistance on the bullet. The results here presented to the reader are probably as consistent as any of those upon which Bashforth based his famous tables. Although Bashforth is still alive, his active participation in matters of this kind has ceased, and it is now left to the present generation to endeavour to elucidate the meaning that lies behind the above seeming inconsistencies. Fortunately mathematical knowledge enables us to reason from the above values, and to show the manner in which the underlying truth may be sought.

In using the Smith chronograph we must not forget that each of the intermediate screens serves a double purpose. That is to say the second, third and fourth screens show the conclusion of one interval of measurement and the beginning of the next. Looking at the second time differences in the accompanying record of experiments, we cannot get away from the fact that the projectile could not possibly have passed between the first two screens in 19·1 interval of time, between the second and third, third and fourth, and fourth and fifth screens in 19·3, 19·8 and 19·8 time intervals respectively. To accept such a result would be to assume that while there was a moderate slowing of velocity between the second and third screens as compared with the first pair, a considerable loss of velocity between the third and fourth screens, and no further loss whatsoever between the fourth and fifth. We know two things from the assumed law of cubic resistance of the air. The first is that for all practical purposes the resistance of the air is proportional to the cube of the velocity of a body passing through it, and the second is that when this condition exists, the diminution of velocity is represented by a uniform addition to the time occupied in passing over successive equal distances. Knowing, therefore, that the second time differences should be uniform in the presence of perfect time measurements, we must find a convenient method for equalising the differences in such a way as to bring out our hidden truth. The arithmetical treatment that must be adopted must of necessity take into consideration the fact that any time record which is obviously at fault must affect the reading obtained for the spaces on either side of the screen which has produced a faulty record. It is to Capt. J. H. Hardcastle that all credit is due for the brilliant method of adjustment shortly to be described.

The incorrect breaking of wires, a lag in the action of the magnet or an error in visually reading the sinuous curve representing tuning fork vibrations may easily produce erroneous readings when tested by the method of taking second differences. By making a certain number of trial corrections we can restate the figures obtained from the experiment so as to show a constant time difference. To do this arithmetically involves a considerable amount of tedious work, but the Hardcastle graphical method entirely obviates this objection. We have shown it in the accompanying diagram. The problem set us is to modify the series of first time differences with the smallest possible departure from the original values, while producing equal second time differences. In the accompanying diagram we have accordingly represented a



sheet of squared paper. The vertical side shows a scale covering from 19 to 20 tuning fork vibrations. From the horizontal base line four equidistant lines are carried. These are used to denote the four distances for which time values were obtained by means of the five screens. We have set out on this diagram a series of spots representing the location of the first time differences as obtained from the table. These have been connected together, and the zigzag result will be apparent to the reader. This curve we know should represent a straight line, and it rests with us to find out the true position that it should occupy. In making the necessary corrections it is better to insert pins at the needful intersecting points than to work from pencil dots. The pins may be rapidly shifted to any desired position, and if black headed ones are used for the original experimental values, and coloured ones for the trial corrections the eye gives rapid information as to the progress of the work.

Looking only at the values represented by the zigzag line we may well assume for a start that the fourth screen was measured ·2 of a vibration long. This would make the interval of time over the fourth section of the range ·2 of a vibration longer and the third ·2 of a vibration shorter. In other words we should insert fresh pins at the positions marked 3a and 4a respectively. Were the curve redrawn using these two new points it would much more nearly resemble a straight line. However, as that result has not yet been attained we may continue the process of correction by assuming that the second screen was delayed by ·1 of a vibration. We must accordingly insert fresh pins at 1a and 2a. The new values now lie nearly in a straight line; and a straight line may in fact be secured if we move 3a up by exactly the amount we move 2a down. The straight line, shown in the diagram as the result of these three corrections, indicates the underlying truth which we have been attempting to unravel. We may now re-construct the tabulated records of our experiments by using the following new values:—

CORRECTED EXPERIMENTAL VALUES.

Screens	1	2	3	4	5
Tuning fork vibrations	0	19·00	38·33	58·00	78·00
First time differences		19·00	19·33	19·67	20·00
Second time differences			·33	·34	·33

A comparison of the two tables will serve to show the exceedingly minute periods of time which are actually involved in determining a question of this kind. We have obtained practically uniform second differences by altering the original readings by an amount which in only one instance represents as much as ·0018 of a second. The record thus smoothed, gives for x a value equal ·00033 of a second, and bearing in mind that $\frac{w}{d^2} = ·338$, K is obtained by the following simple piece of arithmetic. It will be seen that we have substituted the values obtained by measurement and test for the factors previously denoted by letters and signs:—

$$K = \frac{·338 \times ·00033}{40 \times 40} \times 1{,}000{,}000{,}000 = 69·7$$

By ignoring the co-efficient we have assumed it for the moment to be unity. Taking for our velocity that which applies to the middle screen, viz., 2,051 feet per second (80 feet in ·039 of a second), Bashforth's tabulated value for this velocity is 68·1. This experiment, therefore, gives the co-efficient of reduction for the ·450 bullet used as 1·02, which is obtained by dividing our own value 69·7 by Bashforth's 68·1. In other words our value obtained by experiment is 1·02 times larger than Bashforth's standard value for unity. Therefore the co-efficient of reduction is 1·02 instead of the unity amount to which Bashforth's table applies.

It is hardly necessary for us to point out that the making of an experiment of this kind represents an important advance in gunnery. Bashforth, by the delicate manipulation of his somewhat rough instrument, which is still on exhibition at the Woolwich Museum, carried us so much beyond the common run of information that it is exceedingly praiseworthy on the part of ordinary individuals, at last to have attained to something approaching the level he reached some years ago. We can now examine the behaviour of modern projectiles in relation to his tables without depending solely on trajectory observations. The *Field* experiments with shot have demonstrated a wonderfully close agreement with the table applying to spherical projectiles, and this agreement is all the more remarkable, considering that the *Field* experiments cover

ground that Bashforth is supposed not to have traversed by definite experiment. That part of his work was nothing more or less than a guess based on other information he possessed, a brilliant guess we must admit, but a guess for all that.

We need scarcely point out that more than one value of x can be obtained from each record. A certain amount of personal judgment enters into the selection of those values that need correction, also the extent of the corrections to be applied. Smoothing of curves, therefore, requires great experience; and a number of rounds must be examined in a similar manner to note the general trend of the resulting so-called curves. When a number of these curves are independently obtained from as many records the varying values of the co-efficient may be added together and an average obtained. Granted a degree of accuracy comparable with that shown in the round we have selected for illustration, the final figure should be exceedingly near to the truth. Experience again will enable us to determine what amount of variation in the second differences may be regarded as passing the limits that are capable of correction by the smoothing process. If the differences display too great a variation then there can be no consistency as between the diverse curves produced from different experiments. The following series of results show a set of experiments which were made with a special bullet. The screens were placed 40 feet apart, and three charges of powder were used in order to examine the influence of air resistance in the presence of different amounts of velocity. The records in question were carefully smoothed by Capt. Hardcastle who has had an exceptional amount of experience in these matters, and 2·00 was found to be the co-efficient of reduction. The readings display an unusual measure of consistency, the average error in the time records being only the twenty-thousandth of a second which is ·00005 in decimals:—

TIME OF BREAKING SCREENS IN SECONDS.

ROUND.		SCREENS.				
		1	2	3	4	5
1st Charge	1	·0000	·0447	·0898	·1361	·1836
	2	"	·0438	·0895	·1365	·1845
	3	"	·0444	·0904	·1378	·1864
	4	"	·0436	·0883	·1347	·1820
2nd Charge	5	"	·0422	·0859	·1308	·1767
	6	"	·0410	·0835	·1274	·1722
	7	"	·0415	·0846	·1290	·1746
3rd Charge	8	"	·0396	·0807	·1230	·1668
	9	"	·0394	·0802	·1226	·1668

NOTE.—The mean muzzle velocity of the first charge is 931 feet per second, and mean difference between the rounds 4 feet per second.

The mean muzzle velocity of the second charge is 988 feet per second, and mean difference 10 feet per second.

The mean muzzle velocity of the third charge is 1052 feet per second, and mean difference 2 feet per second.

Those of our young gunmaker readers who desire to familiarise their minds with the smoothing process, which has been explained at length in this lecture, may take the values above set forth and work out from them the necessary table of differences and finally the co-efficient of reduction which is obtained from a truly smoothed curve.

TRADE MARKS.

ADVERTISED. OCTOBER 5—26, 1904. 266,007. The word AXITE to apply to explosive substance. Kynoch, Ld. September 3, 1904.

REGISTERED. SEPTEMBER 22—OCTOBER 19, 1904. 264,550 and 264,551. Cogswell & Harrison, Ltd.

APPLICATIONS FOR PATENTS.

SEPTEMBER 26th—OCTOBER 22nd, 1904.

20,654. Moving Targets. J. Gorst.
20,692. Gun Report Silencer. A. Thompson.
20,734. Submarine Mines. E. A. Jeffreys.
20,779. Projectile Fuses. H. C. Leddon.
20,781 * Ordnance Sights. C. D. Abel (Agent for *Rheinische Metallwarren und Mf.).*
20,802. Telescopic Sighting. J. E. Bousfield (Agent for *A. Salmoiraghi*).
20,825. Wind Gauge for Rifles. A. W. Harrison.
20,891. Small-Arms. C. R. S. J. Hallé.
20,921. Targets. A. W. Turner.
21,148. Quick Firing Ammunition. E. J. Rogers.
21,149. Air Gun Targets. H. F. Harvey
21,204 * Gunpowder. La Soc de la Poudre Peigne et des Brevets Jacques Luciani. (Date of application in France, February 17, 1904).
21,230. Wind Gauge Sights for Rifles G. B. H. Austin.
21,453.* Ammunition Hoist P. M. Justice (Agent for *The Bethlehem Steel Co.).*
21,456.* Torpedo Adjuster and Exploder. J. V. Burris and F. W. Kerr.
21,487.* Small-Arm Sights. F. Labiaiux.
21,508. Torpedoes. J. Barn.
21,797. Wind Gauge Rifle Sights G. B. H. Austin.
21,967. Projectile Fuses. W. Bean.
22,316. Aiming Drill Apparatus. E. Somervell.
22,337. Sights for Firearms. H. L. Bock.
22,390. Explosives. J. F. Bennett and E. J. Castigloine.
22,619. Ranges. J. Suttie and W. A. Craig.
22,811.* Sighting Mechanism. P. de Nordenfelt and E Ternström. (Date of application in France, October 28, 1903).

*These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

SEPTEMBER 29th—OCTOBER 20th. 1904.

COMPILED BY HENRY TARRANT.

17,759 (1903). **Automatic Small-Arms.** General E. H. Clive and J. A. Timmis, London. A machine to which one or more rifles may be fitted, and may be operated and fired continuously, while the feed supply of cartridges lasts. In Patent No. 4,643, 1896, a machine was dealt with capable of automatically firing straight-pull rifles; and in patent No 15,051 a machine for working rifles with an axial bolt action was described. The faults in these machines are obviated, and the present apparatus is a modification of both. Accepted September 17, 1904.

19,957 (1903). **Formation of Projectiles.** Dr. H. Burrows, London A projectile is shaped with its rear end hemispherical, conical, or of any such conformation. At the end of the body, before the tapering commences the bullet is slightly undercut so as to provide a ledge to receive an annular wad. The retardation due to vacuum formation in the rear of projectiles is by this means obviated, and greater penetration is claimed for this shape of projectile Other advantages are also set out. Accepted September 15, 1904.

20,194 (1903). **Gun Mountings.** W. Beardmore & Co., Ld., and A. Bremberg, Glasgow. In this very bulky specification a gun mounting is set out, in which the elevating, sighting and range-adjusting gear is so modified as to allow of an expeditious running up of the sight to the required range, and to allow of the laying gun and sight upon the object together.

The sight gear may be locked to the carriage, so that the gun may also be trained without disturbing the sight line. Accepted September 15, 1904.

20,336 (1903). **Ordnance Projectiles.** J. S. Forbes, Glasgow. A copper driving band ordinarily used at the base of heavy projectiles is replaced by a number of balls arranged in the walls of the projectile and adapted to engage the rifling. The walls of the cavity in which each ball works is also provided with a series of balls, so that a ball-bearing is formed. Cells are formed at the base of the projectile in which water is contained. The water is ejected when the explosion occurs, and is intended to prevent erosion of the bore. Accepted September 22, 1904.

20,761 (1903). **Cartridge Belts.** A. H. Corbet and G. G. Blackwell, London. Hitherto the soldier has been handed single cartridges to be loaded into leather belts. The patentees describe a cheap wire woven cartridge belt, which may be given out to the soldier, having already been fully loaded at the cartridge factory. The belt has to be of cheap make, because a large number would be required and a good many would be lost. Accepted September 15, 1904.

21,887 (1903). **Binocular Telemeter.** C. Pulfrich and A. König, Germany. A telemeter for binocular observation, consisting of two double telescopes having different total stereoscopic powers, the difference in the stereoscopic images varying according to the distance of object, the range of which is to be discovered. Accepted September 22, 1904.

22,485 (1903). **Ammunition Wagons.** A. T. Dawson and G. T. Buckham, London. A wagon for "fixed" ammunition, in which the tubes receiving the ammunition are so arranged that the base or flanged end of the cartridge is inserted first. The object of this modification is to allow the fuse at the nose of the projectile to be set without first having to draw the cartridge from the tube. Accepted September 8, 1904.

22,950 (1903). **Shot Cartridge Case.** W. Lock, Senr., Windsor A sleeve or short tube is inserted in the shot chamber of a shot gun cartridge case. The tube is about three-quarters of an inch in length, and is designed to concentrate the power of the powder gases, and so to bring about greater destruction. Accepted September 15, 1004.

24,432* (1903). **Air-Gun Pellets.** F. Clarke, Birmingham.

24 511* (1903). **Ammonium Perchlorate Explosives.** Marie E. A. C. Yonck.

25,116 (1903). **Time Fuse for Projectiles.** The King's Norton Metal Co., Ld., and T. A. Bayliss, London, and H. M. Smith, Abbey Wood. In order to obtain increased safety in time fuses, the mechanism controlling the igniting pellets is positively locked by bolts which are held in position by the safety cap enveloping the fuse. When the cap is removed springs disengage the bolts, and so just preparatory to firing release the pellets. The complete release of the pellets is effected by the shock of discharge. Accepted September 8, 1904.

26,940 (1903). **Range Finder.** J. Thomas, Newcastle-on-Tyne. Two telescopes are arranged at right angles to a base. One is fixed and the other is pivoted. The movement of the pivoted telescope in being directed upon the distant object already viewed through the fixed telescope, is caused to indicate the range of the object on a graduated dial over which the telescope moves. Accepted September 8, 1904.

27,081 (1903). **Armour Piercing Projectile.** A. T. Dawson, London; J. L. S. Benthall, Sheffield. A projectile fitted with a plate-piercing cap. The cap may be readily fitted to the projectile nose either on land or sea since all that is necessary is to fill several shallow holes on the nose with solder to correspond with tinned patches on the inside of the cap. This method of fixing also obviates the weakening of the projectile which is involved when grooves have to be cut. Accepted September 29, 1904.

26 (1904). **Electric Blasting Fuse.** Curtis's & Harvey, Ld., London; and T. Malson, Stirchley. A small tube simply and cheaply constructed of paper, the middle portion of which is of smaller internal diameter than the two ends. The ends for about a quarter of an inch form recesses, one of which is used for the reception of wire holding material and the other for an explosive composition adapted to contact with the exposed ends of the wires lying in the narrow portion of the tube. Accepted September 29, 1904.

10,635 (1904). **Ammunition Wagons.** Fried. Krupp, Ag., Germany. The door of an ammunition wagon box is so constructed as that it may be made o act as a shield against lateral and frontal fire. The door is formed of steel—channel-shaped in cross section. The door is attached so that the web of the channel-shaped cross section normally covers the opening of the box, but when opened forms a frontal shield whilst the side flanges form side shields. Accepted September 22, 1904.

11,000* (1904). **Blasting Explosive.** E. Steele.

14,558 (1904). **Gun Bore Cleaning and Cooling.** Lieut. F. L. Sawyer, U.S.A. Apparatus by means of which compressed air is blown through the bore of a gun from an air flask. The air is admitted before the breech plug is out of the screw box, and is blown through a number of jets set tangentially to the axis of the bore. In addition to the air blast water in spray form may also be admitted. Accepted September 15, 1904.

15,441 (1904). **Automatic Discharge of Naval Ordnance.** Dr. H. von Péchy and V. Rea, Austria. Apparatus has hitherto been devised for electrically discharging a naval gun at the moment when the rolling of the ship allows the gun to take up its proper position. The present apparatus arranges that ignition shall take place slightly before the gun has reached its exact position so that the projectile shall just be leaving the bore as the gun is exactly right. The retardation due to combustion of charge and travel of the projectile along the bore is in this way obviated. Accepted September 15, 1904.

18,247 (1904). **Breech Mechanism of Ordnance.** P. M. Justice, London (Agent for *The Bethlehem Steel Co., U.S.A.*). Loading mechanism for breech loading ordnance constructed especially to support the projectile as it passes through the breech box and so protects the breech box screw threads from injury. A tray, provided with the loading apparatus, is pushed from the hoist into the breech. A bridge is so formed over which the projectile passes into the chamber. Accepted September 29, 1904.

23,038 (1904). **Short Base Range Finder.** H. D. Taylor, York. In order to reduce the complexity and delicacy of range finders of the short base type, the patentee constructs one consisting of two total reflecting right-angled prisms and one telescope. The two prisms are connected in such a fashion as to be mutually adjustable by the reflex collimating principle. Accepted September 29, 1904.

23,765 (1904). **Projectile Fuse.** W. T. Unge, Sweden. A percussion fuse for projectiles which is caused to ignite the bursting charge either upon impact with a solid body or on descent into water. In the latter case the water enters through a hole in the front end of the projectile into a closed chamber and moves a piston which brings the firing pin into contact with the detonator. The inertia of a percussion hammer is caused to bring about the same effect upon impact of the shell with a solid body. Accepted September 8, 1904.

* These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

A NEW EXPLOSIVE.

11,000 (1904). E. Steele, Germany. A method of producing "an absolutely safe explosive" forms the subject matter of this specification. The explosive is claimed to be indifferent to the action of moisture, to an ordinary blow, shock or friction, or to the variations of temperature. It is composed of a nitrated mixture of resin with starch cereal, starch meal or meal, and an oxygen carrier such as chlorate or permanganate of potassium.

A granulated explosive is produced in which a protective mass forms an integral constituent part of each grain so that the compound, without this protective element, would not be explosive at all. The protective mass is only oxidisable in a very slight degree and is consequently well suited for mechanical combination with an oxygen carrier such as chlorate or permanganate of potash, because the mass can only be intentionally exploded by detonation. This protective mass consists of a mixture of resin and either

cereal starch meal or starch or meal. The mixture is nitrated with nitric acid.

In the process of manufacture the resin is very finely powdered and is intimately mixed from 5 to 50 per cent. of finely powdered starch or meal. This mixture is immersed in nitric acid at about with 40 deg. Beaumé. The acid is absorbed by the mixture, and, when the chemical action begins the mixture is in a semi-liquid state, but becomes hard immediately afterwards. The moment it is hard it is taken out of the nitric acid and is immersed in water, the process of nitration taking less than a minute. The mixture is allowed to cool and is then pulverised and afterwards is washed in clear cold water. When again dried it is ready for use. Under no circumstances must sulphuric acid be used in nitration because if it were and the slightest traces remained after washing decomposition and spontaneous ignition of the mass would readily take place.

To combine the chlorate or permanganate of potash with the nitrated mixture the two compounds are intimately mixed and granulated in the known manner. The final mixture should contain 10 to 25 per cent. of the nitro compound, and from 90 to 75 per cent. of the oxygen carrier. Accepted September 15, 1904.

AMMONIUM PERCHLORATE EXPLOSIVE.

24,511 (1903). Marie E. A. C. Yonck, Belgium. Explosives of the ammonium perchlorate class possess drawbacks which have hitherto prevented their practical use. One disadvantage was embodied in the freeing of chlorine and hydrochloric acid during explosion; and another in the possession of great inflammability, and a sensitiveness to shock and friction. It has been proposed to obviate these disadvantages by adding vegetable oil to the ammonium perchlorate compounds, but this method, according to the patentee, does not appreciably diminish the danger inherent in the contact of glowing or ignited bodies.

The patentee describes a method of imparting safety to this type of explosive by adding alkali oxate or nitrate, ammonium nitrate or oxalate, or oxalate of earthy alkali. In the composition of the improved explosive the substances employed are, first, ammonium perchlorate; second, combustible bodies composed of the hydrocarbons of the fatty series and their derivatives, the aromatic hydrocarbons and their derivatives, and wood pulp or fecula; third, alkali nitrates; fourth, alkali oxalate; and fifth, ammonium picrate and pre-nitrocresylate of ammonium, chiefly in the presence of oxalates and in the substitution in whole or part for the hydrocarbons.

The amounts of the alkaline salts mentioned, salts of the earthy alkalis, and salts of ammonium most suitable in obtaining a safe explosive, are such that for each chlorine atom in the ammonium perchlorate, there shall be at least one corresponding atom of sodium, one atom of potassium, one molecule of ammonium, half an atom of calcium, and half an atom of barium or strontium. The amounts to be used for example for two molecules of ammonium perchlorate (235 parts by weight) are two molecules of sodium nitrate (170 parts by weight); or two molecules of potassium nitrate (202 parts by weight); or one molecule of sodium oxalate (134 parts by weight); or one molecule of ammonium oxalate (124 parts by weight). Explosives containing ammonium perchlorate to which these quantities of alkaline salts are added, yield neither free chlorine nor hydrochloric acid in exploding, the chlorine of ammonium perchlorate appearing after the explosion, according to the substance selected and employed, in the form of alkali chloride, ammonium chloride and chloride of the earthy alkalis.

In order to reduce the temperature of explosion so as to render the explosive described suitable for use in fiery mines, ammonium nitrate and hydrated salts may be added to the composition. The amount of combustible substance to be employed is such as will cause the carbon and the hydrogen to be completely converted into carbonic anhydride and water vapour.

Examples of varying types of this modified explosive are as follow:—(1) Ammonium perchlorate, 51·2 per cent.; sodium nitrate, 37·3 per cent.; and naphthalene, 11·5 per cent. (2) Ammonium perchlorate, 37·40 per cent.; sodium nitrate, 27·17 per cent.; ammonium nitrate, 8·34 per cent.; and trinitronaphthalene, 27·09 per cent. The foregoing contain alkali nitrates. The third composition contains alkali oxalates, and consists of ammonium perchlorate, 47·7 per cent.; sodium oxalate, 27·3 per cent.; ammonium picrate, 25·0 per cent. The fourth composition contains ammonium oxalate:—Ammonium perchlorate, 53·24 per cent.; ammonium oxalate, 32·30 per cent.; trinitronaphthalene, 14·46 per cent. The fifth compound contains oxalates of the earthy alkalis:—Ammonium perchlorate, 48·4 per cent.; calcium oxalate 33·8 per cent.; dinitrotoluol, 17·8 per cent. Accepted September 29, 1904.

PELLETS FOR AIR-GUNS.

24,432 (1903). Frank Clarke, Birmingham. A pellet or slug for use in air guns is described in this patent. The pellet is so designed that during its flight towards the target the air shall act through spiral ribs and induce it to rotate. Its flight is in this way caused to be straight and true.

Fig. 1

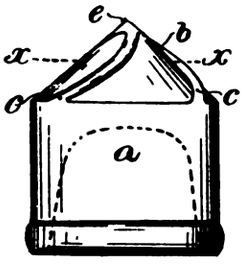


Fig. 4

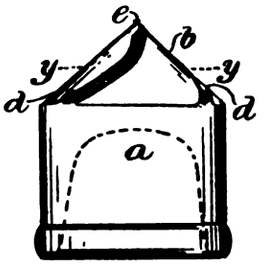


Fig. 2

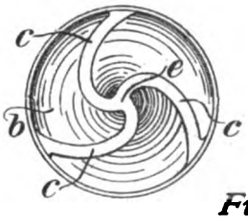


Fig. 5

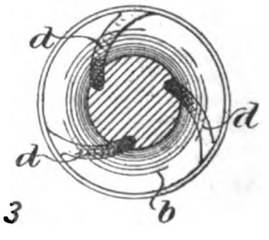
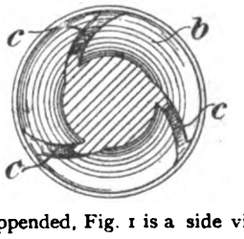


Fig. 3



In the drawings appended, Fig. 1 is a side view, and Fig. 2 is a plan of the new pellet. Fig. 3 represents a sectional plan on the line x-x (Fig. 1), and Fig. 4 illustrates a modified form of the pellet. Fig. 5 is a sectional plan on the line y-y, Fig. 4. The body *a* of the pellet is cylindrical, and its conical nose *b* is provided with the spiral ribs or vanes *c* (Figs. 1, 2 and 3), or the flutings *d* (Figs. 4 and 5). These spirals extend from the point *e* of the nose *b* to the base of the cone where it joins the body *a*. The pellets illustrated are each made with three spirals, and this number is found to work well in practice. They may, however, be increased or decreased Accepted September 15th, 1904.

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CONTENTS.

CURRENT TOPICS.

Instruction to Sportsmen.—A question that is frequently debated in trade circles relates to the amount of technical information which it is wise to place in the hands of sportsmen. The general view appears to be that no amount of information is too great, always provided it teaches him to appreciate good workmanship and pay liberally for it. Knowledge on the other hand that makes him critical of the goods supplied is regarded as an injury to those who make a livelihood by the sale of guns and ammunition. It would be a matter of some difficulty to an expert logician to lay down the boundary line that divides these two forms of instruction. The manufacturer naturally desires to introduce improvements only when he considers the time is ripe for their adoption. He objects to a forcing of the pace by the urgent solicitations of his customers. If the essentials of a perfect appliance are laid down by theory a little earlier than the manufacturer is ready to apply them in practice, he is inclined to regard the would-be reformer as a nuisance. Conversely, if a period of careful enquiry and research has shown the desirability of a certain improvement, and he has taken time by the forelock and incorporated it into items of current manufacture, no advocacy of the new order of things can be considered by him as in any way overdone. The manufacturer who would adopt a reasonable attitude in the face of so many opposing arguments should recognise that things would not be where they are to-day unless some kind of stimulus to effort in new directions had been applied in the past. The experimentalist ascertains the laws which govern practical results. A full appreciation of these laws may indicate the way for further improvement, and it is by a simultaneous appeal to the user, the seller, and the manufacturer that the ground is prepared for putting the new ideas into practice. It is, therefore, only those that are blind enough to wish to arrest progress who complain of the efforts which are constantly being made to render the sportsman an appreciative patron of the best practice that is available. Under an enlightened system of progress bad things have a short if merry existence, and good things make headway with a rapidity that soon brings compensation for the labour incidental to their production.

The Troubles of the Machine Minder.—For manufacturing purposes mechanics must be divided into two classes, viz.: those that are mechanics in the best sense of the word, and the others who have not had the industry and perseverance to acquire a comprehensive grasp of skilled workmanship. We are acquainted with the works organisation of one of the most capable manufacturers in the country, and his experience has been that an unskilled labourer may be drilled into the performance of a single task so as to produce immensely superior results to the journeyman tradesman who is supposed to have an all-round practical experience. In so far that this method of employing labour works for the joint benefit of the workman and the master it must be regarded as a highly beneficial economic development. Things go well for the workman so long as there is plenty to do in the particular process on which he is a refined specialist; but trouble begins when employment is slack and he must turn his hand to another pursuit. It is sheer ignorance to blame the workman because

he has not in the days of his youth passed through the period of small earnings which is incidental to the apprentice and improver stages. These men are necessary in successful manufacture. The brilliant mechanicians who have acquired facility in one or other of the several branches of industry must of necessity chafe at the confinement and monotony of spending their lives in doing a single thing. On the other hand there are many useful members of the community whose ambition it is to settle down into some routine employment that provides the necessaries of life, all unspoilt by the need for cultivating originality of intellect. These men whom we may, for want of a better term, describe as machine minders, are frequently subjected to the severest straits of poverty when thrown out of work. The deputations to members of Parliament of constituencies containing Government factories serve to show that when one employment ceases it is very difficult to find another. We have frequently urged that our patent law is mainly responsible for this trouble. By the provisions of the Patent Act we grant complete immunity from competition to all foreign manufacturers of patented articles. If we went back to the *rationale* of letters patent it would be found that we conferred the monopoly of exclusive rights for the purpose of encouraging manufacturing enterprise amongst our own countrymen. There was a fair exchange when everyone benefited from the increased employment due to the protection of the inventor. Now that our patent law protects the foreign inventor, without any sort of balancing advantage to this country, we find that many millions of articles which are in daily use are made abroad, and this at a time when a slight change in the patent law would bring the work back to this country, and find regular employment for the very class who are first to feel the pinch of poverty when the volume of trade diminishes. The foreign inventor should either sell his patents in this country, or manufacture within its boundaries. He imposes this restriction upon us, and while we do not complain of it we should like to see the adoption of a similar policy here for our own protection.

Our Lecture on Trajectory.—For a long time we have had in mind the idea of explaining in our series of lectures those aspects of trajectory calculation which most nearly concern the maker of sporting rifles. The user of these weapons necessarily acquires many practical notions which relate to the flight of his bullet, and he naturally desires to know all that is possible about any new type of weapon which he may be considering as a probable addition to his armoury. One must of course assume that the rifle maker is well supplied with target and other particulars which reach him in the ordinary course from the man at the shooting ground. The better understanding of trajectory tables may, however, suggest certain additional experiments which may serve to emphasise the advantages of a particular combination of rifle and cartridge. For instance, nothing so clearly indicates flatness of trajectory as the firing of a series of shots from a distance other than that for which the sights are adjusted. It is well known to those who can differentiate between target and sporting results that a close group over a measured distance may be accompanied by a roundness of trajectory that militates against the use of the weapon for sporting work. Assuming for instance that 30 yards in 100 is a quite frequent error of range estimation, the rifle which is truly sighted for 100 yards may be shot at 70 and 130 yards respectively in order to show the amount of error that arises from this difference between actual and estimated range. The mention of this experiment serves to show only one of the many items of interesting information which are available to the rifle maker who has made a systematic study of the behaviour of a rifle bullet in its passage down the range. Other questions of equal interest are developed at length in the lecture on trajectory which forms part of this issue.

Commercial Scare-mongers.—To those who have access to large libraries containing work on miscellaneous subjects, it will be apparent that the defenceless state of Great Britain is not by any means a novel subject to write upon. In just the same way that Oliver Goldsmith wrote passages that would serve for use in the present fiscal discussion, so other writers have in the past shown the dangers that confront our national existence. The fact that each writer speaks of the future means only that his arguments cannot be proved or discredited within a reasonable time. While a certain amount of self-criticism paves the way towards further effort in the direction of efficiency, we cannot entirely agree with the policy underlying an agitation which at present manifests little more than newspaper enterprise. The main idea seems to be that so long as we fail to adopt certain types of German artillery we are likely to be outclassed in any war that may come upon us. One cannot but feel a certain amount of suspicion that an agitation of this kind has more at the back of it than meets the eye. Were the newspapers to initiate a campaign to prove that the human race would degenerate unless certain proprietary remedies were freely used, the more intelligent members of the British public would fail to rise to the bait so alluringly cast. We are, however, more susceptible to nervousness, and more likely to adopt the proposed remedy, when our feelings of patriotism are worked upon. In order, however, to avoid losing all sense of proportion, we must not forget that the remedy for the trouble which is painted in such despairing colours is to buy something which the makers are no doubt very anxious to sell to us.

Repairs to Gun Barrels.—A curious illustration of the need for stringent regulations to govern the re-boring of gun barrels recently came to our notice. The gun in question had suffered some injury which necessitated a liberal boring out to produce a clean surface within. So much of the original fabric had actually been removed as to render the weapon exceedingly dangerous to the user. Nevertheless, the work which had been put into the gun was carried through without a thought of the responsibility that attaches to such a process. The making of a repair of this kind necessarily renders the weapon unproved within the meaning of the Act. An offence is not, however, committed except by the person who offers such a weapon for sale. Consequently it is very difficult under existing circumstances to bring the blame home to the person that is morally responsible. A man who has the skill to bore out a shot gun barrel must of necessity know that there is a limit to the amount of material that may be removed with safety to the subsequent user. If the man who bores the gun, or at any rate, he who orders the process to be carried out, were made responsible for seeing that the weapon received a fresh proof, a good deal of danger to the public would be removed.

PUBLIC INTEREST IN SHOOTING.

ONE of the most satisfactory signs of the times is the increasing amount of attention that is devoted to shooting in its several branches by the newspaper press which caters more especially for the general public. So long as we have a king who, as a private gentleman, is first and foremost a sportsman, we shall find that the pursuits that fascinate him are those which both the fashionable and unfashionable world desire to study and pursue. The finest hospitality which we seem able to offer to monarchs visiting these shores is the participation in a series of covert shoots. We again find that those who are honoured by the visits of royalty in their country domains must of necessity place shooting in the foreground of the amusements offered. Thus we find that the chronicles of the fashionable world at this season of the year are largely concerned with the outdoor sport of shooting. The popularity of this pastime is not likely to diminish so long as it remains a pursuit which can be shared by old and young alike, while satisfying an impulse which comes to us from the distant ages.

The growth of rifle clubs under the influential patronage of those who are best able to direct the patriotic instincts towards a useful end, has brought another branch of shooting into a prominence which is duly reflected in the pages of the newspaper press. A very few years ago, shooting men of a social position below that of the landed gentry were very infrequently met with, and they found among their private acquaintances very few to share their enthusiasm. Nowadays the popularity of the miniature weapon brings shooting of a sort very early into the life of the average school-boy. The attitude of fathers twenty years ago was generally a distrust of firearms and a feeling of anxiety the moment one was brought into the house. We may compare this state of affairs with that which now exists. With Christmas-time upon us there will be many parents whose first thought in the purchasing of presents will be a rifle for the boy. With it he will be encouraged to become a marksman, duly studying the precautions that are necessary to obviate all risks of danger. It will not be long before the fascination of the rifle becomes part and parcel of the boy's existence. This in due course of time will produce a longing for shooting in the country. Provided the means exist for gratifying this taste—and there are few who are denied the necessary opportunity—the boy before long becomes personally acquainted with the peculiar form of exhilaration and joy of shooting for which there is no parallel in any other sport. From the rifle to the shot gun is then a very obvious step.

We can accordingly see in the trend of modern opinion every reason for anticipating great developments in a form of sport which has too long been the perquisite of men of wealth and position. The game resources of the country are obviously inadequate, under present methods of working, for any considerable increase in the supply of game. It is, however, in the better organisation of second-class shooting that means may be found in the future for satisfying the aspirations of the new generation of shooters, who are so rapidly developing a keenness that will not be discouraged by obstacles. Under such circumstances there is good reason for hoping that the future of the gun trade will offer a bright prospect for those who will lay themselves out to satisfy the growing demand.

THE SMALL-ARMS HANDBOOK.

SINCE our review of the above-mentioned book was published, we have had the pleasure of a chat with Capt. Tulloch concerning the portions of it with which his name is connected. In reference to our query of last month as to whether he was responsible for the values of pressure and velocity given in Table IV. of the appendix, his reply was emphatically no, and that he had nothing whatever to do with their compilation. With reference to the chapter which we described as dealing cursorily and incompletely with the very important subject of internal ballistics, Capt. Tulloch somewhat disarmed criticism by saying that in this he most cordially agreed with our view. He would, however, have preferred the word "sketchy" as a description of his chapter rather than the more severe phrase which we employed. So far as we could understand, it was extremely unsatisfactory to him that his instructions were to deal only in a very general way with the subject, within a space rigorously limited to ten pages. This at least enables us to appreciate the difficulty of dealing with such a complex subject within such narrow limits. Moreover, the introduction of mathematical details was absolutely barred.

While Capt. Tulloch thoroughly endorsed the discretion which was vested in Major Wallace as author of the volume, he is none the less emphatically of opinion that, from his own point of view, it would have been better either to have left out the subject of internal ballistics altogether, or else to have published Part II., which deals principally with theoretical considerations, in a separate volume. This would have allowed for a detailed discussion of many of the scientific questions which are brought up in the course of its pages. Capt. Tulloch pointed out that our grumble at the amount of mathematics involved in Chapter V., Part II., was inconsistent with the demand for more information under the heading of internal ballistics. In fact, had he dealt with the subject in the light of the information he possesses by reason of the numerous researches he has carried out for the Government, it would have been necessary at almost every turn to point out the mathematical moral that underlies each area of investigation.

The more we learn of the action of Cordite in its more intimate phases, the more certain we feel that its course of action proceeds upon lines which can be evaluated with much the same kind of precision that is met with in the case of the steam engine. The relations are certainly more complex, but to the man who has studied them with a proper grasp of mathematical principles their general line of action is quite obvious. For this reason we feel most sincerely indebted to Capt. Tulloch's recommendation to all who wish to grasp the first principles of the behaviour of Cordite, that they could not do better than read Mr. Jones's contributions in our "Lectures to Young Gunmakers" on the subject. Although certain captious critics have endeavoured to minimise the value of Mr. Jones's research work in this direction, the fact remains that for small-arms cartridges he can tell within a fractional amount the exact result that will follow from firing any given combination of powder, bullet and cartridge case. Consequently, when we found in the course of conversation that Capt. Tulloch is in sympathy with the process of reasoning evolved in our lectures dealing with Cordite ballistics, we feel that endorsement has come from a well informed source.

THE SIZE OF CARTRIDGES AND CHAMBERS.

THERE can be no denying the fact that a certain amount of difficulty has been experienced during the current shooting season on account of what we may term a misunderstanding on the question of cartridge and chamber sizes. When the ruling authorities in this matter decided that the best way of securing harmony between cartridge and gun chamber was to define a minimum size of chamber which should be the rejecting size for the cartridge, it was thought that a happy solution of all possible difficulties had been attained. This sanguine hope has not, for several reasons, been fully realised, chiefly because the published sizes have not been interpreted with sufficient reference to practical conditions. Among gunmakers there has been a decided tendency to uphold the idea that the whole of their available skill should be directed towards keeping the size of chamber as near as possible to the minimum dimensions. This practice may, no doubt, be to a great extent attributed to the unwillingness on the part of either of the two Associations to commit themselves with regard to the manner in which the published sizes should be translated into practice. They refused, in fact, to state the amount of toleration that should exist in ordinary good quality manufacture. The absence of guidance of an authoritative character has opened the way for a diversity of practice bound in the end to lead to difficulty. Had counsel been taken from experienced mechanical engineers who have been in the habit of working to gauges on a more extensive scale than is adopted in the manufacture of guns, there is little doubt that a policy different from that which has been adopted would have been recommended.

Being in the position ourselves to act in an advisory capacity, we may lay down the line of conduct which seems to us to meet the present difficulty. Granting a minimum size, there must be a maximum size. This we are prepared to fix for chamber diameters at four thousandths of an inch above the published minimum sizes. We are then at once in possession of an average size lying midway between the extreme dimensions, thus allowing chambers to vary by two thousandths of an inch on either side of the average size. It will be seen at once that we interpret the published figures by suggesting an average size to be followed as closely as possible for current manufacture. We do not wish to suggest that any chamber which lies at either extreme is satisfactory. In fact we would rather say that good practical workmanship should result in finished chambers within one thousandth of an inch of the above average dimensions. The practice here recommended of recognising an average size two thousandths of an inch above the minimum size is infinitely preferable to aiming at an average size only fractionally larger than the minimum gauge. The slightest wear on a tool or a gauge is so liable to run individual weapons below the minimum size that the adoption of a safe margin has much to recommend it from the point of view of the practical manufacturer.

When we come to consider the relative efficiency of the alternative average sizes which have been put forward, we can at once name several arguments that favour the policy recommended. Modern powders are so severely tested as to give a certain level of ballistics in the presence even of moderately large chambers. Hence any chamber which errs on the small side will be likely to give a great enhancement of velocity such as will make it exceedingly difficult to regulate the gun to give correct patterns. When, on the other hand, a chamber is made with a nice margin of toleration, allowing for the proper opening of the case and the correct value of resistance to the expulsion of the wads, a normal velocity results, whereby the quality of pattern obtained will lie very close to what is standard for the boring of the barrel. In so far that few, if any, gunmakers are in the habit of testing their guns for velocity, any course of action which tends to produce standard results in this respect should merit hearty approval.

Speaking from a considerable experience in these matters, we are able to affirm that the velocity of a standard cartridge may vary within wide limits, according to the dimensions of the chamber. Consequently if the chamber is made to a size which guarantees a satisfactory velocity one of the chief difficulties in regulating the boring of a gun will disappear. To take a gun giving a velocity some 50 or more feet in excess of what an ordinary cartridge should produce, and to endeavour by alterations of the cone and the choke to produce a satisfactory grade of pattern is to correct one fault with another. On the other hand, if the gunmaker starts with the knowledge that his chamber is of a satisfactory size, he may, when he comes to fire the gun for the first time, expect patterns ranging very closely to those aimed at in the boring of the barrel. It is often affirmed that it is impossible to bore guns to a standard size and obtain the necessary pattern without recourse to the process known as regulation for shooting. Our own experience, which covers experiments with a good many barrels, goes to show that when a true size of chamber is assured in the first place, the amount of subsequent regulation necessary in the presence of a well-shaped cone and a truly bored barrel is very small. On the other hand, if the chamber is too small an unsuspected source of bad shooting arises, which necessitates a large amount of regulation to produce passable results. The usual remedy is to open out the rear of the barrel in the form of a lead passing from the cone to the cylindrical portion of the tube. This method of treatment tends to lower the ballistics in proportion to the amount they have been raised by the tightness of the chamber. There is, however, always the difficulty that an unduly prolonged cone and lead creates a tendency towards balling, and when this occurs the pattern results are both irregular and patchy.

Turning now to the cartridge, experience has shown that if the minimum gun chamber is the rejecting cartridge size this instruction shall be interpreted in a very broad sense. In fact, the allowable degree of tightness of fit of the cartridge must alone open the way to the personal element. The same cartridge case which passes freely into the gauge when well loaded may obstinately refuse to enter when swelled by damp and with tight wads. It, is, therefore, far safer for all loaded ammunition to be rejected on a gauge two thousandths of an inch smaller than the minimum size than to leave too much to chance by gauging with the published sizes. In this matter we can of course leave the cartridge maker to look after his own interests; but we feel that we have every justification for pointing out the line of conduct to be pursued by the two parties most interested in order to produce a satisfactory interpretation of the published sizes.

THE RIFLE CLUB SIGHT QUESTION.

JUDGING by the opinions expressed in the organs of club rifle shooting, acute disagreement appears to be prevalent. So soon as the rifle club movement was initiated, it became a thing apart from military organisation and the views of civilian riflemen began to assert themselves. According to the military point of view, the service rifle should be the standard weapon with which all practice should be made. In so far that the service rifle and ammunition made excellent shooting over the military distances, no great hardship, and in fact a great deal of good, results from the use of this weapon for all practice and competitive work. But when it comes to miniature distances of less than 50 yards, the service rifle with the Morris tube must be recognised as a cumbersome, inaccurate and expensive combination for the work. The civilian rifleman has his virtues and his vices. Being of a strictly utilitarian frame of mind, he prefers for shooting at a given distance the most accurate and economical combination of weapon and cartridge that is available. The miniature rifle has, therefore, come to stay, notwithstanding the Astor donation and other restricting influences.

Having found that a virtually theoretical perfection of shooting is obtainable with inexpensive miniature weapons and ammunition, the civilian rifleman next turns his attention to the question of sights. He finds that a great deal is lacking in open sights, especially as regards their power for rapid and certain adjustment to correct any given error of aim. The miniature shooter, moreover, finds that his sport is carried on in ranges which are as a rule defective in illumination. Ordinary combinations of open sight are in any case difficult to define for short-distance shooting where there is a lack of atmosphere between the firing point and the target. Deep shadows and a bad background have far more effect at a short distance than when they are viewed through several hundred yards of intervening haze. If the difficulties of sighting are considerable at a short distance, they are still more irksome when firing at night in an artificially lighted range.

It is not, therefore, surprising that the civilian rifleman should have called to his aid the advantages which arise from the use of orthoptic sights. The balance of disadvantage in respect to the range is more than made up by the use of an orthoptic backsight and a fine-bead front sight, a hollow bead being still better. Here at least the civilian rifleman finds that the finest skill he can exercise in the steady holding and delicate pulling of his trigger is faithfully reproduced by the results shown on the target. With such sights he need not be fussy as regards the particular method of illumination of target adopted. Consequently he is a strong advocate of the home-rule principle in regard to the sights and weapons that are permissible for club shooting. In other words, the civilian rifleman asks for the same liberty of action and the same kind of encouragement that is given to the match rifle shot at Bisley. The rifle club organs advocate his case with a sympathy which we can well understand.

At this stage of our argument we should like to say a few words in favour of the National Rifle Association. It is governed by a body of gentlemen who are sportsmen in every sense of the word; and, however unpopular some of their decisions may be, the fact remains that they invariably act in accordance with the principles which they believe to be right. Being above all things desirous of making the civilian rifleman an adept with the service rifle, they endeavour so to direct his practice as to lead him by easy stages to the volunteer class of competition which is conducted at Bisley. They may not for the moment sufficiently appreciate the parallel which their own Bisley meeting affords.

The civilian rifle shot uses match sights, the volunteer employs the service weapon. The scientific aspects of rifle shooting attain a much higher development with the match rifle than with the service weapon. The civilian miniature shooter thus desires to be on the miniature range what the gentleman, we might almost say the noblemen, shooters are at the Stickledown butts. Practically the whole of these members of the N.R.A. Council, who are shooters at all, are match rifle shots. They legislate for the volunteer using the service rifle, but they themselves prefer the more scientific kind of sport which is obtainable at the 1,000 yards distance. It is possible that as time goes on they will find themselves forced to admit that the civilian rifle shooting fraternity must be separated into two classes, each following its own ideals in the same way that obtains at Bisley. We should then have the miniature match rifle, on the one hand, and the ordinary miniature rifle, on the other; the former governed by the same kind of regulation that applies to the match rifle, the latter being a miniature weapon with open sights. Even then it would come about that the service rifle, shooting the Morris tube, would fail in competition against miniature rifles using the same kind of sights.

The only way of bringing the military type of rifle on to a level with the miniature would be the introduction of a practice model of service weapon. A revised form of the new shortened Lee-Enfield would perfectly serve the requisite purpose. It could be made with a special barrel bored and chambered for a miniature cartridge, and so much of the mechanism as relates to magazine fire could be dispensed with in favour of a simple bolt movement designed to operate in combination with a single-loading system of charging. With the delicacy of sight manipulation that the new rifle affords, there is no reason why such a weapon should not hold its own for practice use over the 25 yards range. It would still do good work at the longer distance of 50 yards; but here the full-size service weapon firing reduced ammunition of the Gaudet type would of necessity come out on top.

In reviewing the circumstances that surround the present differences of opinion, we arrive at the conclusion that if practical experience really shows that a proportion of the civilian riflemen in this country are determined to use match sights, there is no alternative but to admit their existence by placing them in a class by themselves. This leaves the users of open sights on miniature rifles in another class, and if the service rifle is to hold its own in the same class we must once and for all abandon the use of the Morris tube, and employ in its place specially bored barrels for practice use. In so far as that a modified weapon of this type could be manufactured for about half the price of the Morris tube and rifle combined, a good case seems to be made out for supplying to drill halls, rifle clubs and other similar centres of rifle practice special weapons at a reduced price, so showing an economy as compared with the present method of injuring an expensive service rifle by using it with the Morris tube.

THE TRADE IN AIR GUNS.

ONE of the most marvellous developments of recent years is the manner in which the ordinary spring air-gun has leapt into prominence. Ten years ago it was open to anyone having a modest mechanical knowledge to re-adjust the parts of an ordinary gem air-gun, and so produce a grade of shooting which surprised the best informed of rifle experts. The tiny lead slug could be projected several hundreds of yards and the degree of accuracy obtained at short distances was not less remarkable. The more one examined the design of the gem pattern, the more one admired its masterly ingenuity of construction. Had one-half the trouble been expended on its manufacture that is commonly given to the making of automatic pistols, a weapon could have been produced which would have given satisfaction to thousands. The gem air-gun is, however, a type of the very worst of Continental garret work. The parts are ill filed, and so rapidly lose adjustment The barrels are never straight, and they are not suitably strengthened so as to stand the constant bending action due to re-setting the propelling spring. Parts which should be made of mild steel are roughly cast in malleable iron, and the plungers are made by such old-fashioned means that the strength is destroyed by an internal screw-thread cut for the sole purpose of holding the piece while in the lathe. The inadequacy of the trigger spring leads to frequent releases of the propelling spring when the gun is in a partially closed condition. The result is invariably a serious injury to the cocking lever, and its attached parts, more than this the accidental release of the spring is a source of danger.

As a natural consequence these guns were always going wrong, and damaged parts could only be replaced by a skilled mechanic, because the weapons were not constructed on the interchangeable plan. Consequently, a part, which if made on the interchangeable system could be forwarded by post at a cost of one shilling, would require the services of a skilled mechanic for halt a day to ensure its proper fitting into the weapon. The propelling spring again necessarily works under conditions of exceptional strain. Consequently, it is at all times liable either to snap in half or to become weak by shortening, according to whether the error is on the hard or the soft side. To replace the spring of a gem air-gun is almost a trick of the trade; and the private user of an air-gun could not, therefore be expected to perform this necessary office for himself. We are thus prone to regard the gem air-gun as the parent of a most important family of guns, and yet one which has been discredited for faults of manufacture that in no way destroy the merits of its well-nigh perfect design. In fact if we were asked at the present time of writing to lay down the specification for a perfect type of air-gun we should be inclined to recommend the adoption of the main features of the gem design, coupled with certain obvious improvements that would enable the private user to replace any worn or broken parts.

As regards its manufacture it would be necessary to make it on the interchangeable plan throughout, so that the heavy wear and tear which is a necessary accompaniment of any spring propulsion weapon should involve as little inconvenience to the user as possible. The design of the parts should again be arranged so as to facilitate the dismounting of the weapon by the amateur user, thereby enabling him to replace without aid any part in need of renewal. A very important item in the manufacture of any air-gun should be the making of screw holes for fixing the Lyman backsight. It is well known that the springs of these weapons are incapable of retaining their force during a lengthy period. Hence the virtue of a sight which can be screw adjusted so as to give true shooting at any selected distance, no matter what may be the strength of the spring at the time. Apart, therefore, from the enhanced accuracy available with the aperture sight, the user has always at hand a means for correcting the constant change of trajectory to which these weapons are subject. The ordinary fixed sight as fitted to the gem air-gun had as a rule very little relation to the elevation of the weapon. The shooting with the fixed sight was generally some six inches above the mark aimed at for the distances appropriate to the weapon. Here again was a defect of manufacture which seriously militated against the commercial success of the gem air-gun.

When we turn to the differences of design that distinguished the old pattern of gem air-gun from the more modern types that are now current, we find one extraordinary departure at least, from the theoretically sound design of the older pattern of the gun. If we assume that the propulsion spring when under full tension exercises a given force on the plunger, the rate at which the latter will move forward when released varies in relation to its weight. If two guns of similar construction were fitted with plungers, one of which was twice the weight of the other, the heavy plunger would move forward with one-quarter the velocity of the light one. Therefore the old gem air-gun with its plunger weighing about 2½ oz. represents a vastly more efficient weapon than the modern one with the heavier plunger. Another fact to be borne in mind is that while the recoil due to the movement of the bullet is insignificant, that which arises from the movement of the plunger is of a much more serious kind. The disturbance of aim due to the firing of the much more powerful ·22 rim-fire rifle may be entirely ignored; but when we come to the air-gun we must recognise that a separate source of recoil of a substantial character is introduced. Taking the weight of a gem air-gun as approximately 5½ lbs., it is at once clear that the velocity of recoil will be the thirty-fifth part of that of the plunger. This, therefore, should provide an additional reason for keeping the piston of the air-gun as light as possible.

Turning now to the slugs which are made in such enormous quantities for the consumption af air-gun users, we have been surprised for years past to notice that the manufacturers are aiming at the solution of a problem which gunmakers abandoned many years ago in connection with smooth bore weapons when using ball cartridges. The idea of making a bullet carry spiral projections and cavities, under the false assumption that these will grip the air and impart a spin, is one of the favourite delusions of the unscientific inventor. The original gem bullet with the bulk of its weight forward, and a base so lightened as to act as a rudder was perfect as regards its general outline. The longitudinal ribs which enabled it to grip the barrel without encountering an excessive amount of resistance were also exceedingly good, though these might be dispensed with in favour of a bullet, small forward and with a slightly enlarged diameter at the base. Such an improvement would produce greater perfection of gas tightness, and would at any rate be infinitely preferable to the spiral bullets whose main recommendation seems to be that they appeal to the imagination of the user.

ROUND THE TRADE.

In our mention of the awards at the St. Louis Exhibition we omitted to include the name of Mr. Charles Lancaster amongst those receiving a gold medal.

We have been asked to notify the change of address of the New Explosives Co., Ld. They have just moved from 75, Queen Victoria Street to 62, London Wall, the telephone number for which is P.O. Central 10728.

It is reported that Greece is on the point of adopting a new rifle in place of the present ·315 in. calibre weapon. It appears that the alternative types under consideration are 1903 model of 6·5 mm. Mannlicher, the Krag-Jorgensen and the Mauser.

We regret that a few weeks ago Mr. F. C. Borer was the victim of an unfortunate cab accident, which occurred in the City at middle day. Though the tendons of the knee were somewhat severely injured, we are happy to be able to inform our readers that he is progressing satisfactorily towards recovery.

At the recent meeting of the De Beers Consolidated Mines Company, which was held in Kimberley on the 18th ult., Sir Lewis Mitchell, the chairman, explained that the price of dynamite had been reduced by 50 per cent., and its quality, as tested by the Government authorities, had proved better than that of dynamite from other factories.

We have received from our American contemporary *Mines and Minerals* a classified directory of manufacturers and dealers who concern themselves with mining and milling machinery, supplies, instruments, tools, &c. We pointed out on a previous occasion that the list of explosive manufacturers seemed far from complete, and this view we still retain.

According to a recent number of the *Times* financial supplement, the gun trade in Berlin is very active in the military branch, and the Krupp works at Essen have so many orders on hand that the men are working in double gangs, in the heavy gun department. In the other departments of the works in which the men work in single gangs overtime with a gang and a half three times a week is universal. Some 2,000 additional men have been taken on at Krupp's since April, so that now about 27,000 hands are employed.

Colt's Patent Firearms Company have recently introduced to the notice of the trade a most interesting form of ·380 calibre revolver on the officer's model. It has been specially regulated and adjusted so as to fire with equal satisfaction to the shooter the full-size cartridge and reduced gallery ammunition containing spherical ball. One of the most interesting aspects of its design is the fact that the front sight may be screw adjusted so as to suit whatever ammunition may be used. The backsight is similarly adjustable in a lateral direction to correct any side deviation that may chance to occur. The pistol weighs 2 lbs., has a 6-inch barrel, and the cylinder movement is of the well known and well tried side-swing type.

According to a paragraph in the *Times*, the blank-firing attachment invented by Mr. Ramsay, one of Messrs. Vickers, Sons, & Maxim's experts, has now been adopted by the War Office for the Service generally, and it is stated that tenders have been invited for the construction of the same. The objects of this attachment are two-fold:—(1) It enables a rifle calibre automatic machine gun to be fired at a very rapid rate at manœuvres or field days, using the service type of blank cartridge without risk of injury to the barrel or mechanism; and (2) it enables the gun to be put through all its functions in slow time in exactly the same manner as the said functions are performed when the gun is firing automatically. This can be done by passing through a series of dummy cartridges, loaded in a belt, thereby affording a ready means of instruction. With regard to (1) this attachment enables the gun to be fired for short periods at the rate of about 200 rounds per minute, whereas, using the service blank cartridge and loading by hand after each round, it is practically impossible to get a rate of even 60 rounds per minute.

The report of the Birmingham and Provincial Gunmakers' Association to be presented to the eighth annual meeting to be held at the Proof House Hall, Birmingham, on Monday, the 12th instant, states that the association is in a satisfactory and thriving condition, and the balance in hand is £359; but an increased membership is desirable, and it is hoped that members will use their influence to induce others to join the association. The sub-committee appointed to consider the standardization of shot-gun chambers, in conjunction with the London Gunmakers' Association, made a special effort to arrive at a solution of the various difficulties with which the question was surrounded, which should not only be satisfactory to the leading gunmakers of the country, but meet the approval of the cartridge manufacturers also. The various sizes were finally adopted, and unanimously approved by the executives of the two associations, and accepted by Messrs. Eley, Kynoch, and Joyce. They have been printed and circulated by the associations among their members, who, it is hoped, have found them of practical value, as, in addition to the chamber sizes, the decimal sizes of the various bores, and the mean diameter of suitable wadding are given. Since the last report the Technical Instruction School has been removed to premises situated in Whittall Street, which have been fitted up to accommodate at least sixty pupils, At the present time there are forty-one pupils attending the various classes, for practical instruction in barrel filing, action filing, stocking, and screwing and finishing. Arrangements are not complete for the theoretical and scientific instruction classes, but the Technical Instruction Committee hope to start them early in the New Year. The Pistols Act has been found to cause a serious check to the legitimate trade in revolvers and pistols, and the executive proposes to make some representation on the subject to the Home Office and to endeavour to get it repealed or amended. The new Proof Rules have come into operation in the course of this year, and special circulars have from time to time been issued by the Proof Master, drawing attention to certain features which it is hoped will receive the careful attention of members of the trade. The executive regret that the proposed rules relating to the marking of foreign arms had to be abandoned.

Mr. A. Mallock, F.R.S., whose technical acquirements are sufficiently expressed by his position as civilian member of the ordnance committee, has recently interested himself in ballistic pendulum, as set up at the last Bisley Meeting, and reported upon in our last August issue. It appears to be the view of Mr. Mallock that this instrument provides a convenient means for interpreting the striking velocity of small arm projectiles at different ranges. Although he has shown a number of interesting curves before certain learned societies, he does not appear to have taken the audience into his confidence by telling them what were the actual readings upon which these curves were based. It is all very well to publish a curve, but if there is nothing to show how much smoothing has taken place before the experimental records were brought to such a state of consistency, it is impossible to say what is the value of this form of test, as compared with the results obtained from an instrument like the Smith chronograph. In our last issue we gave full particulars of a series of experiments which were conducted for the purpose of arriving at the influence of air resistance on a given type of bullet. To make the necessary observations it was needful to obtain a result to the nearest hundred-thousandth part of a second. We were successful in showing that fairly consistent values could be obtained by correcting the original readings by an amount not exceeding ·002 of a second. Now, what we should like to know from Mr. Mallock is what relation the differences in his experimental results bear to the final answer, as shown on his curve. It is a matter of great importance to the trade to know whether the ballistic pendulum really represents a practical alternative to the chronograph. The simplicity with which the readings are obtained, the absence of electrical complications, and so forth, combine to make this instrument one that might give valuable information when properly handled and understood. We cannot, however, accept, even from a Fellow of the Royal Society, a series of curves, when Bashforth's tables show the direction they should follow, unless we are placed in possession of some means for determining the actual reliability of the instrument that has been used.

FRENCH CARTRIDGE AND CHAMBER SIZES.

Now that our present practice in cartridge and chamber sizes is fairly well established it will be interesting to consider how far they are in agreement with the dimensions which are adopted in France. It must be important, at any rate, to some gunmakers and cartridge manufacturers to be familiar with the dimensions that are recognised on the other side of the Channel. The figures for French sizes which are usually recognised relate to the average cartridge. A working toleration of ten millimetres is allowed. This represents ·0039 of an inch which may be regarded as four-thousandths. According to our way of thinking this is a large toleration to allow, since the actual variation from the average size may be plus or minus this amount. At any rate the plus value would give the maximum cartridge. In this country we standardise cartridge sizes on the basis of the minimum gun chamber, which may, for all practical purposes, be taken as ·003 of an inch in the tube, and ·002 of an inch in other dimensions, larger than the maximum cartridge case. Among the French figures available those of Journée and Société Française des Munitions may be specially mentioned. If their figures are corrected by the addition of the above value of toleration a comparison can be made between the latest English sizes and the corresponding French values. The accompanying table gives the two sizes in relation to one another, both being in decimals of the English inch. To make comparison more easy we have shown the English sizes in italic figures. The French cartridges dealt with are those of the thin rim pattern which are the ones most used and at present the standard,

Bore.	Length.		Diameter at Front.		Size Under Head.		Rim.			
							Diameter.		Depth.	
	French.	English.	F.	E.	F.	E.	F.	E.	F.	E.
10	3·15	*3·25*	·843	*·845*	·859	*·861*	·927	*·933*	·069	*·074*
12	2·569	*2·56*	·796	*·800*	·814	*·812*	·881	*·886*	·061	*·074*
14	,,	,,	·765	*·763*	·775	*·775*	·832	*·847*	,,	*·068*
16	,,	,,	·735	*·732*	·748	*·744*	·817	*·815*	,,	*·062*
20	,,	,,	·691	*·685*	·701	*·698*	·754	*·766*	,,	*·060*
24	,,	,,	·647	*·649*	·663	*·662*	·730	*·729*	,,	,,
28	,,	,,	·613	*·614*	·631	*·627*	·682	*·688*	,,	,,
32	,,	,,	·560	*·562*	·573	*·575*	·642	*·637*	,,	,,

It will be seen that the material differences between the two sets of sizes exist mainly in the rim. We may well affirm that an English gun carefully chambered for the English size of cartridge will take French ammunition, but that French guns may reject English cases unless the latter are made on the small size.

Our special reason for calling attention to the differences that exist between English and French cartridge sizes is that the comparison put forward clearly illustrates the very small differences of practice which separate the two countries. As the English sizes have been very carefully built up with reference to the best mechanical practice it is more than likely that French gunmakers would find a distinct advantage were they to accept our figures with the same whole-hearted appreciation that has been shown in Germany. Major Thiel, who is a most enlightened student of English firearms manufacture, has maintained during the past few years the closest touch with all that has transpired during the period in which we have been engaged in slowly evolving a perfect series of dimensions. He has, moreover, maintained very close relations with the Loewe factory in Berlin. Herr Bechstein, one of their brilliant managers, has made a very close study not only of shot gun chamber sizes but of the gauges which must be made to control them. In so far that the English sizes have been built up with special reference to the experience and advice of Herr Bechstein in consultation with Major Thiel it is not surprising that the ultimate conclusion of our labours has been so fully endorsed in that country. It is, moreover, recognised that the English system of denoting the calibre of shot guns according to the diameter of spherical ball running so many to the pound has become universal. It is, therefore, not extraordinary that English practice in respect to other dimensions should be regarded as standard. However perfect may be the workmanship of the best Belgian and French firms it can hardly be denied that London still remains the centre from which the finest firearms in the world are issued. Ours is a very wealthy aristocracy, and from the King downwards, our great landowners vie with one another in the production of a quality and quantity of sport at winged game which finds no equal in any other country. The individual whose shooting engagements cover every available date during the season is of necessity a fine judge of a gun, and even if he were not, the amount of service he gets from his weapon would soon bring to light any latent defects.

When, therefore, the combined experience of the gunmaker and cartridge manufacturer demands a certain size of cartridge rim it is because that size is necessary to procure satisfactory ejection. The principle of the shot gun ejector is an English invention, and it is our own mechanicians who have brought it to a state of perfection. The greatest worry of the gunmaker is that the extractor may slip past the rim of the cartridge in the act of opening the gun. He wants the rim to be of sufficient size to ensure a reliable grip, and he would deplore any attempt to make it smaller than the present size. At any rate, we have reason to know that perfect ejection of the cartridges conduces to the enjoyment of sport, and if the difficult task of the gunmaker is to be lightened, the road to progress is by way of a universal recognition of one size of cartridge.

LECTURES TO YOUNG GUNMAKERS.

XXXII.—THE TRAJECTORY OF RIFLES.

To produce by calculation a table of trajectory for a given combination of rifle and cartridge it is necessary to know:—

(1) The muzzle velocity of the bullet,
(2) Its sectional density, viz., the square of its diameter divided into its weight, and
(3) Its coefficient of reduction, that is, the factor which represents the influence of air resistance due to the shape of its point and other allied characteristics.

The two first values are obviously determined by well-known methods of measurement. The third may be obtained by any one of the following tests:—

(1) By noting the time intervals that elapse during the passage of the bullet through a series of screens, the first being near the muzzle,
(2) By actually recording the trajectory as registered on paper screens placed in the track of the bullet at different distances along the range, or
(3) By noting the angle of elevation needed to hit the target on a still day at a long range.

The first-mentioned test was fully described in our last lecture. When we wish to interpret actual measurements of the flight of the bullet, whether they take the form of the second or third experiment, we must carry through a certain amount of careful study of the action of a bullet during its passage from the muzzle to the target. The needful calculations may take several forms. Those, for instance, which are described in the usual text-books involve the use of a good deal of mathematics. We propose to take one of these methods and show it in a simplified form. But before we proceed with our demonstration it will be necessary to educate the reader concerning some of the more elementary aspects of trajectory. The subject is really exceedingly simple; but most gunmakers have fought shy of it, first, because the mathematics appear too alarming, and second, because mistakes are apt to arise from a failure to appreciate the importance of grasping the true meaning of the terms and phrases used.

For instance, the *line of fire* is a continuation of the axis of the bore at the instant when the bullet leaves the muzzle. There is, therefore, no danger in placing one's hand in the line of fire at a suitable range. When shooting the ·303 rifle at 100 yards the line of fire will cut the target at a point 4·7 in. above the mark made by the bullet.

The *line of sight* is the straight line passing from the foresight to the point aimed at during the action of pulling the trigger. The *jump* of the rifle is, therefore, the movement it makes between the pulling of the trigger and the moment when the bullet leaves the muzzle. This shows us that the axis of the bore moves during the progress of the bullet up the barrel away from the position it occupied at the moment of pulling the trigger.

The *angle of departure* is thus the angle which the line of fire makes with the horizontal. For experimental purposes the line of sight is always assumed to be horizontal. Therefore the angle of departure is the angle which the line of fire makes with reference to the line of sight when the latter is horizontal.

The *trajectory* of a bullet is the curve described by its centre of gravity in its flight through the air to the first point of impact. The trajectory of a group of shots is the trajectory of the bullet which would strike the point of mean impact. The trajectory of a rifle at any particular range is the trajectory of a group of shots fired at that range under normal atmospheric conditions, with standard cartridges.

The *drop* of a bullet when spoken of in connection with tables of trajectory relates to the vertical distance that separates the trajectory of the bullet from the line of fire at any given range. The 4·7 in. for the ·303 rifle at 100 yards already given is the drop at that distance.

Many ridiculous mistakes have been made through the misuse of this term, notably on the occasion when a well-known gunmaker wrote in the *Field* to challenge certain values of drop which had been published. The gunmaker in question mistakenly supposed that the values of drop referred to the fall of the bullet below the line of sight, having forgotten that true drop is related to the line of fire; and this inclines upwards, while the line of sight is horizontal. The only circumstance in which these two forms of drop would give the same measurement would arise in the case of a barrel aimed so that the line of fire would be horizontal. In all practical firing the muzzle of the gun is directed slightly upwards. Consequently the true drop is from an imaginary line in continuation of the axis of the bore, whereas the drop which concerns the sportsman is the amount which the bullet falls below the line of sight at distances beyond the range for which the sights are adjusted. This last form of drop is best described as the vertical distance between the line of sight and the trajectory. For distances less than the range for which the sights are adjusted the trajectory is above the line of sight, and the measurements are given as plus values. The trajectory and line of sight cut one another at the distance for which the sights are adjusted; therefore beyond that range the trajectory lies below the line of aim, and the vertical distances separating the line of sight from the trajectory are then given as minus quantities.

The accompanying diagram, Fig. 1, will serve to expand our definition of the line of sight. Ordinary trajectory tables ge-

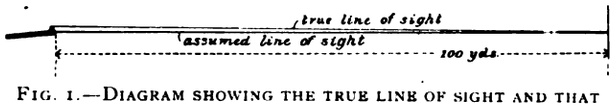

FIG. 1.—DIAGRAM SHOWING THE TRUE LINE OF SIGHT AND THAT GENERALLY ASSUMED IN TRAJECTORY TABLES.

nerally assume that the line of sight connects the centre of the muzzle with the point aimed at, whereas the true line of sight starts from the tip of the foresight. In other words the line of sight is in most trajectory tables assumed to be on the same plane as the centre of the muzzle orifice. As the foresight is generally less than an inch above the centre of the barrel this distinction is of little or no importance for the longer distances; but trajectory curves which relate to short distances must take account of the height of the foresight. In a trajectory table for 50 or 100 yards, where the figures relate to the height of the trajectory above a line of sight assumed to join the centre of the muzzle with the point aimed at, the values given must be corrected by deducting the distance separating the two lines of sight shown in Fig. 1. As-

suming, for instance, that a distance of 1 in. represents the height of the foresight above the centre of the barrel, we have the very simple condition of an inclined plane with a fall of 1 in. in 100 yards. The height of the incline will thus become three-quarters of an inch at 25 yards, half an inch at 50 yards, and a quarter of an inch at 75 yards. These distances must be deducted from the values in the trajectory table if the height of the trajectory above the true line of sight is required.

In firing the Greener ·310 sharpshooter cartridge at a range of 50 yards the height of the trajectory above a line connecting the muzzle with the point aimed at is ·74 of an in. at the halfway distance. Assuming a height of foresight equal to this same value, it will be seen that the bullet will exactly cut the true line of sight at 25 yards. In other words, the sighting of a Greener ·310 rifle should be exactly the same for 50 and 25 yards for an ordinary height of foresight, a circumstance as to increase the probability of a high score. We have shown in Fig. 2 a diagram illustrating the line of fire, the trajectory and the line of sight, all of which the reader is assumed to understand when dealing with a table of trajectory. The vertical lines *a* and *b* are termed *ordinates of trajectory*. It will be seen that, so far, no reference has been made to the relation which exists between trajectory and the angle of elevation. Before, however, we can talk of angles of elevation we must define the *zero* of a rifle. At a distance of ten yards from the muzzle it may be assumed that the drop of the bullet is so small that it may be ignored. Mr. Metford showed that if the sights of a rifle were adjusted so as to be truly parallel with the bore, and aim were taken, say, at a

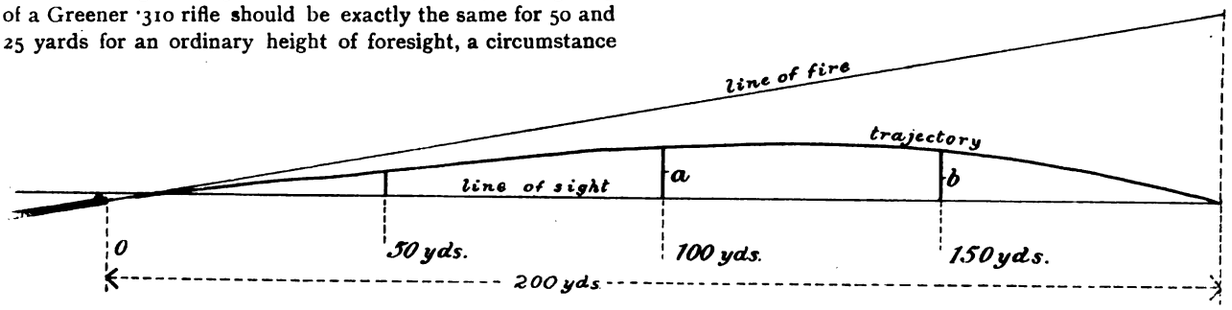

FIG. 2.—DIAGRAM SHEWING THE LINE OF FIRE, THE LINE OF SIGHT AND THE TRAJECTORY IN RELATION TO ONE ANOTHER.

which is not made apparent by a trajectory table based on an assumed line of sight level with the centre of the barrel. This justifies the definition of *range* as the distance from the muzzle of the rifle to the second intersection of the line of sight by the trajectory. That is to say, the barrel lies below the true line of sight, and is inclined slightly upwards. During the first portion of the bullet's travel up the range it rises until it cuts the line of sight. Following that, it rises above the line of sight, and after it has reached its climax the trajectory curve descends till it cuts for the second time the line of aim. From this it will be apparent that every adjustment of a set of rifle sights provides for shooting dead on the mark at two distinct ranges. A good deal could be said in favour of so adjusting the height of foresight for short-range weapons as to give true shooting for two distances at which the rifle is likely to be most used. Another point to be remembered is that where the lower edge of the bull is the point aimed at, and the centre of the bull is the point to be struck, there must be an added elevation on the sights equal to about one inch for every 50 yards, *i.e.*, two minutes of angle.

The influence of the height of the foresight on the behaviour of a rifle produces several apparent anomalies when shooting at the shorter distances. We have already mentioned that the same adjustment of the sights is absolutely appropriate for 25 and 50 yards with the rifle specified. For distances less than 25 yards the backsight must be raised and not lowered to produce true shooting. At ten yards, for instance, the rifle must be aimed ·27 of an inch higher than for 25 yards shooting. Again, although the rifle produces point-blank shooting at 25 and 50 yards, it must be aimed ·27 of an inch low at 40 yards to strike the point aimed at. Although some of these distances may represent less than the natural dispersion of the shots, the fact remains that a shooter who really understands his weapon would do well to adjust his sights in accordance with the figures here given so distance of ten yards, no rifle would fulfil the expectation that the bullet would strike below the point aimed at by exactly the distance that separates the line of sight from the axis of the barrel. The jump of the weapon in every instance produces a deviation from the expected behaviour. It was accordingly decided that every rifle must be shot for zero. That is, that the sights of the weapon should be exactly adjusted until, when aiming at an extremely short distance, the bullet should strike exactly the amount below the point aimed at that represents the height of the foresight above the axis of the bore. Any additional elevation then given may be graduated in minutes of angle. This system of sighting is carried out with all match rifles. The weapon is first of all shot for zero and a mark is made on the vertical stem. The distance between the foresight and the backsight is then carefully measured and the portion of the backsight stem above the zero line is marked off in minutes of angle of elevation. Each minute of angle is for all practical purposes equal to one inch for every 100 yards, or to be exact 1·047 in. We may now define *angle of elevation* as the angle formed by the line that connects the fore and backsight, when shooting for zero, with the line of sight that gives correct shooting over any given range. The resulting angle is the angle of elevation for that range.

Those who have read the chapters in shooting books which relate to trajectory have been worried by the circumstance that tangents of angle are spoken of instead of the angles themselves. As a matter of fact the tangent of an angle is a far more instructive value than the angle. A little careful explanation will enable us to show the relation that exists between the angle of elevation, the tangent of this angle and the drop of the bullet at any given range. For instance, the angle of elevation required for firing the service cartridge at 1000 yards is 1° 28′ (read one degree twenty-eight minutes). We must now assume that Fig. 3 represents the conditions of

shooting at this distance. The vertical distance D is the drop of the bullet at 1,000 yards. A very simple calculation will enable us to deduce from the angle of elevation the value of this drop in feet. The angle in question may be stated as 88 minutes.

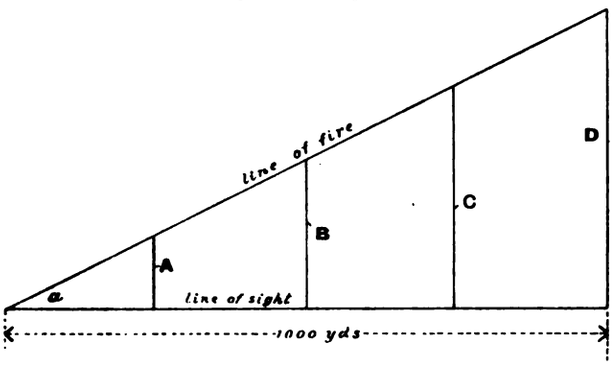

FIG. 3.—DIAGRAM SHOWING THE PROPERTIES OF A TANGENT.

Each minute of angle being equal to 10·47 in. at 1,000 yards, the drop is 88 times this distance, viz., 76·78 feet. Knowing, therefore the height of the line D, that of the other lines A, B and C may be deduced by simple proportion. In working out trajectory tables it is much more convenient to be able to obtain the values of the vertical lines by a direct method. If we turn to a table of tangents we find that the tangent for the above angle is ·0256. This decimal value may be obtained by dividing the distance D, viz., 76·78 feet by 3,000 feet, the equivalent for 1,000 yards. The answer is ·02559 which agrees with the ·0256 above quoted from the table. This same value of tangent could be obtained by dividing the height represented by any of the lines A, B and C by the distance which separates their base from the apex of the angle. If the height of the line is taken in feet the length of the base line must be in the same measure to obtain a true answer. Mysterious as the *tangent of an angle* may appear to be it is thus nothing more or less than the arithmetical result of dividing the perpendicular of a right-angled triangle by its base. Referring to Fig. 3, the line D represents the perpendicular, the 1,000 yards is the base, and *a* is the angle for which the tangent is obtained.

Having shown that the tangent of an angle is the result of the above sum in division it should be quite obvious that the height of any of the lines A, B, C and D can be readily obtained by multiplying the tangent by the distance on the base. Having already shown that the height of the line D is 76·78 feet as obtained from the angle of elevation we will now show that the same answer can be obtained from the value of the tangent. That is to say, if we multiply ·0256 by 3,000 we obtain for answer 76·8 feet. The difference of one-fifth of a foot in the two answers is merely due to the fact that the table of tangents used is true to only four places of decimals. We need not, however, argue about a difference of 2·4 inches in 76 feet.

A further application of the power of transposing the values of drop and angle obtained by firing may now be described. Supposing that we desire to find the angle of elevation for a given rifle and cartridge for a distance of 100 yards, it would only be necessary to fire at that distance with the sights set at true zero. The fall of the bullet below the point aimed at can easily be measured in inches. This divided by 1·047 will show the number of minutes of angle necessary on the sights for shooting at this distance.

An apparent anomaly of rifle shooting consists in the fact that a greater elevation may under certain circumstances be required for a cartridge firing the same bullet but giving a higher velocity. This is of course due to an alteration in the jump of the rifle, whereby the gain in velocity is more than compensated by an extra depression of the muzzle in the act of firing. If, however, the high velocity cartridge is shot for zero, and the true angle of elevation obtained, it would be found that the anomaly disappears. In other words, the sighting of a rifle assumes a given quantity of jump, and if a different cartridge is used apparent peculiarities of action are displayed which disappear when the rifle is re-adjusted by locating the true position of zero that agrees with the altered conditions. Although many questions have been introduced into this lecture which may appear to be of an unduly elementary character our excuse must be that the proper understanding of trajectory tables can only be acquired on a basis of accurate appreciation of elementary principles.

Our future programme will be to indicate how the various properties of a bullet's trajectory, as obtained by experiment, may be turned into tables, showing first, the time of flight over any given distance; second, the average velocity over that distance; third, the striking velocity and energy of impact; and finally, the position of the trajectory curve with reference to the line of sight. All these properties of a bullet follow in the most obvious way from the particulars which are ascertained either on the range or by the use of the chronograph. At any rate, granted certain necessary particulars, such as the manufacturer of the ammunition can generally supply, it is open to the gunmaker to obtain a large amount of valuable information concerning the characteristics of sporting missiles. The actual mathematical reasoning which underlies many of the relations with which we shall have to deal is in itself of a highly technical and complex character. The young gunmaker, however, will not be asked to go so deeply into the subject as this. He must accept the conclusions of such men as Bashforth, and be satisfied to adopt the values given in the published tables as being as near the truth as our present state of knowledge permits.

TRADE MARKS.

ADVERTISED. NOVEMBER 2—23, 1904.

266,253. The word RUBY over an illustration of a ruby. To apply to gunpowder for sporting purposes Curtis's & Harvey, Ld. September 16, 1904.

266,428. The word REXER. To apply to ammunition. H. de M. Snell, London. September 22, 1904.

REGISTERED. OCT. 20—NOV. 16, 1904.

265,375 & 265,376. Eley Bros., Ld.

260,361. King's Norton Metal Co., Ld.

APPLICATIONS FOR PATENTS.

OCTOBER 24—NOVEMBER 19, 1904.

22,887.* Gun Lock. J. Meffert.

22,899. Ammunition Hoists. Sir W. G. Armstrong, Whitworth & Co., Ld., and Sir A. Noble.

22,956. Ordnance Sights. Fried. Krupp Ag. (Date of application in Germany, January 24, 1904).

22,975*. Sighting Apparatus, C. D. Abel (Agent for *Rheinische Metallwaaren-und-Mf.).*
22,986. Projectile Fuses. H. C. Seddon.
23,018. Cartridges. S. Trivick.
23,031.* Blasting Fuse Heads. F. Render.
23,113. Machine Guns. L. W. de Grave.
23,202. Bullets. L. B. Taylor.
23,269. Blasting Cartridges. W. K. L. Dickson.
23.366. Detonators King's Norton Metal Co., Ld., T. A. Bayliss and H. W. Brownson.
23,368* Ordnance. P. M. Justice (Agent for *The Driggs-Seabury Ordnance Co.).*
23,369.* Ordnance. P. M. Justice (Agent for *The Driggs-Seabury Ordnance Co.*).
23,387. Automatic Small-arms. T. R. R. Ashton.
23,516. Wind Gauge Rifle Sight. G. B. H. Austin.
23,517. Wind Gauge Rifle Sight. G. B. H. Austin.
23,710. Small-arm Covers. C. Heseltine.
23,872. Range Finder. W. H. Lock and A. H. Pollen.
22,962. Detonator Priming. R. Sohlman.
23,973.* Explosives. J. C. Mitchell.
23,986. Compressed Guncotton. J. A. Carter and The New Explosives Co., Ld.
24,055. Projectiles. Cammell, Laird & Co., Ld., J. E. Fletcher and L. Burrows.
24,073. Machine Gun Carrier. W. S. Simpson.
24,223. Blasting Compound. A. F. Hargreaves and Curtis's & Harvey, Ld.
24,506. Compressed Air Motor Torpedoes. W. H. Webb, W. G. Brettell and A. J. Adamson.
24,658.* Repeating Rifles. Fabrique Nationale d'Armes de Guerre Soc. Anonyme. (Date of application in France, January 23, 1904.)
24,659. Safety Bolt for Small-arms. Fabrique Nationale d'Armes de Guerre Soc. Anonyme. (Date of application in France, January 23, 1904).
24,782.* Explosives. C. Duttenhofer.
24,790. Range Finders. A. H. D. Raich.
24,800. Night Sights for Fire-arms. D. Spiller.
24,882. Sighting Devices. T. Haddon (Agent for *M. Haensaler.*)
25,003. Torpedo Propulsion. Sir W. G. Armstrong, Whitworth & Co., Ld., and W. H. Sodean.
25,028.* Automatic Fire-arms. W. J. Whiting.
25,030. Wire Cutting Attachment for Rifles. A. Wallis.
25,201. Gun Mountings. Sir W. G. Armstrong, Whitworth & Co., Ld., and A. G. Hadcock.
25,211. Shooting Practice. F. Courtinade.

*These Applications were accompanied by complete Specifications.

SPECIFICATIONS PUBLISHED.

OCTOBER 27th—NOVEMBER 24th, 1904.

COMPILED BY HENRY TARRANT.

22,078 (1903). **Ordnance Breech Mechanism.** A. T. Dawson and G. T. Buckham, London. General improvements in the breech mechanism of quick-firing guns of the type described in patent No. 15,088 (1893) are set out in the present specification. The firing gear and a safety device are particularly dealt with. The cocking and release of the striker is operated by the toe of the actuating shaft through the intervention of a hinged slip-block on the striker; whilst a cam on the shaft imparts additional compression to the striker spring beyond what it receives by the retraction of the striker. Accepted October 13, 1904.

23,124 (1903). **Range-Finder.** Lieutenant F. H. Baker, Coventry, and J. Lena, London. A range-finder and station keeper adapted to show range when the base height is known or *vice versa* The movement of a drum upon which the ranges are marked is communicated through an eccentric to an arm carrying an index mirror. When the movement of the range drum has caused the images to present the proper appearance in the telescope, the movement is stopped and the range may be read off the drum. Accepted October 20, 1904.

24,372 (1903). **Time Fuse for Projectiles.** The King's Norton Metal Co., Ld., & T. A. Bayliss, London, and H. M. Smith, Abbey Wood. A method of constructing the protective caps and time fuses of projectiles by means of which accidental turning of the graduated time ring is prevented. A rib is formed on the cap, and this rib is adapted to engage by a sliding movement with two slots, one in the fuse body and one in the time ring. When the cap is in position the ring is positively locked. Accepted October 6, 1904.

24,703 (1903). **Ordnance Sighting Apparatus.** A. T. Dawson and G. T. Buckham, London. Gun sighting apparatus in which the setting mechanism is so arranged that uniform movement is imparted to the range dial when changes in range are made, irrespective of the variable nature of the movement that has to be imparted to the elevating pinion in so changing range. The connection of sighting apparatus on both sides of a gun dealt with in Patents Nos. 10,916; 11,819; and 17,509 all of 1903, is also modified so that the same angle of displacement is imparted to each. Accepted October 13, 1904.

26,215 (1903). **Target Practice with Ordnance.** A. J. B. Légé, London Apparatus for facilitating instructional target practice with ordnance and for recording the accuracy of such practice without actually firing. The apparatus is so constructed that the training of the gun causes a corresponding angular movement of the target. A marking instrument follows the gun's movement, and when the trigger is operated the marker is caused to record upon the target at what point the gun is aimed. Accepted October 27, 1904.

26,575 (1903). **Nitroglycerin Weighing Apparatus.** G. E. Arnold, Faversham. Apparatus for weighing such substance as nitroglycerin, consisting of a pair of scales, one of the pans of which is designed to receive the nitroglycerin whilst the other takes the form of a graduated reservoir for a liquid such as water. Accepted October 6, 1904.

26,978* (1903). **Potassium Chlorate Explosive.** M. S. Talbot Natal.

27,237 (1903). **Disappearing Targets.** Maj.-Gen. C. E. Luard, Sevenoaks. A disappearing figure target consisting of a rotating disc upon the periphery of which is mounted a series of independent figures. When one of the figures is knocked over by a bullet it is automatically righted again by the rotation of the disc. Accepted October 13, 1904.

27,725 (1903). **Ordnance Sighting.** A. T. Dawson and L. Silverman, London In place of the ordinary large range-dial, the size of which is an objection to its use, an endless band is provided. The ranges are marked upon the band and are as easily legible as those on the large range dial. The band is arranged horizontally below the sight bar Accepted October 20, 1904.

28,490 (1903). **Ordnance Breech Mechanism.** Sir W. G. Armstrong, Whitworth and Co., Ld., and Sir A. Noble, Newcastle-on-Tyne. A construction of ordnance breech operating mechanism through which one continuous motion of the hand lever unlocks and swings out the breech block. A groove on the spindle of the hand lever engages a roller on a lever pivoted in the carrier and is caused to rock the breech block when the lever is started. Accepted October 27, 1904.

28,495 (1903). **Supply of Ammunition to Ordnance.** A. T. Dawson, London, and J. Horne, Barrow-in-Furness. In order to ensure the rapid and continuous supply of large calibre projectiles to the hoisting cages in the revolving trunk, a ring of loading cells is provided at the foot of the trunk in conjunction with waiting trays arranged directly to serve the cages. The loading cells are supplied from overhead rails, and may be rotated relatively to the shell room or to the trunk. Accepted October 27, 1904.

28,588 (1903). **Self-Propelling Explosive Projectiles.** W. T Unge, Sweden. The formation of cracks or interstices in the propelling charge of self-propelling explosive projectiles is prevented by sub-dividing the charge and enclosing each part in a separate cell with elastic walls. The compressed complete charge so made up is elastic all through and the explosive tends always to expand. Accepted October 27, 1904.

28,710 (1903). **Blasting Explosive.** J. Russell, Hamilton, N.B. Ordinary explosives used for blasting are rendered frost proof by an admixture of from 2 to 10 per cent. nitrotoluol, dinitrotoluol, or tri-nitrotoluol. The percentage used varies with the degree of frost existing when the explosive is required. Accepted November 3, 1904.

28,774 (1903). **Ordnance Breech Mechanism.** A. T. Dawson, London, and J. Horne, Barrow-in-Furness. A safety device

for ordnance, particularly single and double turret guns using a swinging loading tray. The device so adapted to prevent the closing of the breech while the loading tray is in the path of the gun's recoil and also to hold the tray clear of the gun when the breech is closed. Accepted October 20, 1904.

1,685 (1904). **Projectile Fuses.** The King's Norton Metal Co., Ld., T. A. Bayliss, London, and C. W. Hill, King's Heath. The solid needle pellet in percussion fuses is provided with two spring bolts. During the flight of the projectile its rotation is caused to disengage the spring bolts from slots in the walls of the fuse and so to allow the needle pellet to reach the cap upon impact of the projectile. Accepted October 27, 1904.

1,686 (1904). **Projectile Base Fuses.** The King's Norton Metal Co., Ld., and T. A. Bayliss, London, and C. W. Hill, King's Heath. A base percussion fuse of the type described in the foregoing Patent No. 1,685. This base fuse is constructed to allow of delayed action. The construction of the needle pellet allows of an elongation of tubular part of the fuse body. The extension is constructed to contain a passage for slow burning powder between the cap and the charge proper. Accepted October 27, 1904.

2,668 (1904). **Telescopic Sights.** J. Stuart, and G. Tochumsen, London. In order to render telescopic sights more useful at night time, a piece of highly polished glass is inserted in the tube at right angles to the optical axis. A cross is scratched on either side of the glass. Above the edge of the glass is arranged a small electric lamp, the rays of which are concealed to external vision, but which impinge upon the polished edge of the glass. Accepted November 3, 1904.

4,699 (1904). **Nitrate of Ammonia Explosive.** R. Haddan, London, (Agent for *J. Führer, Austria*). The explosives of the nitrate of ammonia class containing fusible components, the melting point of which is below the temperature at which the ammonia nitrate is decomposed, are difficult to explode. To obviate this disadvantage, the patentee freely divides and mixes the components of the explosive, and compresses them into suitable shapes. The explosive is then heated to a temperature slightly below the melting point of the fusible component, is immersed in a bath of fusible substance and is subsequently cooled. Accepted October 20, 1904.

7,490 (1904). **A New Explosive.** C J. Rushu, and G. W. Baudinet, Cape Colony. A new explosive "manganite," consisting of carbonate of ammonia added to a mixture or compound di-nitro benzol, or nitro-napthaline and nitrate of ammonia, or nitrate of sodium, or sulphate of ammonia, or any or all of those ingredients, or of the Sprengel explosives, but preferably by impregnating one or more of the component parts with ammonia gas. Accepted October 27, 1904.

13,649 (1904). **Ordnance Firing Device.** Fried Krupp, Ag., Germany. In order to dispense with the sear spring in repetition firing devices the sear is provided with a second nose which is so arranged that when the trigger is returned to a position of rest the nose operates in conjunction with a nose on the part to which the sear is pivoted and so effects the return of the sear to the normal position. Accepted October 6, 1904.

13,901 (1904). **Projectile Fuses.** Fried. Krupp, Ag., Germany. A fuse protecting cap attached to the fuse quite independently of the projectile. The bottom part of the cap, consisting of a tear-off metal ring, is so formed as to engage with an undercut part of the fuse body. Accepted November 3, 1904

14,468 (1904). **Hammerless Drop-down Gun Mechanism.** C. Lohse, Belgium The barrels of a hammerless drop-down gun are provided with projections adapted to engage with recesses in the sides of the breech body and so to obviate lateral movement of the barrels An arrangement of detachable lock mechanism and an ejector system are also described and fully illustrated. Accepted November 3, 1904.

16,239 (1904). **Shot Making Apparatus.** A. G. Baker, New Zealand. Apparatus for making spherical shot from sheet lead. The sheet lead is first cut into cubes and the cubes are then introduced between a revolving hollow conical upper part and a stationery conical base. The upper part is capable of a vertical movement on its spindle, and its up and down and rotary motion is caused gradually to knead the cubes of lead into spheres. Accepted October 13, 1904.

17,658 (1904). **Ordnance Firing Mechanism.** C. D. Abel, London. (Agent for *Rheinische Metallwaaren und Mf., Germany*). Combined with the spring in ordnance firing mechanism is a movable abutment, which is in such connection with the trigger that by the cocking motion of the latter the abutment is moved so as to compress the spring. On firing, the spring forces back the abutment and causes it to reset the trigger. Accepted October 13, 1904.

17,788 (1904). **Shrapnel Shell.** Fried. Krupp, Ag., Germany. In base chamber shrapnel shell the ignition tube has hitherto been perforated with holes which served to allow the smoke-producing compound to be ignited. By this means the desired effect was only imperfectly attained since the smoke-producing compound was partially fused. The patentees do not perforate the walls of the ignition tube but only weaken them by cutting recesses. Accepted October 13, 1904.

17,882 (1904). **Loading of Ordnance.** Schneider & Cie, France. A ramming appliance for ordnance adapted to be continuous in action, and designed to dispense with the space occupied by the ordinary form of rammer. The rammer work in conjunction with a carriage receiving the powder charge and projectile, and consists of "pushers" attached to an endless chain. These pushers are brought into operation only when the carriage is in position at the gun breech. Accepted October 13, 1904

18,090 (1904). **Loading of Ordnance.** P. M. Justice, London (Agent for *The Bethlehem Steel Co., U.S.A*). A rammer for ordnance consisting of a number of interlocking chains connected with a common head. The rammer is designed particularly for ordnance of the turret type and may be conveniently manipulated in contracted places where economy of space is a consideration. Accepted October 6, 1904.

18,346 (1904). **Ordnance Sight Carrier.** Fried. Krupp, Ag., Germany. In relation with front sight carriers of ordnance a rebounding catch is so arranged as to hold the carrier in either the sighting or the travelling position. The interlocking faces of the catch are enclosed in the cylinder which encloses the pivot pin of the sight carrier. Accepted November 3, 1904.

18,489 (1904). **Magazine Rifles.** C. Ryland, Birmingham; and R. C. Stevenson, Kilmarnock. In repeating rifle mechanism of the type described in Patent No. 11,972, 1903, the magazine and the cartridge feeding mechanism are modified further to perfect the working of the complete arm. The tabular magazine is so constructed beneath the barrel as to hold twelve ·22 calibre cartridges. Accepted October 20, 1904.

18,727 (1904). **Ordnance Sighting.** Fried. Krupp, Ag., Germany A device of compact but open construction by means of which guns, capable of adjustment laterally in relation with the carriage and an independent sighting line, may be elevated together with the attachment bar and relatively to the attachment bar. One of two elevating gears engages the barrel, whilst the other is connected with the attachment bar. Accepted October 13, 1904.

19,059* (1904). **Target Cleaning Apparatus.** W. H. Pike, Manchester.

20,106*(1904). **A Potassium Chlorate Explosive.** L. Evangelidi, Russia.

20,145 (1904). **Projectile Fuses.** The King's Norton Metal Co., Ld., T. A. Bayliss, London, and H. M. Smith, Abbey Wood. Improvements in protecting caps for fuses of the type described in Patent No. 24,372, 1903. Such caps are provided with an inner cap of a size to fit the fuse. The inner cap is adapted positively to lock the protector to the fuse; and the caps are made of such a length as to protect the fuse against moisture. Accepted October 20, 1904.

20,150 (1904). **Rifle Cleaner.** W. C. Buckelew, and J. P. Flournoy, Junr., U.S.A. A rifle cleaning device consisting of a rod possessing a reduced end provided with a shoulder. The shoulder bears against the free portions of string strips and when the rod is operated is caused to force the strips outwards into close contact with the gun bore. An outside tube is adapted to collapse the strips when the rod is to be withdrawn. Accepted October 20, 1904.

20,730 (1904). **Ordnance Sighting.** C. D. Abel, London (Agent for *Rheinische Metallwaaren und Mf., Germany*). Elevating apparatus for ordnance having a line of sight independent of the motion of the gun, wherein the bar carrying the back-sight serves both as the adjusting device for varying the position of the gun, and as the adjusting device for simultaneously varying position of gun and sight. Accepted November 3, 1904.

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* These Specifications are more fully described under "Selected Patents."

SELECTED PATENTS.

A POTASSIUM CHLORATE EXPLOSIVE.

20,706 (1904). L'Evangelidi, Russia. An explosive compound, of which potassium chlorate is the principal constituent, is described in this patent. It is claimed for the mixture that it is quite safe to handle, and has very great explosive force when exploded by flame or spark, or by a very strong shock. It consists roughly of chlorate of potassium, ferricyanide of potassium, glycerin, and wood charcoal.

The proportions of each of these ingredients in one example are as follows:—780 parts of potassium chlorate; 375 parts of yellow prussiate of potash; 60 parts of wood charcoal, and 65 parts of glycerin. The explosive is stable, is not subject to spontaneous decomposition, and is only suddenly exploded at a temperature of 260° to 270° Cent. The gases developed when the explosive is ignited by flame are not poisonous, nor are they stupefying. The specific weight of the compound is about 2·01 to 2·05. The gravimetric density of the ungranulated compound is from about 0·58 to 0·6. It is only slightly hygroscopic, the moisture of the ungranulated mixture under ordinary laboratory conditions being about 2½ per cent.

The combustion products of the explosive give about 57 per cent. of gases and about 43 per cent. of dry residue, chiefly composed of oxide of iron and a mixture of potash salts. The reaction of this residue is alkaline, and is not injurious to gun bores. Although the compound contains a cyanogen salt, there is no sign of hydrocyanic acid in the decomposition products. Nor is there any cyanide of potassium in the dry residue. It is thought possible, that, during the oxidation, potassium cyanide gives off carbonic acid, nitrogen and oxide of potassium. Experiments have shown, moreover, that carbonic acid and not carbonic oxide is given off.

The use of glycerin in the compound is especially important, as it is said to give the powder safety and permanence, and through its medium, a very intimate mixture of the ingredients is obtained. The glycerin combines with the oxygen of the potassium chlorate to form gaseous carbonic anhydride. To produce a granulated powder about half the charcoal is replaced by tannin, which is mixed with the remaining charcoal. The potassium chlorate is then mixed with the charcoal, the prussiate of potash being added afterwards. Finally the glycerin is intermixed. Accepted November 3, 1904.

ANOTHER POTASSIUM CHLORATE EXPLOSIVE.

26,978 (1903). M. S. Talbot, Natal. An explosive is made from potassium chlorate and camphor, to which is added some body, such as castor oil or paraffin wax, which will prevent deterioration due to volatilisation of the camphor. To these principal components are added others capable of facilitating the reaction or of modifying the rate of explosion such as manganese dioxide. Burnt umber, it is found, also enhances the effect of the powder.

The following is an example of the composition:—Potassium chlorate, 56 parts; camphor, 4 parts; castor oil, 4 parts; burnt umber, 8 parts; manganese dioxide, 12 parts; potassium bichromate, 12 parts; and water, 12 parts. The umber, manganese dioxide and bichromate are well mixed with warm water, and the camphor, which has been previously well powdered and mixed with the castor oil, is added. When the whole has been well stirred together the powdered chlorate of potash is gradually added with constant stirring until a mixture of even character is produced. The mixture is then run out in thin layers and is allowed to dry. After drying it may be ground into powder, or it may be cut up and be introduced into cartridges ready for use. It is claimed that such a compound is very powerful, is very safe in manipulation and use, being less sensitive to friction or percussion than any other explosive. Accepted October 20, 1904.

TARGET CLEANING APPARATUS.

19,059 (1904). W. H. Pike, Manchester. An automatic target whitewasher is described in this patent. The invention especially relates to an agitator which is designed mechanically to keep the whitewash, or other colouring mixture, well stirred.

The drawings appended illustrate the appliance. From Fig. 1 it will be seen that the target proper *a* (consisting of an iron plate) is mounted upon the upright *b*, whilst *c* is a strut for steadying the structure. The sliding beam *d* is adapted to slide up and down the standard *b*, and it is worked by the cord *e* passing over the pulley *f*. Attached to the beam *d* is a bent arm *g* which carries the brush *h*. The brush dips into the whitening matter contained in the trough *k* when the beam *d* is in its lowest position. When the cord *e* is pulled the brush is caused to pass over the face of the plate *a* leaving a deposit of whitewash, and so obliterating any shot marks which may have existed thereon.

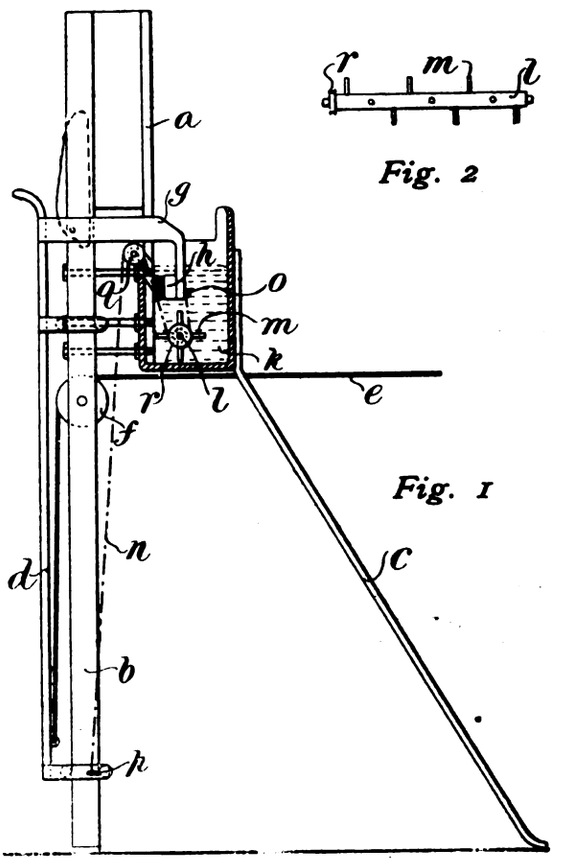

Fig. 1

Fig. 2

The principal part of the invention is embodied in the mechanical agitating device *l* (Fig. 2), consisting of a shaft journalled in the trough *k*. The radial arms *m* are attached to the shaft, and when the shaft is rotated these arms are caused to stir up the whitening matter which has a tendency to settle at the bottom of the trough The shaft is rotated by the chain *n*, one end of which is secured at the point *o* on the bent arm *g*, and the other at *p* on the frame *d*. The chain is passed over the pulley *q* situated above the level of the liquid in the trough, and beneath the pulley *r* on one end of the shaft *l*. It will be easily understood that when the frame *d* is raised by pulling the cord *e*, the chain *n* will be caused to travel over the pulleys *q* and *o* and so to rotate the stirring device *l*. Accepted October 6, 1904.

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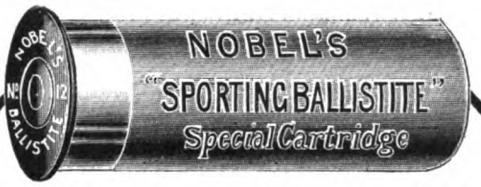

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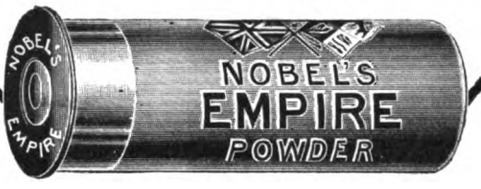

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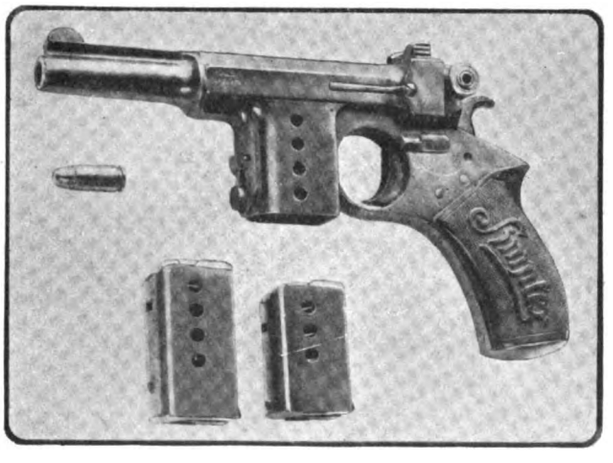

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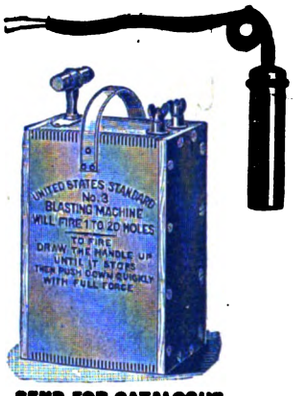

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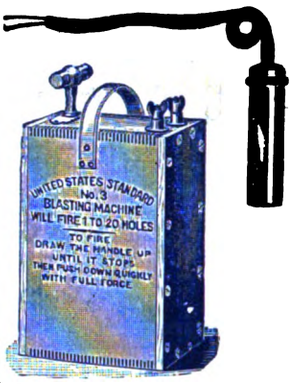

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